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CLEVITON VINICIUS FONSECA MONTEIRO

INNOVATIVE BEHAVIOR MODEL OF SOFTWARE PROFESSIONALS

Doctoral Thesis

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CLEVITON VINICIUS FONSECA MONTEIRO

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STRUCTURED ABSTRACT

Background: Innovation has been recognized as an important, if not essential condition to gain competitive advantage and survive in the software industry. From the initial moments of any innovation process, the company`s employees play an essential role. They are the ones who should engage in the search for opportunities as well as generate and implement new ideas. Their behavior towards innovation is called innovative behavior and it can be observed at different levels on each professional.

Goal: The aim of this study is to build a model to explain which factors influence the innovative behavior of individuals in software development teams. To achieve higher explanatory power and close the gap of current researches, which are mostly based on quantitative data, this model was built grounded on deep analysis of rich qualitative and quantitative data.

Method: A mix method research composed of a systematic literature review (SLR) and two industrial case studies were used to analyze the phenomenon of innovative behavior. The SLR analyzed 80 primary studies, from an initial set of 10.399 articles. The first case study was conducted on a small Canadian software firm, involving 2 projects and 6 participants, and its results were used to produce an initial model. The second case study was performed on a large Brazilian software organization, involving 8 projects and over 60 participants.

Results: The resulting model, called IBMSW, confirmed several antecedents from previous models as well as proposed new antecedents of innovative behavior. In particular, the findings showed that the individual's personality exert influence on individual's innovative behavior and two competing explanations were identified.

Conclusion: The results obtained provided explanatory power to the innovative behavior model as well as showed the importance to study such phenomena in the software industry. In addition, several recommendations for practitioners from different organizational levels were provided based on the IBMSW.

RESUMO ESTRUTURADO

Contexto: Inovação tem sido reconhecida como uma condição importante, se não essencial, para se ganhar vantagem competitiva e sobreviver na indústria de software. Desde os momentos iniciais de qualquer processo de inovação, os funcionários da empresa desempenham um papel essencial. Pois são eles quem devem engajar-se na busca por oportunidades de melhoria, assim como gerar e implementar novas ideias. Esse comportamento em busca da inovação é chamado de comportamento inovador, o qual pode ser observado em diferentes intensidades e frequência em cada profissional.

Objetivo: O objetivo deste estudo é construir um modelo para explicar quais fatores influenciam o comportamento inovador dos indivíduos de equipes de desenvolvimento de software. Para que fosse possível obter poder explanatório e preencher as lacunas das pesquisas atuais, que se baseiam apenas em dados quantitativos, este modelo foi construído com base numa análise detalhada de dados qualitativos e quantitativos.

Método: Um método misto composto por uma revisão sistemática da literatura (SLR) e dois estudos de caso industriais foi utilizado para analisar o fenômeno do comportamento inovador. A SRL analisou 80 estudos primários, de um conjunto inicial de 10.399 artigos. O primeiro estudo de caso foi conduzido em uma pequena empresa de software do Canadá, envolvendo 2 projetos e 6 participantes. O resultado foi a elaboração de um modelo inicial. O segundo estudo de caso foi realizado em uma grande organização brasileira de desenvolvimento de software, envolvendo 8 projetos e mais de 60 participantes.

Resultados: O modelo final, chamado de IBMSW, confirmou a influência de diversos fatores propostos em modelos anteriores, assim como propôs a existência de novos fatores que influenciam o comportamento inovador. Em particular, os achados mostraram que a personalidade do indivíduo exerce influência no seu comportamento inovador e duas explicações competidoras foram identificadas.

Conclusão: O resultado do estudo proporcionou poder explanatório ao modelo de comportamento inovador, assim como mostrou a importância de se estudar o fenômeno na indústria de software. Além disso, diversas recomendações baseadas no modelo foram propostas aos profissionais da área com base no IBMSW.

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1 INTRODUCTION

Innovation has been recognized as an important, if not essential condition to gain competitive advantage and survive in the software industry. A company can innovate on its products, services, processes, business model, or organizational structure. To be innovative, the organization should turn ideas into something valuable and profitable. This pathway is fully embedded in risks and uncertainties and begins with the identification of a problem to be solved or opportunity to be exploited. Then ideas shall be generated and the best ones selected to be developed and then deployed or marketed.

From the initial moments of any innovation process, the company`s employees play an essential role. They are the ones more likely to be engage in the search for opportunities as well as in the generation, promotion, and implementation of ideas, such as new working methods and new products/services. That is, they should behave innovatively. In fact, it is difficult (if not impossible) to devise methods or tools that can make a company innovate without its employees' active participation. However, the contribution from employees to organizational development and innovation is underestimated and under-explored (Åmo, 2005).

Although researchers and practitioners have provided important insights into individual innovative behavior, they have also stressed the need to explore what makes this behavior flourish and under what circumstances it is inhibited. Previous exploratory studies found that a set of antecedents can affect the individual innovative behavior such as cultural aspects, rewards, job design, and personality. Specifically, the behavior of leaders and working peers can positively or negatively influence the individual towards innovation. Even unintentionally, they can negatively influence their working peers by the excessive criticism, risk avoidance, lack of support, and many other behaviors that are still not well studied. In particular, in the software industry, work is often performed by teams whose members must interact and coordinate their efforts towards the construction of a product or the delivery of a service. In teamwork, the individual innovative behavior may depend not only on personal characteristics and on the cultural aspects of the company but also on the interaction among team members and between them and the team leaders.

Despite several efforts from academia and industry, there is no reliable and useful model that explains what influences the individual innovative behavior. This is particularly true for the software industry, for which there is no study that investigate this phenomenon in the context of software development teams. This research aims at contributing to close this gap in academic research as well as in the industrial practice of software engineering.

1.1. RESEARCH QUESTION AND GOALS

The research questions that will guide this study are the following:

Which factors influence the innovative behavior of individuals from software development teams? How this influence happens in the workplace in practice?

Based on this research questions, the main objective of this study is to build a model about what influences the innovative behavior of individuals in software development teams. The intent of a normative model, in the sense used by Hackman (1987), is to identify the factors that most powerfully enhance or depress the innovative behavior of software engineers and to do so in a way that increases the possibility that constructive change can occur. It is very difficult to define adequate plans to foster the employees' innovative behavior without knowing what incentives or inhibits them towards these behaviors.

The first research question is about factors such as the company environment, the working team, leadership, client, and individual personality. The second question is about how the individual behavior can be explained by the combination of these factors. For example, how the behavior of an individual that always proposes ideas and try to promote it to be implemented is explained by her own personality, her role in the team, her perception about the organization environment, and her perceptions about leadership.

Therefore, the model should identify the relevant factors for software engineering professionals as well as explain how they are related to each specific identified behavior, in particular proposal of ideas and their implementation.

1.2. JUSTIFICATION

The relevance of this study can be explained in terms of its contribution to academic research and to the practice of software engineering in industry.

First, a model is the basis to build diagnostic tools to identify if an organization possesses the factors that foster or inhibits its employees' innovative behavior. Further, such model also is essential to define action plans to guide the changing process from a diagnosed state to a desired state.

Second, the current knowledge about innovative behavior was based on quantitative studies, mostly performed by survey research. Thus, the majority of studies only identified the existence of the correlations among some factors and dimensions of innovative behavior. However, they did not explain how it happens, that is, they had limited explanatory power. Therefore, this study aims to contribute to the research on this topic by constructing an explanatory model base on rich qualitative data, complemented by confirmatory analysis using quantitative data, to unfold how individual behavior is explained by the identified factors.

Third, the current models (see section 2.4) were built based on several industries but none of them focused on the software industry. The focus of this study shall uncover factors that take place specifically in the software engineering area, such as factors arising from specific project domain, development process, individual role in the team, or technologies used. In particular, industrial software development is often performed by teams. As observed by Hackman (1987), the relationships among factors that explain individual behavior during teamwork appear to depend substantially on the properties of the group task being performed. Therefore, findings for one type of task often turn out not to hold for groups working on different kinds of tasks. Further, in software development, each individual is affected by the group's decisions and actions, and there is a heavy dependency among the team members work, because the artifacts to be built are shared. Thus, the dependency among team members affects their appraisal and behaviors. In addition, technological change requires constant evolution and opens space for innovations. Then, decisions about changing and evolution have to be constantly considered. Therefore, the results found in the context of the software engineer industry, which are controversial for other industries, probably arose because of these particularities. Third, the problems to be solved in the software engineering

usually are ill defined and the possible solutions are diverse and not obvious (Ford, 2000; Mumford, 2002; Reiter-Palmon and Illies, 2004). Hence, the professionals from this area should deal with several trade-offs from scope definition to solution fit with regards to their complexity, cost, and quality.

Finally, the improvement of current theory is essential to inform and support practices' improvement towards innovation at the organizational, managerial, and individual level.

1.3. SUMMARY OF THIS THESIS

This thesis is organized as follows. Chapter 2 will presents the theoretical background, which is composed of the definitions of main constructs, theories used, the results of the Systematic Literature Review performed. and the previous models described in the literature. In Chapter 3, the overall research design is presented, detailing the methodological framework considered and the research steps followed. Then, Chapters 4 and 5 describe Case Study 1 and Case Study 2, respectively. Chapter 6 presents the proposed model together with its hypotheses and compares this model with the previous literature models, explaining the contribution of this study. Finally, Chapter 7 summarizes the study, provides recommendations for practitioners, and proposes directions for future work.

2 THEORETICAL BACKGOUND

This chapter presents the constructs, theories, and current models that describe antecedents of innovative behavior. In Section 2.1, the constructs innovation, creativity and innovative behavior (IB) will be defined and the differences between them explained. In Section 2.2, the Systematic Literature Review findings about the leader influence on individual's innovative behavior will be presented. The section 2.3, will present the theories that provided foundations to our resulting model. Finally, some innovative behavior models will be presented in Section 2.4.

2.1. DEFINING CONSTRUCTS: INNOVATION, CREATIVITY AND INNOVATIVE BEHAVIOR

The construct innovation is heavily used in the academic, professional, and government settings because of its increasing importance in the last years. Garcia and Calantone (2002) noted that more than fifty definitions could be found in the literature for this construct. They highlighted that different meanings can be understood from the word *innovation* if different definitions are taken. Therefore it is essential to define the construct innovation in the scope of this study and also differentiate it from innovative behavior.

The Oslo Manual's (OECD, 2005) definition of innovation is widely accepted and the Brazilian government adopted it[1]. Therefore, it also was adopted in this study.

> *"An innovation is the implementation of a **new or significantly improved** product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations. […] A common feature of an innovation is that it must have been **implemented**. A new or improved product is implemented when it is introduced on the market. New processes, marketing methods, or organizational methods are implemented when they are brought into actual use in the firm's operations."*

[1]Translated version of Oslo Manual. It can be downloaded from the Brazilian Ministry of Science, Technology and Innovation (MCT) website: http://www.mct.gov.br/index.php/content/view/4639.html. Last access in: 02/25/2012.

The definition talks about four types of innovation: product, process, marketing, and organizational. The term "product" innovation is used to cover both goods and services. A product innovation is "*the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics*" (OECD, 2005).

The process innovation is defined as "*the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software*" (OECD, 2005). This type of innovation can be intended to reduce the production cost, increase the quality of delivered products and services, or reduce the delivery time.

A marketing innovation is "*the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing*" (OECD, 2005). They are aimed at better addressing the customer needs, increasing product sales, or improving the firm positioning in the market.

Finally, the definition of organizational innovation is "*the implementation of a new organizational method in the firm's business practices, workplace organization or external relations*" (OECD, 2005). It can be intended to reduce overall enterprise cost or improve workplace satisfaction, for example.

Innovation also can be classified with respect to its novelty and diffusion as well as according to its impact. In the former, it can be classified as *new to the company*, *new to the market* and *new to the world*. An innovation is considered *new to the company* when it was already used by another company and was recently introduced in the analyzed company. The innovation is classified as *new to the market* when the company was the first to introduce it in a particular market. When an innovation is firstly introduced in all markets and industries then it is classified as *new to the world*.

The classification according to the innovation impact categorizes it as radical or incremental. The radical innovations are those that redefine or create a new market overwhelming the precedent products and making them obsolete. The incremental

innovations generate significant value but they do not reshape the market at the point to extinguish other products or procedures.

Once innovation was defined for this study it is important to differentiate it from other constructs that are usually used as synonym, albeit in a wrong way: creativity, invention and innovative behavior. Creativity is defined as the generation of new and useful ideas (Amabile, 1996). Invention is an idea that was implemented (or developed) but did not generate value for the society or organization (Ahuja and Lampert, 2001).

Finally the construct innovative behavior has a particular importance to this research and has a close relationship with the innovation, creativity, and invention, but has a significantly different meaning. This construct will be discussed in the following section.

2.1.1. INNOVATIVE BEHAVIOR

The innovative behavior (IB) is a multidimensional construct defined as "*the intentional generation, promotion, and realization of new ideas within a work role, work group, or organization in order to benefit role performance, a group, or an organization*" (Janssen and Yperen, 2004; Yuan and Woodman, 2010; Cingöz and Akdogan, 2011). Examples of such behavior include the suggestion of a new product, a new process, the adoption of a new technology, or the application of new working method.

The multidimensional aspect of the innovative behavior construct comes from the definition of innovation that covers not only the proposal of new useful ideas but also talks about their implementation (Scott and Bruce, 1994). Therefore, the innovative behavior begins with the proposal of a new useful idea and its promotion to gain support from colleagues, managers or sponsors that can provide necessary power to materialize the idea. The next step is the implementation of the idea that can be operationalized as the production of a prototype to proof a concept, or the use of a new technology within a software project. Thus, innovative behavior is viewed as a multistage process. Different activities and different individual behavior are essential at each stage (Jong and Hartog, 2007; Cingöz and Akdogan, 2011).

Nevertheless, some authors have defined innovative behavior as a one-dimension construct that encompasses the idea generation and its implementation

(Janssen, 2000). However, this definition may hide or overlap the factors that influence the innovative behavior in each phase individually. Therefore, the multidimensional construct as suggested by Mumford and Licuanan (2004) and adopted by Jong e Hartog (2007), was chosen in this study.

It is important to highlight that creativity is an important component of innovative behavior. Particularly, it is closely related to the first stage of the innovation process: idea generation. However, the striking difference between creativity and innovative behavior is that for the latter the individual has to promote the idea and it has to be useful and implemented.

Finally, this study will use both creativity and innovative behavior researches as conceptual base keeping the analysis of factors influencing creativity isolated to the idea generation phase, as proposed by West (2002) and Jong and Hartog (2007).

The innovative behavior definition adopted by each model that composes the theoretical background of this research will be further detailed in the next section.

2.2. THE LEADERSHIP INFLUENCE ON THE INNOVATIVE BEHAVIOR: A SYSTEMATIC LITERATURE REVIEW

A Systematic Literature Review (SLR) (Kitchenham and Charters, 2007) was performed in conjunction with Igor dos Santos (dos Santos, 2013) to enfold the literature about the influence of leadership on the innovative behavior using an unbiased approach. Initially, Dos Santos (2013) compiled the results of the primary studies to understand such influence using the original SLR's research questions. After that, our study proposed new research questions to perform a separate analysis in the second phase of this thesis, which was based on the same set of primary studies of Dos Santos' review. The following research questions were used to guide the data analysis related to the problem addressed in this thesis:

- RQ1. How leaders influence the innovative behavior of individuals?
- RQ 1.1. Which factors related to leadership have been studied most?
- RQ2. Which are the other antecedents of individual innovative behavior found in the studies?

The answers to these questions provided important results about the leadership factors, which is a growing research topic in the area and yet little explored, according to Mumford, 2002. He also considers "*as evident the exercise of influence by leaders to increase the likelihood of idea generation by followers and the subsequent development of these ideas into useful products*".

The SLR research protocol described by Dos Santos (2013) can be found on Appendix B.

A total of 10.399 articles were retrieved at the end of first search step and after the selection process eighty primary studies remained for a deeper analysis. More details about the search process and the primary studies profile can be found on Dos Santos (2013). Then the analysis of the primary studies in the scope of this study and the results obtained will be detailed below.

The full text of each primary study was coded using qualitative analysis techniques and the results were synthetized to answer the three research questions presented above. First, it could be identified that a wide range of leadership factors that influenced the innovative behavior of individuals were being studied. A total of 60 constructs were mapped, such as: leadership styles, leadership behaviors, and leader-member relationship. In particular, the most studied topics were about the influence of the transformational leadership, transactional leadership, and charismatic leadership styles on the creativity and individual behavior. Furthermore, it was also identified 46 constructs related to organizational, individual, task, and team factors.

The majority of the identified factors were analyzed by a single study. Then, the synthesis of the results of some of these factors could be inconclusive due to the lack of comparative basis among different studies. This gap on the literature will be called as:

Literature Gap 1: The literature findings about the leadership influence on the innovative behavior are sparse and lack confirmatory evidences.

Thus, an important advice for the researchers in this area is to deepen the studies on the already identified promising factors in conjunction with the search of new ones.

Besides, due to this challenge on the synthesis and the research focus on software engineering teams, the strategy adopted to answer the research question was to

focus the analysis on the most studied factors and on the articles that have software engineering professionals as subjects. Therefore, the research questions below were answered following this approach.

RQ1. How leaders influence the innovative behavior of individuals?

From 80 primary studies only eight had software engineering teams as subjects in which two of them were focused on this industry and the other six also studied other industries.

The table 2.1 presents the studies and the research method used in each one.

Table 2.1 – Primary studies' research method and industry

Context	Research Method	Primary Studies
Only IT	Survey	PS070, PS355
IT and other industries	Survey	PS014, PS016, PS123, PS169, PS345
	Interviews	PS304

Observe that the majority of the studies used surveys as research method and only one used interviews, which is a qualitative data collection technique.

Therefore, based on such result, the second and third literature gaps are the following.

Literature Gap 2: The literature findings about the leadership influence on the innovative behavior are almost all based on quantitative studies.

Literature Gap 3: Few studies about innovative behavior studied, or focused on, software development organizations.

These gaps also existed for the studies about other antecedents of innovative behavior (IB). Therefore, it implies that the literature findings lack explanatory power and confirmatory studies using qualitative evidences. In addition, it lacks studies using software development professionals as subjects.

The antecedents studied by these studies are summarized in table 2.2. They were grouped according to the main construct studied.

Table 2.2 – Antecedents of IB studied with SE teams as subjects

Primary Studies	Factors studied
PS304	The only qualitative study among the eight. It identified thirteen leadership behaviors that influenced the innovative behavior of individuals. In particular, this study considered innovative behavior as idea generation and idea implementation. It also separated which behavior affeceds each one of these two dimensions.
PS070, PS169, PS355	These studies investigated the influence of different leadership styles on subordinates' creativity. In particular, they explored the role of intrinsic motivation and psychological empowerment of the subordinates as mediators of this relationship.
PS016, PS123	These studies explored the influence of leadership styles on team creativity through knowledge sharing among team members.
PS014	This study analyses the influence of team stress factors on each New Product Development (NPD) phase and highlights the importance of management support as facilitator.
PS345	This study investigated the relationship between the individual proactive personality and her individual creativity when exposed to different levels of creativity support by their supervisors, and different levels of creativity required by their work.

The primary study **PS304** (Jong and Hartog, 2007) identified specific leader behaviors that influenced the subordinate idea generation and implementation. The interviews were performed with leaders from knowledge intensive firms (IT, engineering, consulting, etc.). The research found the following connection between leader behaviors and subordinate innovative behavior (see Table 2.3).

Table 2.3 – Leader behaviors' summary

Behavior	Consists of.	Idea gener.	Idea implem.
Innovative role-modelling	Being an example of innovative behaviour, exploring opportunities, generating ideas, championing and putting efforts in development.	X	X
Intellectual Stimulation	Teasing subordinates directly to come up with ideas and to evaluate current practices.	X	
Stimulating knowledge diffusion	Stimulating open and transparent communication, introducing supportive communication structures like informal work meetings.	X	
Providing vision	Communicating an explicit vision on the role and preferred types of innovation, providing directions for future activities.	X	X
Consulting	Checking with people before initiating changes that may affect them, incorporating their ideas and suggestions in decisions.	X	X
Delegating	Giving subordinates sufficient autonomy to determine relatively independently how to do a job.	X	X
Support for Innovation	Acting friendly to innovative employees, being patient and helpful, listening, looking out for someone's interests if problems arise.	X	X
Organizing Feedback	Ensuring feedback on concepts and first trials, providing feedback to employees, asking customers for their opinion.		X
Recognition	Showing appreciation for innovative performances.	X	X
Rewards	Providing financial/material rewards for innovative performances.		X
Providing resources	Providing time and money to implement ideas.		X
Monitoring	Ensuring effectiveness and efficiency, checking-up on people, stressing tried and tested routines (negative relationship).	X	X
Task assignment	Providing employees with challenging tasks, make allowance for employees' commitment when assigning tasks.	X	

Source: Jong and Hartog (2007)

In particular, while Jong and Hartog's study investigated the influence of each leader behavior on the followers' innovative behavior, the other studies investigated the influence of leadership styles, which are higher-level constructs, on individual's innovative behavior.

The primary studies **PS070** (Gumusluoglu and Ilsev, 2009) and **PS169** (Shin and Zhou, 2003) found a positive relationship between transformational leadership and subordinates creativity. However, they diverged about the role of intrinsic motivation (Utman, 1997) as a mediator of this relationship. The first found the mediating effect as significant and the last as partial. Furthermore, the PS169 also studied the role of conservation (Utman, 1997) between the transformational leadership and subordinates

creativity. The author found that individuals submitted to transformational leadership are more creative when there was high level of conservation. However, the effect of transformational leadership on creativity was reduced on individuals with low level of conservation. Finally, the PS070 did not found the individual perception about innovation support (Scott and Bruce, 1994) as a mediator between transformational leadership and individual creativity.

Both **PS355** (Zhang and Bartol, 2010) and **PS070** (Gumusluoglu and Ilsev, 2009) found similar results about the psychological empowerment (Spreitzer, 1995) as a mediator of leadership behavior and individual creativity. However, PS355 did not find enough evidence about the role of intrinsic motivation as a mediator. Therefore, these three studies did not agree about the role of intrinsic motivation as a mediator.

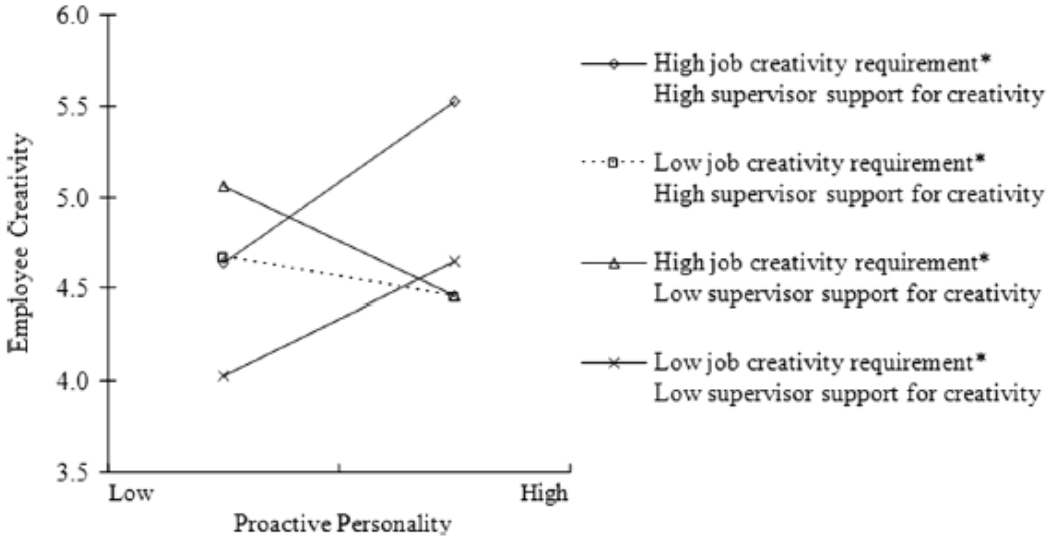
The leadership style also was studied in **PS016** (Zhang, Tsui and Wang, 2011) and **PS123** (Liu and Phillips, 2011). In these studies, the authors analyzed the role of knowledge sharing (Bartol et al., 2009; Srivastava, Bartol and Locke, 2006), collective efficacy (Zaccaro et al., 1995) and team identity (Jung & Sosik, 2002; Jung & Avolio, 1999). Both studies agreed about the positive relationship of transformational leadership and team creativity. Particularly, PS016 found that this relationship was also mediated by knowledge sharing and collective efficacy. On the other hand, the authoritarian leadership was negatively related to group creativity and also through the mediating effect of knowledge sharing and collective efficacy. PS123 studied the role of team identity, individual intention to share knowledge, and team knowledge sharing intention. The results showed that transformational leadership climate was positively related to team innovativeness through the mediation effect of team knowledge sharing intention. The team innovativeness construct used by this study had the item "*the number of innovations or new ideas introduced by the team*" as one of the four items that compose the construct's operationalization. Therefore, the relationship between team innovativeness and team creativity was considered through the use of this item, but should be interpreted with caution.

Stress factors (Kim and Wilemon, 2001) were studied by the authors of **PS014** (Akgun et al., 2007). This research focused on project and process outcomes regarding new product development projects, such as: new product success, speed-to-marketing, team learning, idea generation and etc. Particularly, the latter factor is related to our

research. They found that at high level of management support (Lynn, 1998), team anxiety (Akgün, Lynn and Byrne, 2006) was positively related to the proficiency in idea generation.

Finally, individual personality and creativity support were analyzed in **PS345** (Kim, Hon and Lee, 2010). The study investigated the relationship between proactive personality (Oldham and Cummings, 1996; Zhou, 2003) and creativity mediated by job creativity requirement (Shalley, Gilson and Blum, 2000) and supervisor support for creativity (Amabile et al., 1996; Madjar, Oldham and Pratt, 2002). The study found that proactive personality was positively and significantly related to South Korean employees' creativity. It also evaluated the impact of situational factors on this relationship. When the job creativity requirement and supervisor support for creativity were both high, a significant positive relationship between proactive personality and creativity was observed. When both were low the relationship was even stronger. However, a negative relationship was found when the job creativity requirement and supervisor support did not match. Figure 2.1 illustrates these findings.

Figure 2.1 – Employee creativity according to proactive personality



Source: Kim, Hom and Lee, 2010.

Table 2.4 summarizes the findings related to the RQ1.

Table 2.4 – Summary of leadership influence on individual IB

Effect	Agree	Do not agree
1. The **transformational leadership** positively affects the individual creativity.	PS070, PS169, PS016	
2. The individual **intrinsic motivation** mediates the relationship between **transformational leadership** and individual creativity.	PS169, PS355	PS070
3. The **psychological empowerment** mediates the relationship between **empowering leadership**/**transformational leadership** and individual creativity.	PS355,PS070, PS169	
4. The **support for innovation perception** mediates the relationship between **transformational leadership** and individual creativity.		PS070
5. The **knowledge sharing** mediates the relationship between **transformational leadership** and creativity.	PS016, PS123	
6. The **authoritarian leadership** style affects negatively the creativity through **knowledge sharing**.	PS016	
7. The **authoritarian leadership** style affects negatively the creativity through **collective efficacy**.	PS016	
8. **Team anxiety** is positively related with idea generation at high levels of **management support**.	PS014	
9. The **proactive personality** has positive relationship with individual creativity.	PS345	
10. The **job creativity requirement** and **supervisor support** mediates the effect of **proactive personality** on individual creativity.	PS345	

RQ1.1. Which factors related to leadership have been studied most?

In general, the researches about leadership factors that influence the followers' innovative behavior were looking for a wide range of different constructs. A total of 60 constructs were found adding up the studies in software engineering and in other industries. Therefore, the results were sparse, i.e., the majority of the antecedents proposed has been investigated only in one study.

On the other hand, some of these constructs were investigated in more than one study and are listed on table 2.5 below.

Table 2.5 – Leader factors more studied

Construct	Primary Studies	Count
Transformational Leadership	PS016, PS040, PS041, PS070, PS077, PS095, PS110, PS111, PS113, PS114, PS118, PS123, PS153, PS169, PS307, PS311, PS 315, PS333, PS337, PS338, PS339, PS346, PS349, PS357, PS358, PS431, PS440, PS450, PS468, PS489, PS525, PS526	32
Transactional leadership	PS041, PS095, PS111, PS113, PS114, PS118, PS307, PS311, PS338, PS349, PS469, PS489, PS525	13
Charismatic leadership	PS040, PS440, PS528, PS114, PS333, PS337, PS339, PS476	8
Leader support	PS047, PS110, PS267, PS359, PS360, PS450, PS451	7
Participative leadership	PS102, PS177, PS263, PS270	4
Intellectual stimulation	PS047, PS089, PS097	3
Inspirational motivation	PS113, PS307, PS339	3

Therefore, the leadership styles transformational and transactional leadership were the most studied as antecedents of innovative behavior.

RQ2. Which are the other antecedents of individual innovative behavior found in the studies?

As observed on leadership antecedents, the majority of other antecedents of innovative behavior were analyzed by only one study. A total of 46 antecedents could be mapped. It is important to observe that the SLR was focused on leadership antecedents. Therefore, the smaller number of other antecedents can be explained due to this fact.

Table 2.6 – Innovative behaviors more studied

Construct	Primary Studies	Count
Knowledge sharing	PS016, PS123, PS467, PS513, PS525	5
Trust	PS123, PS428, PS467, PS114	4
Innovative climate	PS196, PS357, PS451, PS153	4
Organizational support	PS428, PS169, PS348	3
Team identity	PS123, PS337, PS339	3

Antecedents at different level of analysis could be identified. Among the most studied ones are the organizational, team and peers relationship level. In particular, the knowledge sharing antecedent was the most investigated by the studies in this area.

The SLR results were used to sharpen the constructs with the use of already existing theories, such as transformational and transactional leadership styles (see Section 2.3.2). In addition, they were used to improve Case Study 2 structure and refine the data collection instruments, once it provided measures and new concepts for investigation that required new questions.

2.3. SUPPORTING THEORIES

Beyond the concepts discussed in previous sections, other three concepts deserve attention and further explanation. The importance of such concepts was identified during this study as a way to build the foundations of the new model based on previously established concepts that explained some of the results found.

In addition, the final model was built based on the Theory of Planned Behavior (Ajzen, 1991; Ajzen 2012). Therefore, such theory also will be presented here.

2.3.1. INDIVIDUAL PERSONALITY

Several theoretical foundations including traits, types, behavioral, and psychoanalytic theories are used in the research about personality. Among them, traits and types theories are the most used in organizational psychology and in the studies about personality in software engineering (da Silva et al., 2013, apud Cruz et al., 2011). In particular, the Big Five is a trait theory (Costa and McCrae, 1992) that has been used in software engineering (Cruz et al., 2011) and creativity (Furnham and Bachtiar, 2008; Patterson, 2002; Walker and Broyles, 1996) researches. Once the case study and the literature review performed in this research pointed for individual characteristics and

preferences as an antecedent of the individual's innovative behavior, the Big-Five emerged as a theory to improve constructs definition, to raise theoretical level, and to sharpen generalizability.

Some researchers used the label Five-Factor Model (FFM) instead of "Big Five". In scientific language, the word "model" can refer either to a descriptive framework of what has been observed, or to a theoretical explanation of causes and consequences. The Five-Factor Model (i.e., Big Five) (Costa and McCrae, 1992) is a model in the descriptive sense. The term "Big Five" was created by Lew Goldberg and was originally associated with studies of personality traits used in natural language. The term "Five-Factor Model" has been more commonly associated with studies of traits using personality questionnaires. The FFM of personality has become an almost universal template with which to understand the structure of personality.

There are several studies that support the FFM as a universal model of personality. Although researchers not always agree on the exact labels for each dimension, these five traits are usually described as follows: Extroversion (warmth, gregarious, activity), Agreeableness (compliance, straightforwardness), Conscientiousness (order, dutifulness, competence), Neuroticism (anxiety, depression), and Openness to Experience (ideas, aesthetics).

These factors are detailed below:

- **Extraversion**: This trait indicates a deep involvement with the external world, characterized by positive feelings and always strives to be in the company of others. The main attributes are excitability, sociability, talkativeness, assertiveness, and high amounts of emotional expressiveness. Extroverts are always seen as full of energy. In groups they like to talk, assert themselves, and draw attention to themselves;

- **Agreeableness**: This trait reflects a cooperative person, always believing in the human nature. An agreeable person believes that people never lie and are always honest and trustworthy. The main attributes are respectful, friendly, generous, helpful, and willing to make compromises. Usually an agreeable person is not at easy in situations that require tough decisions;

- **Conscientiousness**: Concerns the way in which the individuals control, regulate, and direct their impulses. These individuals are self-disciplined. They exhibit a tendency to show self-discipline, act dutifully, and aim for achievement. Conscientious individuals are generally hard-working and reliable. When taken to an extreme, they may also be "workaholics", perfectionists, and compulsive in their behavior;

- **Neuroticism**: This trait is marked by mental distress, emotional suffering, and an inability to deal effectively with the normal demands of life. The main attributes are emotional instability, anxiety, moodiness, irritability, depression, vulnerability, and sadness. Their persistent negative feelings tend to continue for unusually long periods of time, which means they are often in a bad mood;

- **Openness to Experience**: This trait describes the cognitive style that distinguishes imaginative people from conventional ones. The main attributes are imagination, artistic interest, emotionality, adventurousness, and intellect. Open people are intellectually curious, appreciative of art, and sensitive to beauty.

It is important to highlight that each one of these five personality traits describes the frequency or intensity of a person's feeling. Everyone has all of these traits described before, to a greater or lesser degree.

In particular, the link between personality and the innovative behavior have been analyzed on the study of the influence of personality on the creativity dimension. Several studies (George and Zhou, 2001; McCrae, 1987; Gelade, 1997; King, Walker and Broyles, 1996; Batey and Furnham, 2006; Furnham and Bachtiar, 2008; Costa and McCrae, 1992; Patterson, 2002) relate each dimension of the Five Factor Model to creativity and the rise of new ideas among employees. Although the object of this study is the emergence of innovative behavior as a phenomenon, the creativity is a dimension of the innovative behavior in employees.

The literature review showed that the findings are divergent about the relationship of each personality trait and creativity. According to the review performed by Batey and Furnham (2006), it is difficult to provide a parsimonious summary of the relations between creativity and personality. Different personality measures have been

used alongside various conceptualizations of creativity. Then, Batey and Furnham (2006) summarized the results according to the conceptualization of creativity and the measure used: (a) using Divergent Thinking (DT) test, and (b) using he expert rating of a product of work (e.g., story writing or quality of work).

The results for the DT test tend to suggest that Extraversion is a consistent and significant correlate. However, the researches highlighted that this relationship may be influenced by the nature of DT test administration, which is a group activity and Extroverts tend to exhibit active participation. In addition, Openness to Experience has also been related to creativity when DT tests are used. The mechanism used to explain this relationship is that individuals scoring high on this trait have defective filters for irrelevant stimuli. Therefore, more ideas enter consciousness and are thereby more likely to be combined in interesting ways to form creative ideas.

When the creativity is measured using expert ratings of a product, the results are less clear then for DT test. Again, Extraversion in some cases appears as correlated to creativity and Openness to Experience in few cases.

In addition, they proposed that the domain of endeavor, the context, is a factor that produces variance on the results. For example, different personality factors may influence the creativity of an artist or a scientist. Therefore, this fact reinforced the importance to study the influence of personality specifically in the software engineering field.

After the analysis of the personality field and its link to creativity, it was possible to understand that the relationships are not clear. However, the correlations for the factors Extraversion and Openness to Experience were the more convergent. Once the innovative behavior concept still is different from creativity, there is an opportunity to study if exists a relationship between the individual's personality and her innovative behavior. Therefore, the following literature gaps were identified.

Literature Gap 4. The literature findings about the influence of personality on the creativity dimension of innovative behavior are divergent.

Literature Gap 5. The literature findings about the influence of personality on the innovative behavior of software professionals are scarce.

2.3.2. LEADERSHIP STYLE

Several studies (see table 2.5) have investigated the relationship between leadership styles and creativity, innovation and performance. In particular, two styles have been extensively investigated over the past 35 years: transactional leadership and transformational leadership (Avolio and Bass, 2004) (see Section 2.3.2).

According to Bass (1985), **transactional leaders** builds the foundation for relationships between leaders and followers in terms of clarifying responsibilities, specifying expectations and tasks requirements, negotiating contracts and providing recognition and rewards in exchange for the expected performance (Liu, Liu and Zeng, 2011). Exhibiting transactional leadership means that followers agree with, accept, or comply with the leader in exchange for praise, rewards, and resources or in order to avoid disciplinary action. The transactional leader usually operates to guarantee that subordinates will work according the existing culture (as opposed to change it). Such leaders pay close attention to deviations, irregularities, and mistakes in order to take action and make corrections. They also attempt to satisfy the need of followers negotiating exchanges for their performance to achieve specific goals as well as using contingent reward behavior.

Further, transactional leaders also operate with an inclination to avoid risk, and focus on time constraints, standards, and efficiency (Bass, 1985). These leaders deal with deviations using hard criticism, which can result in followers taking the leader's desired pathway of approaching problems instead of trying new ways to deal with the challenges and improve the results (Lee, 2008).

On the other hand, the **transformational leader** "*raises associates' level of awareness of the importance of achieving valued outcomes and the strategies for reaching them"* (Burns, 1978). They also encourage followers to transcend their self-interest for the sake of the team or organization. Furthermore, they encourage the followers' needs to higher levels in such area as achievement, autonomy, and affiliation, which can be both work related and not work related (Burns, 1978). Burns was the precursor of the transformational leadership theory and Bass and Avolio (1995) evolved it. According to them, transformational leaders encourage others to both develop and perform beyond standard expectations. A process of personal identification takes place

and the motivation level of followers is raised as well as their self-efficacy and the willingness to accept extraordinary challenges (Shamir, 1990).

In certain circumstances, both styles have been exhibited by a given leader. In addition, it is expected that they can be exhibited in varying degrees over time.

Bass and Avolio (1995) developed the Leadership Multifactor Questionnaire (MLQ) to assess the perceptions of leadership behaviors. The MLQ 5X-Short version is composed of 45 items which assess 9 dimensions of leadership style and 3 dimensions of outcomes. The leadership dimensions are listed on table 2.7.

Table 2.7 – MLQ scale and leadership styles

Scale	Leadership Style
Idealized Influence (Attributed)	Transformational
Idealized Influence (Behavior)	Transformational
Inspirational Motivation	Transformational
Intellectual Stimulation	Transformational
Individual Consideration	Transformational
Contingent Reward	Transactional
Management-by-Exception (Active)	Transactional
Management-by-Exception (Passive)	Laissez-faire leadership
Laissez-faire Leadership	Laissez-faire leadership

A total of five dimensions are associated with transformational leadership, two of them with transactional leadership and the other two with laissez-faire leadership.

Several studies showed positive relationship between transformational leadership and creativity or innovation (e.g., Shin and Zhou, 2003; Gong, Huang and Farh, 2009; Gumusluoglu and Ilse, 2009). Some studies showed positive relationship of transactional leadership and innovation under certain circumstances (e.g., Jansen, Vera and Crossan, 2009; Sosik, Avolio, and Kahai, 1997; Kahai, Sosik, and Avolio, 2003). However, other studies (e.g., Jansen, Vera and Crossan, 2009; Lee, 2008) found a negative relationship between transformational and transactional leadership and

creativity or innovation. To explain the variance in the results, Rosing and colleagues (2011) proposed that the traditionally studied leadership styles are too broad in nature to promote innovation as they might both foster and hinder innovation. Therefore, they propose that to explain the relationship between leadership and innovation the theories should incorporate behavior flexibility instead of define stable and inflexible behaviors.

According to them, innovation requires explorative and exploitative activities. Therefore, the leaders should be able to behave in both ways and to influence the followers to engage in exploration and exploitation, which they call ambidextrous leadership.

> *"Ambidextrous leadership is the ability to foster both explorative and exploitative behaviors in followers by increasing or reducing variance in their behavior and flexibly switching between those behaviors. That is, ambidextrous leaders are able to support their followers in the attempt to be ambidextrous."* (Rosing et al., 2011)

In addition, the leader should be able not only to balance exploration and exploitation, but also to integrate both and switch between them with flexibility as the situation requires.

The theories of transformational and transactional leadership were used in this study to identify the managers' leadership style and allow the comparison between followers' behavior from teams managed by transformational and transactional leaders. The embedded cases selection strategy to obtain such leaders diversity was performed only on the second case study. It provided results in accordance with the ambidextrous leadership theory, as will be further detailed in Chapter 5.

2.3.3. PROJECT CLASSIFICATION SCHEMA: THE THREE HORIZONS MODEL

The Three Horizons model presented by Terwiesch and Ulrich (2009) proposed a classification schema for innovative projects.

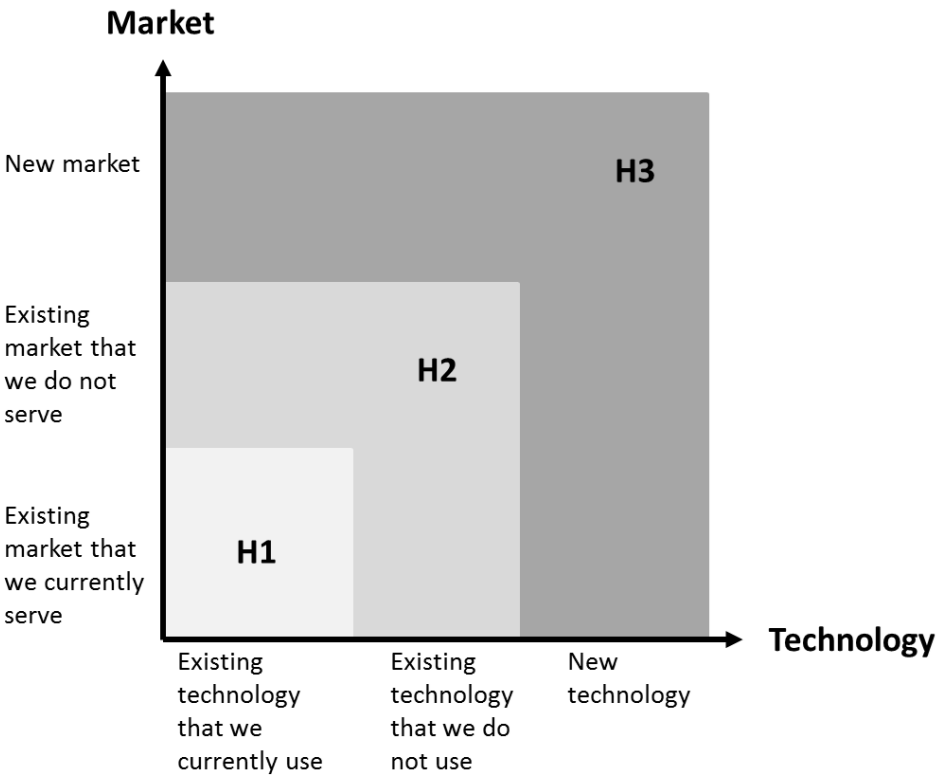
According to Christian Terwiesch and Karl Ulrich "*conventional wisdom in innovation strategy says that companies should balance the exploitation of existing opportunities with the exploration of new ones. People also talk about core versus peripheral innovation or incremental versus radical innovation; these all terms mean*

the same thing, and they can all be unified under the single perspective of uncertainty horizons".

The most part of innovations face two types of uncertainties: technological uncertainty and market uncertainty. The technology uncertainty is defined by the organization ability to overcome the technical difficulties of an opportunity. In turn, the market uncertainty is defined by the organization ability to understand and address the needs of a group of customers.

Using the technological and market uncertainties as axes, the Three Horizons model define three spaces of innovation (Figure 2.2).

Figure 2.2 – The Three Horizons Model



The horizons definition are presented following.

- Horizon 1 (H1): projects that involve mature technologies and that are targeted to the markets already served by the organization are classified as H1. In this horizon, the risk is small and the improvements are marginally incremental. Therefore, such projects result on lowest levels of innovation.

- Horizon 2 (H2): this classification is used for projects that involve technologies that are new to the organization and/or that are targeted to a market that the company has not explored yet. Such technologies already exist but they are not dominated by the organization. However, such technologies can be acquired by the organization. In this horizon, there are relative uncertainties and projects with moderated level of innovation.
- Horizon 3 (H3): this horizon comprehends projects that involve emerging technologies and/or are targeted to a market that yet does not exist (are untapped by any other organization). Such technologies still are in development and are used in an experimental way. In this horizon, there is high level of uncertainties and projects that can provide the highest levels of innovation.

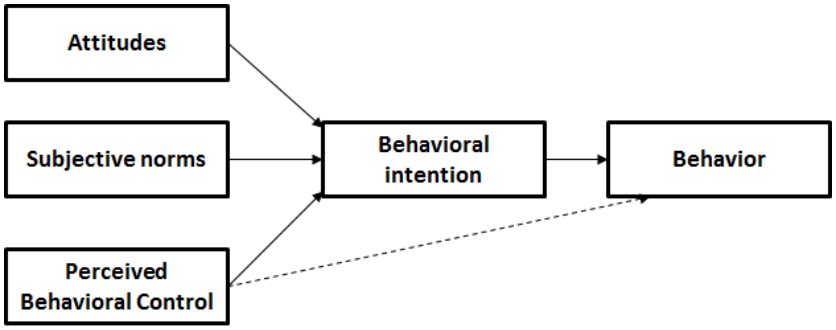
This Horizons model was used in this study to classify the participant projects. It was considered that when higher levels of uncertainty exist in a project, the technical challenges will be higher and less will be known about how the final solution. Then, when the final solution is not defined *a priori*, the project scope can change during project's execution. Therefore, to obtain project diversity regarding technical challenges and scope stability, projects classified on different horizons were selected.

2.3.4. THE THEORY OF PLANNED BEHAVIOR

The Theory of Planned Behavior (TPB) (Ajzen, 1991; Ajzen 2012) is a framework designed to understand, predict and changing human social behavior. Such theory was created using the Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1980) as its initial underpinnings.

The TPB proposes that three types of antecedents guide the human action: attitudes towards the behavior, subjective norm, and perceived behavioral control. See in the Figure 2.3 how such concepts are related.

Figure 2.3 – Theory of planned behavior model



Source: Ajzen (2012)

As defined by Ajzen (2012), the individual attitudes towards the behavior represent the "*readily accessible beliefs about the likely outcomes of the behavior and the evaluation of these outcomes"*. In addition, the subjective norm is the *readily accessible beliefs about the normative expectations and actions of important referents and the motivation to comply with these referents"*. In turn, the perceived behavioral control is the "*readily accessible beliefs about the presence of factors that may facilitate or impede the performance of the behavior and the perceived power of these factors"*.

Together, the attitudes towards the behavior, the subjective norm, and the perceived behavioral control lead to the formation of a behavioral intention. Generally, the more favorable the attitude and the subjective norm, and the greater the perceived control, the stronger the person's intention to perform the behavior in question (Ajzen 2012).

Such intention is the intermediate between these three antecedents and actual behavior. Thus, it is expected that the individual will carry out her intention towards the behavior when sufficient degree of actual control over the behavior is in place when the opportunity arises.

See in Figure 2.3 that the perceived behavioral control influences both the intention and the behavior. Actually, in some situations factors may exist that impede or allow the individual to perform a behavior. For example, the intention to solve a specific problem may depend on the existence of resources, such as physical devices and technologies that allow experimentation. Therefore, despite the individual intention, if the required resources are not available, the behavior will not be performed. Thus, the

TPB proposes that external factors influence the behavior. However, the author explains that, according to several studies, the individual perceived behavioral control is correlated to these external factors of influence. Thus, it is possible to suppress the external factors from the model.

There is a particular link between these uncontrolled factors and our study of innovative behavior of software professionals. Note that the individual innovative behavior intention may depend on the existence of resources, technical knowledge, experience, technologies, etc. In addition, if the individual innovative behavior is considered in the context of an organization, additional factors may influence, such as the organization rules, the leadership, the work-group, etc. Therefore, while in some contexts the individual have volitional control over her behavior (e.g. practice of physical activity), in the organizational context several factors may influence and should be considered.

TPB offers a robust framework to guide the innovative behavior model construction. Once the external factors of the innovative behavior model may be related to organizational factors, it is important to represent them explicitly in the model to highlight the aspects that are uncontrolled by the individual and should be supplied by the organization. TPB was used to support the development of our innovative behavior model after the construction of the results of Case Study 2.

2.4. INNOVATIVE BEHAVIOR MODELS

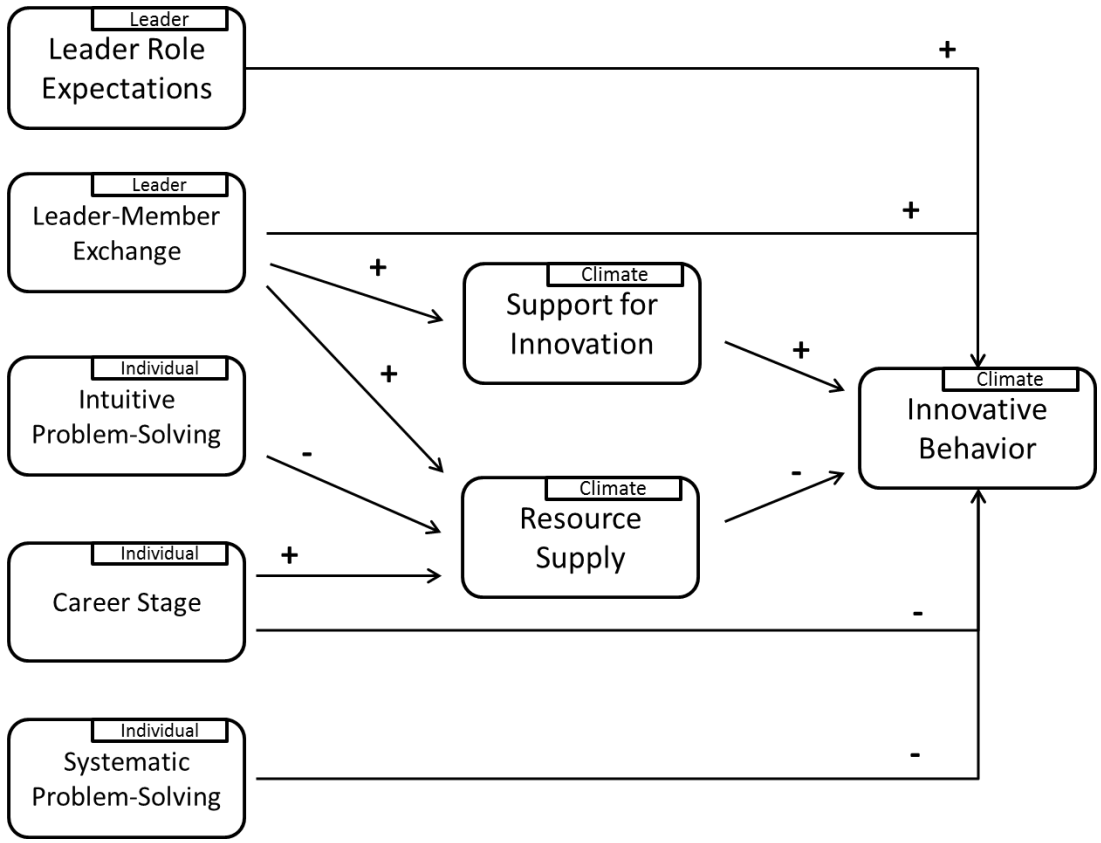
Several factors have been proposed by the current models to explain the antecedents of innovative behavior (Scott and Bruce, 1994; West, 2002; Mumford et al., 2002; Åmo, 2005; Dzulkifli and Md.Noor, 2011). In general, these factors are related to:

1. the characteristics of the organization and their intersection with the individual (e.g. strategy, support for innovation);
2. characteristics of the intersection between individual and workgroup (e.g. culture in the workgroup, task characteristics, group process);
3. characteristics of the intersection between individual and her leader (e.g. leader role expectation, leader behaviors, intellectual stimulation); and
4. characteristics of the individual herself.

In particular, three models are closely related to this research and will be detailed and compared to the results found in Chapter 5. An overview of them will be presented below.

The model proposed by Susanne Scott and Reginald Bruce (1994) postulated that the innovative behavior is an outcome of four interacting systems: individual, leader, work group, and climate for innovation. Figure 2.4 illustrates the antecedents that represent each system (see the labels).

Figure 2.4 - Scott and Bruce's Model



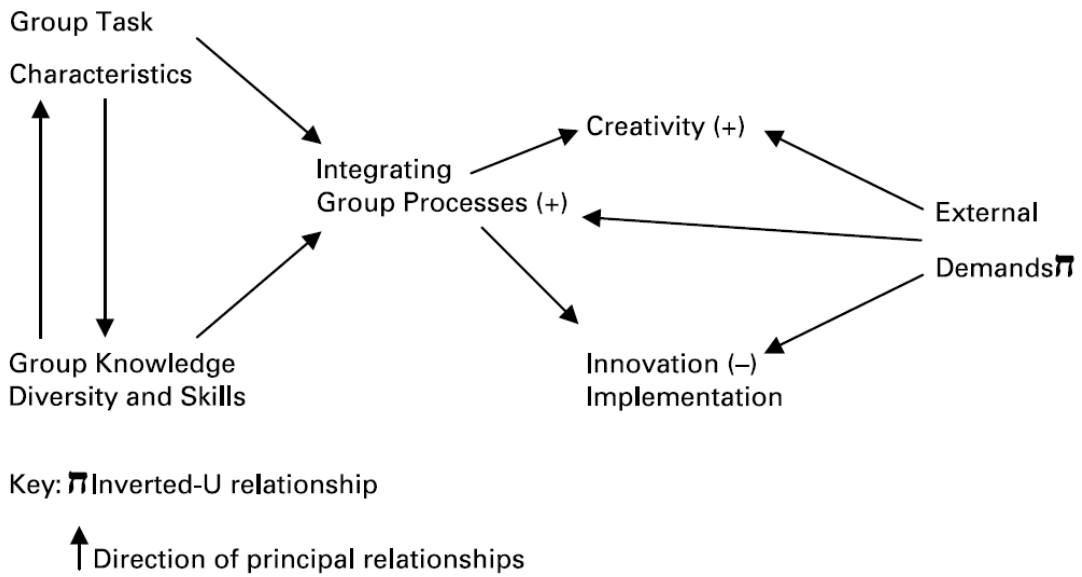
Source: adapted from Scott and Bruce (1994)

Another model that provided comparative basis for this study was proposed by Michel West (2002). It contributed with the area of creativity and innovation implementation among work teams. The use of his model in this research was performed with caution because West did not use the innovative behavior construct and the model was proposed for the group level instead of individual level. However his model clearly stated the antecedents that affect the dimensions **creativity** and **innovation implementation**. Because of the close relationship of this model and the

innovative behavior construct, it was considered an important source of theoretical background for this research.

It is composed of four elements (see Figure 2.5) that interact with each other and with the group creativity and innovation implementation: group task characteristics, group knowledge diversity and skills, integrating group processes, and external demands. Particularly, the author proposes the external demand as a new element that should be considered in the study of work group creativity and innovation implementation.

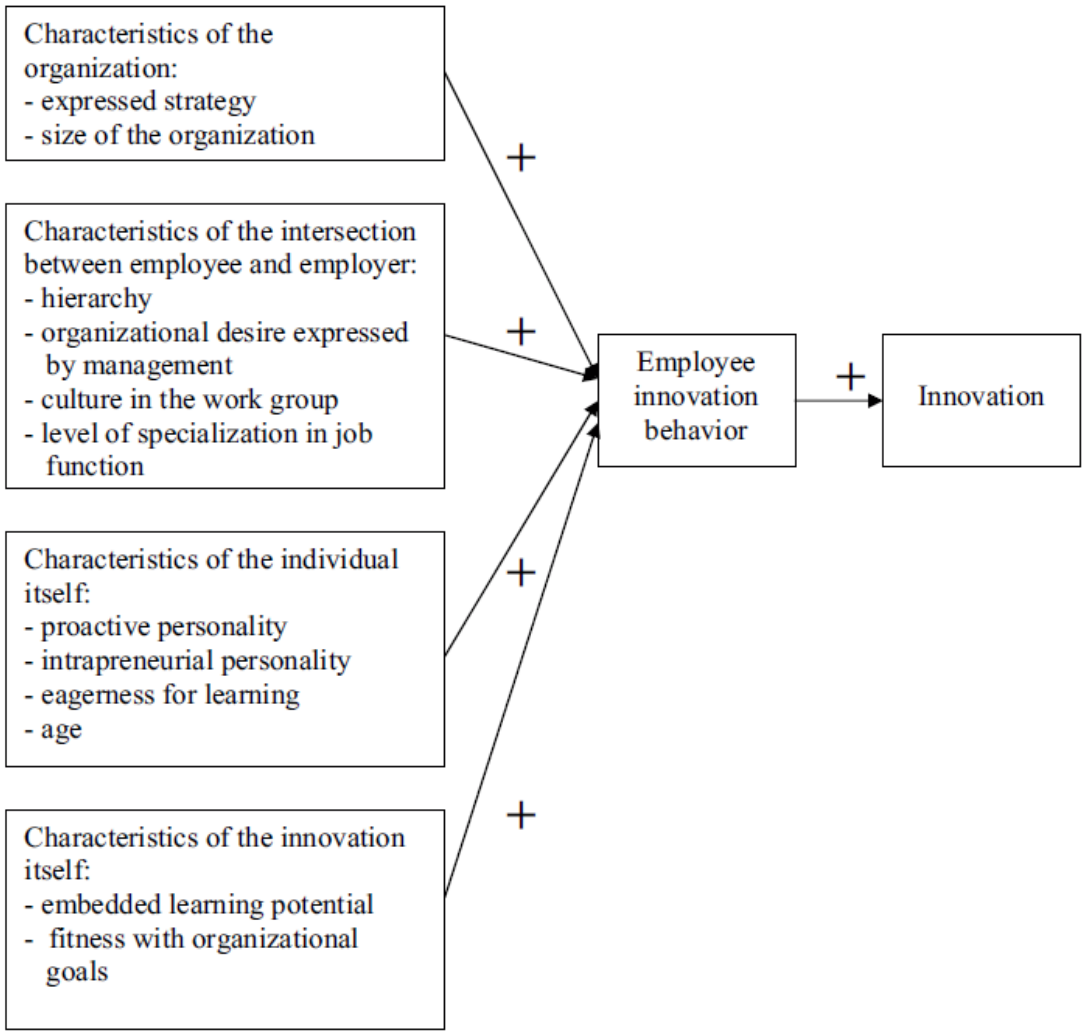
Figure 2.5 – West's model



Source: extracted from West (2002)

Finally, Bjørn Åmo (2005) proposed a third model (see Figure 2.6) composed of four sets of antecedents: characteristics of organization, characteristics of intersection between employee and employer, characteristics of the individual itself, and characteristics of the innovation itself. All of the proposed antecedents influenced positively the employee decision to enroll in innovative behavior.

Figure 2.6 – Åmo's conceptual model of innovative behavior



Source: Åmo, 2005

Notice that Åmo's (2005) and Scott and Bruce's (1994) models have some minor similarities, but are significantly different. Both expressed antecedents from organizational, leadership and individual level. However, the antecedents itself were very different, which shows that the innovative behavior is a phenomena that requires further study.

2.5. SUMMARY

This chapter presented the theoretical background that provided the foundations of this study. First, the constructs of innovation, creativity and innovative behavior, which are central for this thesis, were defined based on the scientific literature.

Then, the results of a systematic literature review about the influence of leadership on the individual's innovative behavior was presented. Such review identified three literature gaps that deserved further investigation and confirmed the importance of our study.

After that, the Big Five Model of personality, the transformational and transactional leadership styles, the Three Horizons model, and the Theory of Planned Behavior were presented. These supporting models and theories were used to raise the theoretical level, support our model construction, and to increase construct and internal validity of our findings.

Finally, three literature models were presented. First, the Scott and Bruce's model proposed that the innovative behavior is influenced by four interacting systems: individual, leader, work group, and climate for innovation. After that, the West's model was presented. It is composed of four elements that interact with each other and with the group creativity and innovation implementation: group task characteristics, group knowledge diversity and skills, integrating group processes, and external demands. Then, the Åmo's model was detailed. Such model is composed of four sets of antecedents: characteristics of organization, characteristics of intersection between employee and employer, characteristics of the individual itself, and characteristics of the innovation itself.

3 RESEARCH DESIGN

The analysis of current body of knowledge about innovative behavior research has revealed opportunities to improve our understanding of this phenomenon. It was observed that most studies in the area are quantitative. This can be explained by the fact that these studies have the goal of identify the existence of a relationship between several antecedents and innovative behavior in different organizations and contexts. However, few studies, such as Jong and Hartog's (2007), had the objective of building explanations about the innovative behavior phenomena based on qualitative empirical evidence. Therefore, the research design that will be presented in this chapter was developed with the aim to overcome this limitation and provide deeper explanations of the phenomenon of innovative behavior in software organizations.

3.1. METHODOLOGICAL FRAMEWORK

The philosophical stance chosen for the study affects the methods that should be used to answer the research question and what can be accepted as truth (Easterbrook, 2009). In this research the *constructivist* stance was chosen which "*concentrates less on verifying theories, and more on understanding how different people make sense of the world, and how they assign meaning to actions*" (Easterbrook, 2009). In such studies, scientific knowledge is attached to the context from where it was created. Constructivists prefer methods that collect rich qualitative data about human activities.

Further, this study aims to understand and explain the innovative behavior phenomena based on deep analysis of qualitative data. According to Seaman (1999) "*the principal advantage of using qualitative methods is that they force the researcher to delve into the complexity of the problem rather than abstract it away*". Thus, the research design of this study was chose to suit the methodological framework presented.

3.2. RESEARCH STEPS

According to Yin (2009) "*the more the question seeks to explain 'why' and 'how', the more that case study method will be relevant*". Further, "*the method also is relevant the more the question requires an extensive and in-depth description of some social phenomena*". Therefore, the case study method was used to build an explanatory model about the innovative behavior phenomena. Moreover, an inductive approach was

followed, with minor adjustments, as proposed by Eisenhardt (1989) roadmap for building theories from case study research (see Table 3.1).

Table 3.1 – Process of building model from case study research

Step	Activity
Getting started	- Definition of research question - Possibly a priori construct
Selecting cases	- Neither theory or hypothesis - Specified population - Theoretical, not random, sampling
Crafting instruments and protocol	- Multiple data collection methods
Entering the field	- Overlap data collection and analysis, including field notes - Flexible and opportunistic data collection methods
Analyzing data	- Within-case analysis - Cross-case pattern search using divergent techniques
Shaping hypothesis	- Iterative tabulation of evidence for each construct - Replication, not sampling, logic across cases - Search evidence for "why" behind relationships
Enfolding literature	- Comparison with conflicting literature - Comparison with similar literature
Reaching closure	- Theoretical saturation when possible

Source: Extracted from Eisenhardt (1989)

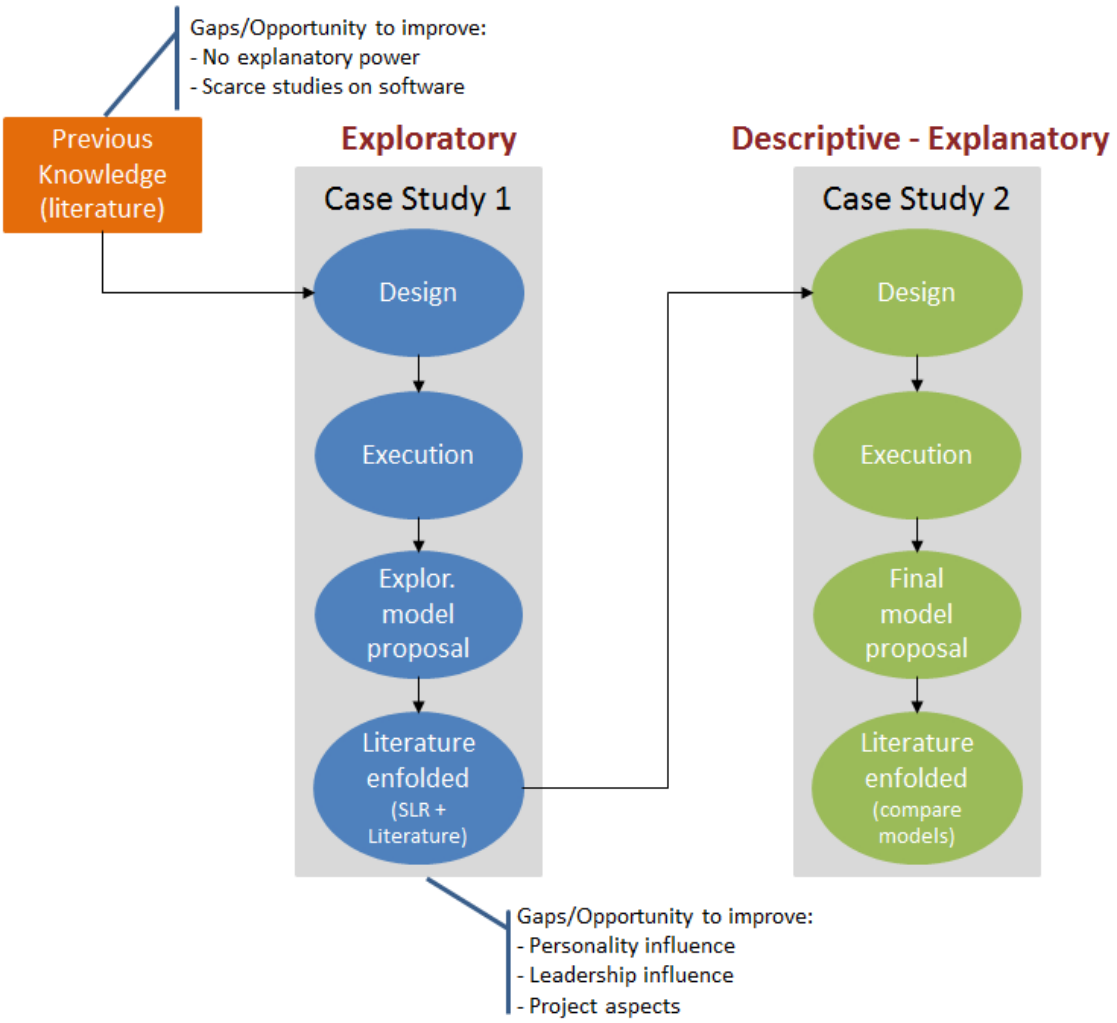
The inductive approach highlights particularities of case study research that are misunderstood by someone familiarized only with quantitative methods, as follows:

- There is not an "a priory" hypothesis and the case selection is performed by purposeful or theoretical, not statistical or random, sampling. This happens because it promotes theoretical flexibility and focuses the effort on replication or theory extension for a specific population at the same time that sharpens external validity;

- The use of multiple data sources strengthens grounding of theory by triangulation of evidence;
- The flexible and opportunistic data collection gives to the researcher the opportunity of analyze emergent themes that may be relevant to the study, or specific to that case, as well as abandon irrelevant aspects;
- The data analysis should be performed within-case to build preliminary theory and identify particularities before compare with other cases;
- After several steps, the emerging hypotheses should be shaped grounded on data and the logic about the established relationships should be explained to build internal validity. These hypotheses should be updated according to new findings;
- The hypotheses should be compared with the literature to build internal validity, to sharpen generalizability, and to raise theoretical level. The process should stops ideally when theoretical saturation is reached, i.e., when incremental learning is minimal because the researchers are observing phenomena seen before. In practice, the ideal stopping rule always combines with pragmatic considerations such as time and money that can be invested in the study (Eisenhardt, 1989).

Beyond the case study method, a systematic literature review (SLR) was performed in parallel with the Case Study 1 in order to unfold the literature using a systematic and unbiased approach (dos Santos, 2013; dos Santos et al., 2014). The research steps are summarized in Figure 3.1.

Figure 3.1 – Research steps



The study started with a literature review about the current models and studies related to the innovative behavior. At this step, it was identified that the current models did not provide explanatory power about the innovative behavior phenomena and there was a scarcity of studies in the software industry. Therefore, there were opportunities to improve the previous knowledge body. Hence, the research questions were defined and Case Study 1 was designed to be exploratory and provide better understanding about the innovative behavior phenomena, which had scarce qualitative information available. After the data collection and analysis execution, a model was proposed and then compared to the literature. At this step, the literature used for such comparison was compiled using both a traditional literature review, which was composed of the previous innovative behavior models and related papers, and a systematic literature review, which was focused on leadership antecedents of innovative behavior. This comparison

revealed that the our initial model had differences and similarities with previous models and studies, but still there were opportunities to improve. At this time, it was identified that individual characteristics and preferences was an important antecedent of innovative behavior as well as leadership factors and project characteristics. Thus, further literature research was performed providing the theories that were used in the design of Case Study 2.

Case Study 2 was a larger and more encompassing study, in which the strategy to select the unities of analysis and the data collection instruments were improved in order to introduce diversity and allow comparison among participants. After the Case Study 2 execution, the resulting model was compared to the models presented in the literature. Such comparisons showed the identification of complementary evidences about the already known antecedents as well as highlighted the novel contributions of the model developed in this thesis.

The details about the Case Studies will be provided in the following chapters.

3.3. SUMMARY

This chapter detailed the methodological framework used to achieve the study's goal. The Case Study method and a Systematic Literature Review were used to compose such framework. The research steps were also presented. They were elaborated adapting the Eisenhardt (1989) roadmap for building theories from case study research.

The remainder of this thesis is organized according to the steps described in Section 3.2. Chapter 4 presents Case Study 1, detailing its method, the followed procedure, the results, and the initial model comparison with the previous literature. Chapter 5 details the method, the procedure, and the results of Case Study 2. Then, the final model and its hypotheses are detailed in Chapter 6 together with its comparison with the previous literature models and the study's contributions.

4 CASE STUDY 1: COMPANY A

Case study 1 was performed between November/2012 and July/2013, in Company A, a software development company specialized on customized software outsourcing as well as business intelligence (BI) services. The company was based in Toronto (Canada) and was founded in 1994. During the case study, Company A had 45 professionals, ranging from 30 to 45 years old, from different ethnic backgrounds. These professionals were designers, system administrators, system analysts, software engineers, software testers, BI specialists, database administrators, project managers and the HR manager. The three company owners directed the company and the company's professionals were employees or contractors[2].

The organizational structure was very flat with the managers reporting directly to the directors/owners. On some projects, the directors were involved in some decisions together with the software development team. The company's projects ranged from several areas, including e-Health, energy and environment, financial services, media, etc.

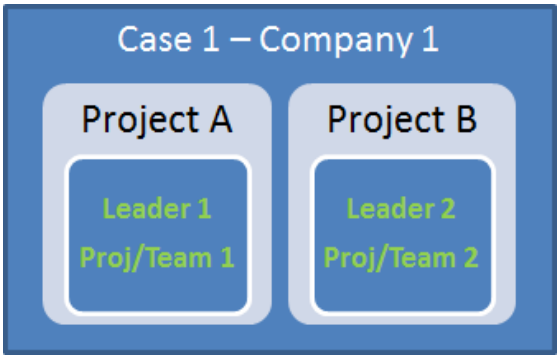
The following section will detail the method used for this case study.

4.1. CASE STUDY DESIGN

The planning of case study 1 started with the definition of a case study's design and the choice of the unity of analysis. After that, the data collection instruments and the data analysis strategy were elaborated. The details about these steps will be presented below. Figure 4.1 illustrates the design if the first case study.

[2] Contractors are full or part-time professionals temporary contracted for a particular project or predefined period of time. Some of them had worked at Company A for more than one contract and period of time.

Figure 4.1 – First case study design



On this company, two projects were studied and the leader from "Project A" was different from "Project B". This design was chosen to obtain variability of leaders and projects. Furthermore, team members from each project participated in the study. The team members variability was obtained using the selection criterion detailed below.

Unity of analysis

The unity of analysis for this study was the individual, i.e. the member of a software development team. In the process followed to select the participants, the leader classified the team members according to the frequency they behave innovatively, following the innovative behavior definition (see Section 2.1.1) explained in person by the researcher. Then, the researcher chose the members with low, medium and high frequency of innovative behavior from each team. This strategy was used to compare members with different level of innovative behavior and analyze which factors could explain their behavior.

Unfortunately, only one team member from the second team could participate on this research due to company's constraints. Despite this fact, the data collected from him was very useful because it allowed the comparison across teams.

Data collection

In order to build strong evidence, two sources of data were used: interviews and observation.

Semi-structured interviews were performed with software development team members and their leaders. The interview guides are detailed on Appendix A. The team members' guide had 77 questions and an estimated duration of one hour. The questions

were grouped by the following categories: team member background, team member innovative behavior, organization characteristics, working group, leadership, and individual characteristics. The leader guide had 27 questions and an estimated duration of thirty minutes. The questions were grouped by the following categories: leader background, organization characteristics, working group and leader, subordinates, and individual characteristics. Both interview guides were piloted with individuals from companies that did not participate in the study. All of the interviews were recorded and the audio was transcribed verbatim.

Observation was chosen as a complementary and confirmatory method of data collection. The method is complementary because allows the researcher to observe behaviors and interactions among team members that cannot be obtained from interviews (Seaman, 1999). Moreover, combined with interviews, the data collection performed from multiple sources allowed data triangulation, which improves the reliability of results (Eisenhardt, 1989; Seaman, 1999).

The observations happened during the project meetings because it was one of the single moments were the individuals interacted face to face during the project.

Data analysis

In order to improve reliability, the case study's results should be linked to the data that originated them. Furthermore, the pathway from results to data should be traceable to provide evidence of what is been proposed is true. However, it is very difficult to trace the rationale used by the researcher to navigate from raw data to the final conclusions (Eisenhardt, 1989).

Therefore, the data analysis of this study was performed using techniques and tools to improve the traceability. The interviews were transcribed and open coded (Strauss e Corbin, 2007) with the support of NVivo[3]. The constant comparison method (Seaman, 1999) was used to synthetize the data and to explain the phenomena looking for theory generation grounded on data.

[3] NVivo is a software that supports qualitative and mixed methods research. It lets you collect, organize and analyze content from interviews, focus group discussion, audio, etc. Webpage: http://www.qsrinternational.com/products_nvivo.aspx (last access on Jul 2nd, 2013).

The following scheme was used to trace the evidences from the data.

<company code><Project code><Individual position><Individual code>_<open code>

In which:

- Company code – company code which is the letter "C" followed by a number. Ex: C1 (company 1)
- Project code – The code of the project within a company which is the letter "P" followed a letter. Ex: PA (Project A)
- Individual position – TL for Team Leader and TM for Team Member
- Individual code – The individual code within the team. Ex: TM1 (team member 1)
- Open code – The code that emerged from the open code and constant comparison process. Ex: "No financial rewards"

An example of a complete code is C1PATM2_No financial rewards. That means that the evidence points to the data "No financial rewards" collected on the interview of team member 2, which works on project A, in Company 1. Therefore, with this information the text excerpt can be easily found in the raw data with support from NVivo tool.

4.2. PROCEDURE

The rich description of context is important in case study research to support findings and enhance the transferability of the results (Merriam, 2009). Therefore, an overview of the projects analyzed in this case study is provided below.

Project A was a software development project for the health insurance area. The team had fifteen members, composed of one project manager, two business analysts, one quality analyst, ten software engineers, and the project manager, who was one of the directors. Two of these developers were also technical architects.

On Project B, nine people composed the team: one project manager, one technical leader, six software engineers and one business analyst/tester. They developed a web decision support tool for a health insurance company based in the USA.

Both teams used a mix of traditional and Scrum methodologies for project management as well as for software development. Some agile practices such as iterative and incremental releases and daily meetings were used. However, some practices were not. For example, the task assignments were predefined according to each professional skill on a specific technology or system layer. In addition, the team had a project manager instead of a Scrum Master and the product owner role did not exist. Therefore, the system analyst, who interacted directly with the customer, defined the system's requirements.

The interviews were performed individually in a meeting room, except the interview with C1PATM2, which was performed by audio conference using the Skype communication tool and the interviewee was in a private room. This particular situation happened because the selected participant got sick on the day of her interview and was out of work. Then the interview happened after four days. All interviews were recorded summing up to 5 hours and 2 minutes of audio. Only one meeting of each team could be observed due to time constraints.

Four people from Project A participated in the observed meeting: the project manager, the business analyst and two software developers. From project B only two people could participate because of the project time constraint from the professionals. On this project, the project manager and the business analyst were interviewed.

The following section will give an overview of one participant's profile, experience, and what could be identified about her innovative behavior and what influenced it. After that, the result of this case study will be detailed.

Project A: Team Member 1

This section details the analysis performed for a participant as an example of how the data analysis was accomplished. The team member 1 from project A was an experienced professional who worked on more than 10 companies and who self-declared as a human rights activist. She liked to work as a software engineer: "*I like to make things. I also like to make other people lives easier*" [C1PATM1[4]]. She started to work on Company A because she was looking for a Job and her friend told her about a

[4] C1PATM1 is the code for Company 1, Project A, Team Member 1.

system administration position. In the interview, she told that the company A was the best place in which she had worked for.

> *"So I think a better question is why I stayed here? And I think it was because It was probably the best company I ever worked for"* [C1PATM1]

During the interview and observation it was identified that C1PATM1 frequently proposed ideas, promoted, and implemented them. Her project manager stated that:

> *"I would say she is a kind of extreme side of spectrum, (she) send me her ideas, sometimes too many ideas coming out and we can't do everything at the same time."* [C1PATL]

The interview also revealed that C1PATM1 developed a script to automate the work of team members on certain database tasks, which is an example of how her innovative behavior outcome provided a benefit to the team and to the company. The general explanation about what made her behave innovatively can be summarized as:

> *"One thing that I always kept in mind is that computers are tools for human use. They are designed to make our lives easier. […] their entire purpose is to make more with less effort. So whenever I project anything is always with that mindset that, ok, we have computers that are excellent at performing boring things repeatedly. How can we use that to make our own life easier."* [C1PATM1]

Obviously, a deeper analysis had to be performed to understand which factors influence people's innovative behavior. First, the interviewed personality and preferences provided some insights. She was a human rights activist who was interested in helping people to make their life better. She also believed in her technical capability (self-efficacy) (Bandura, 1997 – PS101) as can be observed below:

> *"Basically, for me I'm more a generalist. So basically whatever involves computers I can probably do it."* [C1PATM1]

In the interview, it could be identified some other factors. For example, she liked to learn new things, always was looking for new technologies, and evaluating if they could be used to make things better. Once she was always looking for new technologies, she proposed the use of something new or adapted the ideas behind the novelties to solve the project problems. Furthermore, the learning possibilities on the ideas implementation also explained the behavior of prepossessing ideas constantly.

Moreover, she appreciated challenges. However, there is no problem if the projects on Company A were not challenging. Her behavior of proposing ideas can be explained as a way of creating challenges. She also liked to be recognized by her colleagues because this was something that made her feel satisfied to propose and implement the ideas.

Therefore, at the individual level these personal characteristics and interests explained her behavior towards proposing ideas. In addition, such behavior also was cited by the project manager and confirmed on the daily meeting observation.

Further, at the individual level some factors impacted positively her behavior towards the implementation of ideas. For example, the desire to learn new things, the scanning for new technologies, and the satisfaction to implement something because of people appreciation explained the extra effort expended on her private time to implement a prototype to proof a concept.

> *"I saw the previous process as a problem. Because it was very manual, very error prone. One issue with me, personally, this problem directly impacts decision making. […] For me doing the same monotonous thing is hard for me to do because it becomes boring. Once I learn how it works it becomes boring. So I have this intrinsic need to try to make things… to eliminate as much boring as I can so I can focus on the interesting parts. The problem solving, the discovery, etc."* [C1PATM1]

Particularly, she expended extra effort not only when working in Company A but also on another company where she worked before.

> *"I did couple of experiments because of one idea I had. I want to do this because it would streamline all of the process of the whole company. [However] people refused to use it."* [C1PATM1]

In her previous job, the manager did not accept her ideas even with a working prototype and did not give her an explanation about the refusal. This fact bothered her and after several similar situations she stopped to propose ideas and then left the company.

> *"Because I had a lot of ideas and I tried to push throught a couple of things. … Because even knowing it was a good idea. No one else wanted to do it. Because they have done things in a certain way and they people didn't care about working together as a team, as a whole to do thing better. They only care about the little piece.*

> *And quite literally they really didn't care about help anybody. […] And eventually I got to the point that I really stopped to propose ideas"*

Observe that on both companies she expended extra effort but at Company A she was satisfied because people appreciated the idea and its implementation helped to optimize the teamwork. But at the previous company, the manager and the team refused the idea and did not give an appropriate feedback. Therefore, her individual characteristics seem to be very important to define her innovative behavior. However, external factors also influenced this behavior. For example, at the previous company the manager and the team systematically avoided changes, which inhibited C1PATM1 and made her unsatisfied with the workplace.

Particularly, in Company A she did not feel inhibited to propose ideas to her team and the team members' usually provide feedback on individuals ideas.

> *"Everyone provides feedback when possible. If they have different ideas they consider it even if the idea is not taken, the ideas are considered."* [C1PATM1]

Furthermore, for her the manager was a very good leader and his professionalism and capabilities to deal with issues stimulated her to work. She also felt comfortable to give ideas direct to the manager on certain situations:

> *"… usually if I have an idea that is completely different in the way they are doing or substantial [different] of what they are doing, I would go to [manager] and say: 'What do you think about this?'. And then [Manager] will either say that: 'Ok. This is an interesting idea, I will consider in which point we can bring it up in the meeting' or he will say 'that is a little bit hard to doing this specific thing and there is no room to either change or add this idea on'. Ok, that is fair enough…."* [C1PATM1]

Therefore some characteristics and behaviors of her team and the manager in Company A influenced her behavior to propose ideas. As could be inferred from the interview data, the team and the manager from her previous job also influenced her behavior to propose ideas, in that case negatively. Then it could be observed that not only the characteristics and interests of the individual defined his/her innovative behavior but also other factors such as the company environment, the client, the team itself, and the leader/manager.

The Table 4.1 below present the factors at different level of analysis that where found for C1PATM1.

Table 4.1 – Factors found for C1PATM1

Factor	Idea proposal	Idea implementation
Individual level		
Self-efficacy	(+) Capability to solve a problem or promote a change	(NLF)
Likes to be recognized	(+) Give ideas worth a value because of colleagues recognition	(+) Satisfaction because of the problem solved and the colleagues appreciation incentives future ideas implementation
Likes challenges	(+) New ideas and new technologies brings challenges to the project when the project is dry or boring	(+) The implementation of new technologies or new ideas challenges her technical capabilities and brings novelty
Likes to learn	(+) The proposal of new ideas and new technologies depends on the individual knowledge. People who likes to learn always is recycling their capabilities and are open to the novelties	(+) The implementation of new ideas and new technologies are opportunity to learn something new and also require previous knowledge
Technology scanning	New technologies can be used to solve project problems. Therefore be up to date about new technologies is a way to propose the use of something new	The use of a new technology may enable or help the implementation of an idea
Extra-effort	(NLF)	(NLF) The extra-effort to implement a prototype helped an idea approval on the Company A but did not work on the previous company
Low specific technology knowledge	(NLF)	(NLF) The low knowledge on a specific technology did not stop the individual to implement the idea using the technology
Team level		

Colleagues appreciate the idea and provide feedback	(+) When this happens the individual do not feels inhibited to propose ideas and believe that good ideas can be accepted. Even when the ideas are refused the evaluation and feedback promote a respectful and receptive environment	(+) When the ideas are evaluated there is a chance to be approved. In contrast, when the ideas are not evaluated they are always refused.
Colleagues change-avoiding attitude	(-) Ideas come up even with a change-avoiding environment. However, after successive refusals without appropriate feedback the proposals stopped.	(-) The ideas always were rejected. Then even when prototypes were built for proof a concept, the ideas were not accepted and never implemented.
Team members commitment	(NLF)	(NLF)
Routine tasks	(NLF)	(NLF)
Predefined task assignment	(NLF)	(NLF)
Team has to see clear benefit to support innovation	(NLF)	(NLF)
Leadership		
Receptivity to ideas	(+) The leader receptivity to ideas did not inhibit the individual to propose ideas. Also when the individual thinks that the idea is very impacting the leader will be the appropriate person to listen the idea	(NLF)
Leader propose and combine ideas	(+) The leader participation proposing ideas or combining individuals ideas motivates people to give ideas	(NLF)
Innovative behavior expectance	(+) When the individual thinks that the leader expects him to be innovative, he/she will do everything possible to solve a problem	(+) When the individual thinks that the leader expects him to be innovative, he/she will do everything possible to solve a problem

Feedback is provided	(+) The leader feedback shows that all ideas are appreciated and may be accepted or not. Thus the individuals feel open space to propose ideas.	(NLF)
Leader technical knowledge	(NLF)	(NLF)
Directors care about product and results	(NLF) The interviewee liked the directors and their attention with the products and results but no link was found from this factor to innovative behavior.	(NLF) The interviewee liked the principals and they attention with the products and results but no link was found from this factor to innovative behavior.
Company		
No financial rewards	(NLF) No financial reward was provided for good ideas and this fact did not demotivate the individual.	(NLF) No financial reward is provided for good ideas and this fact did not demotivate the individual.
Openness for opinion	(+) The company openness for opinion creates an open space for new ideas and the individuals feel a participative environment instead of an authoritarian environment	(NLF)
Bad atmosphere	(-) When the individual feels a company with a bad atmosphere (people is hostile) he/she feels it is worthless to propose ideas.	(NLF)
Client		
Client requests or issues	(+) The clients' requests (or issues) trigger a discussion about how the solution could be enhanced to solve a problem. Therefore brainstorms are performed and lots of ideas proposed.	(+) The individuals are impelled to test the ideas and find a solution to the concrete problem.
Client constraints	(+)(-) The client constraints both inhibits people to give ideas, since the constraints are restrictive, but also cause new ideas to come up, because they have to propose a work around to solve the problem.	(NLF)

(+) impacts positively, (-) impacts negatively, (NFL) No Link Found

In particular, some factors analyzed did not influence her innovative behavior, or a link between the factor and the innovative behavior could not be found. For example, the interviewee answered the team commitment question saying that the team members' were committed with the project goals. However, this information itself did not explain her behavior towards innovation, once she did not provide further information that could be used to link this fact to her behaviors. Even with the use of probing, such information was not obtained. Therefore, these factors where explicitly registered as (NLF) and maintained on the table because they are important for future analysis of irrelevant factors. Furthermore, some factors explicitly impacted negatively the behavior to propose ideas such as the team avoidance of changes and the absence of clear feedback.

Putting all together, the analysis of the individual C1PATM1 revealed that the personal characteristics and interests seems to explain most part of her innovative behavior. She was naturally very proactive to propose ideas and implement them. Further, some links to explain this behavior could be traced from her particular personality and interests. Additionally, the influences at the team, leadership, company, and client levels were also identified and clearly modified her individual behavior as could be explained above.

4.3. RESULTS: THE IBMSW-I

A detailed analysis was performed for all team members as explained on previous section. The resulting model for this phase was called Innovative Behavior Model for Software - Initial (IBMSW-i), with the *initial* suffix that represents it is the initial model.

The IBMSW-i was designed based on similarities and differences among the identified factors that influenced the individual's innovative behavior. The multilevel analysis allowed the comparison among the unities of analysis on the factors at each level. Particularly, two aspects were recurrent and exerted strong influence on all individuals' innovative behavior: their personality and some projects characteristics.

The individuals with high innovative behavior were more open to new experiences. They were curious, proactive to identify problems, liked to learn and were always looking for the new technologies. Even under situational factors that could

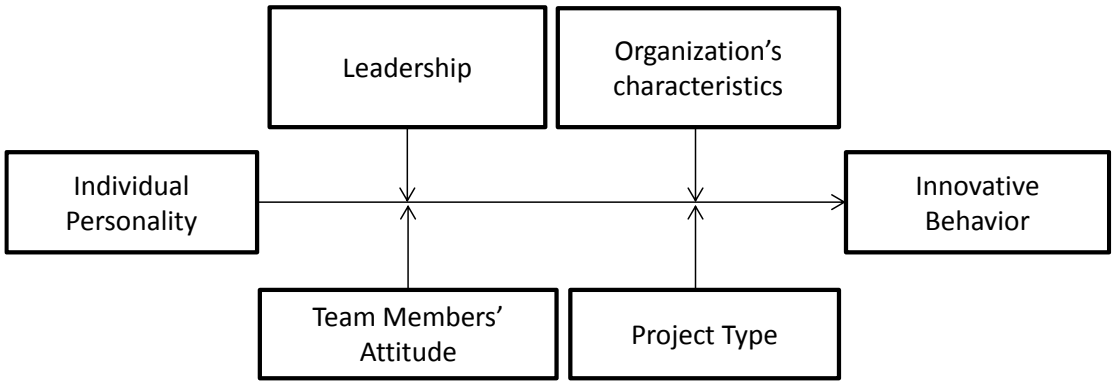
inhibit innovation, such as team change-avoiding attitude and poor leadership feedback, they tried to push ideas and challenge the status *quo*. However this attitude did not last long. It changed when they were bothered by repetitive rejections and perceived that proposing ideas and implementing them were worthless for their colleagues, leaders, or company.

Some project characteristics also imposed some constraints on individual behavior. The requirements stability and the technical challenges to implement them shaped the type of ideas the individuals could propose and limited the implementation resources the engineers could ask for. For example, projects with pre-defined requirements, such as projects for the implementation of a legacy system on a new platform or technology, usually did not have space for new requirements, once the new systems had to provide the same functionality as the previous one. Therefore, the individuals were constrained and their ideas used to be more related to the development process and technology adoption than on new products or new requirements. In addition, projects without technical challenges did not require the expansion of current knowledge thus the innovation expectancy on these cases was lower and the individuals perceived less space to innovate.

Other aspects found that influenced the individual's innovative behavior were the leadership, team members' attitude, and organization characteristics.

In particular, the individual personality seemed to exert the stronger influence on the individual's innovative behavior. Some individuals were naturally motivated to behave this way. Further, even under situations in which constraints were imposed and negative influence for their innovative behavior were provided they behaved innovatively at least during some time. However, on the other hand, the situational factors, such as the project characteristics and the leadership, also exerted influence over individuals' innovative behavior and could inhibit or incentive her to engage in such behavior. Therefore, the model depicted in Figure 4.2 was designed based on the trait activation theory (Kim, Hon and Lee, 2010; Tett and Guterman, 2000). According to this theory, *the behavioral expression of a trait requires arousal of that trait by trait-relevant situational cues*.

Figure 4.2 – High level IBMSW-i



See that the individual personality is the main antecedent and its influence on individual's innovative behavior is shaped by the situational factors. These factors, at high level of abstraction, are leadership, team members' attitude, organization characteristics, and project type.

The leadership factor can be refined as: the leader openness for listening the ideas and provide appropriate feedback; the ideas promotion to obtain resources to implement them; and the autonomy provided to the team members to perform their tasks and participate in the decision making.

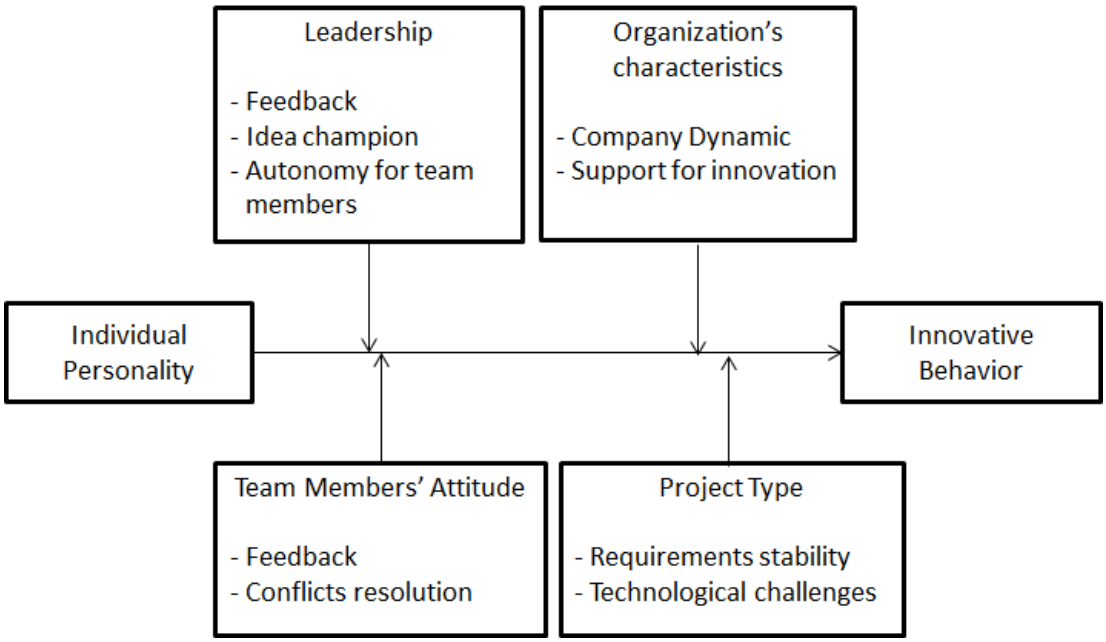
At team level, some team members' attitudes that can influence the individual's innovative behavior are the receptivity of new ideas and the way the conflicts are resolved. The former influences the behavior in the same way the leadership does because the colleagues' change-avoiding attitude and the feedback provided can inhibit the individual or stimulates her to share ideas and champion it to be implemented. Also the way the conflicts are resolved is important because when there is space for discussion and the decisions are shared the individuals perceive they have voice and they are not inhibited due to authoritarian decision or colleagues disagreements.

Another antecedent is the organization characteristics. It can be detailed as the company dynamics and support for innovation. It was found that individuals' innovative behavior was inhibited when they perceived the company as a bureaucratic place or when it had poor planning, i.e., the tasks were chaotic and unmanaged. The bureaucracy influenced negatively because the changes required too much effort and the poor planning because there was no time to think or make something better due to the urgency of every demand.

The company support also is important to incentive individuals to behave innovatively. If the company does not provide resources, for example time to implement an idea, the individual will have to spend extra effort to try something new. Therefore, some professionals will not be motivated to try the new and will feel worthless to propose ideas that never are accepted to go ahead. The support also can be provided and communicated through actions to promote innovation, such as the organization of meetings to discuss new technologies and ideas. This leads the individuals to realize the importance of innovation for the organization.

Finally, the project type aspects are the requirements stability and the technological challenge due to the reasons explained before. The Figure 4.3 presents the IBMSW-i detailed model.

Figure 4.3 – Detailed IBMSW-i



The model depicts the innovative behavior as the outcome instead of the individual performance or the innovation itself as one could expect. This is purposive to highlight that the scope of this research is to understand how to foster the software engineering professionals' innovative behavior, i.e., to understand the antecedents that influence the phenomena. As explained in the introduction of this thesis, the individual behavior is the seed of new ideas and innovation initiatives. However, the impact of such initiatives on organization performance depends on several other factors, such as marketing, laws and regulations, competitive forces, etc., which are not on the scope of

this study. Therefore, the focus here is to understand the innovative behavior phenomena as a consequence of other factors.

The IBMSW–i was the first result of this research. Together with the systematic literature review, presented in Chapter 2, they provided the basis to improve the second case study's design. The comparisons between the SLR and the Case Study 1 findings will be presented in the next section.

4.4. ENFOLDING LITERATURE

The SRL and the Case Study 1 provided important findings for this thesis. First, the leadership autonomy antecedent proposed on the IBMSW-i could be related to the literature findings about the leadership styles according to the following rationale. Several studies (see Tables 2.4 and 2.5) analyzed leadership styles as antecedents of innovative behavior and many found a positive relationship between transformational leadership and innovative behavior. Further, the autonomy provided by the leader can be considered in the opposite side of his over control. In the same way, the transformational leader stimulates the individual using influence and motivates them to engage in actions to promote the change. On the other side, the transactional leader uses the explicit task definition to control and measure performance. Therefore, leadership style was used as a selection criterion to sample the projects of case study 2 with the purpose to obtain leadership diversity.

Second, both the intrinsic motivation and proactive personality factors indicated the existence of individual personality antecedents such as on the IBMSW-i. Therefore, further literature research was performed about personality factors and resulted in the use of the big five theory (see section 2.3.1) in the data collection of Case Study 2. Then, the use of such theory allowed the quantitative analysis performed on Case Study 2, as will further detailed on Chapter 5.

Third, the job creativity requirement mediator proposed on PS345 (Kim, Hon and Lee, 2010) was interpreted as a combination of both scope stability and technical challenges in the software engineering industry. The parallel considered is when the scope is open and when there are more technical challenges, the job requires more creativity. However, when there is small space to change the initial solution and no

technical challenges are observed, the job requires less creativity. Therefore, both SLR and IBMSW-i results agreed on this finding enforcing the results.

Finally, questions about the factors identified in the SLR were added to the interview guide used on the Case study 2 in order to identify if and how these factors influenced the individuals' innovative behavior.

4.5. LIMITATIONS

Some limitations of the case study method and its usage in this study should be discussed. Case studies usually generate a large volume of information and rich qualitative data. This can result in theories very rich in details, but lacking in simplicity and overall perspective (Eisenhardt, 1989). Therefore, not only data analysis techniques should be used to overcome this limitation, but also the researcher's insights should guide the identification of the most important antecedents of innovative behavior to incorporate them into the proposed model. Particularly, the classification of codes presented in Section 4.1 and Table 4.1 was used with this aim.

Regarding the sampling of participants for this study, the following difficulty was faced. There was no questionnaire or scale widely validated to evaluate the innovative behavior of an individual. Therefore, the selection was performed according to the team's manager appraisal about the individuals' innovative behavior using a low/medium/high scale. The limitation of this approach is that individuals considered highly innovative by their leader could be considered as non-innovative if evaluated by another leader. Moreover, there was a risk of considering an individual as exhibiting low innovative behavior when she had the same innovative behavior of a member who was considered highly innovative by another leader. Thus, the data analysis was performed considering this limitation. For the second case study, the Scott and Bruce (1994) questionnaire were used to overcome this limitation as performed in other studies (Janssen, 2001; Carmeli, Meitar and Weisberg, 2006; Vinarski-Peretz, Binyamin and Carmeli, 2011).

Finally, different definitions of innovative behavior were found in literature and represent a threat to construct validity. For example, some definitions of innovative behavior do not consider the construct as multi-dimensional, composed by idea proposal

and implementation. Therefore, to integrate the results the differences between definitions were considered.

4.6. SUMMARY

The goal of this case study was to build a model based on both empirical research and on an extensive systematic literature review.

At this point of the research, preliminary results pointed to several factors that could influence the innovative behavior of such professionals. These factors were presented at different levels of analysis. In general, it could be identified that each individual has different triggers to behave innovatively. Moreover, even when working in the same team, professionals perceive different levels of importance to be innovative at the workplace.

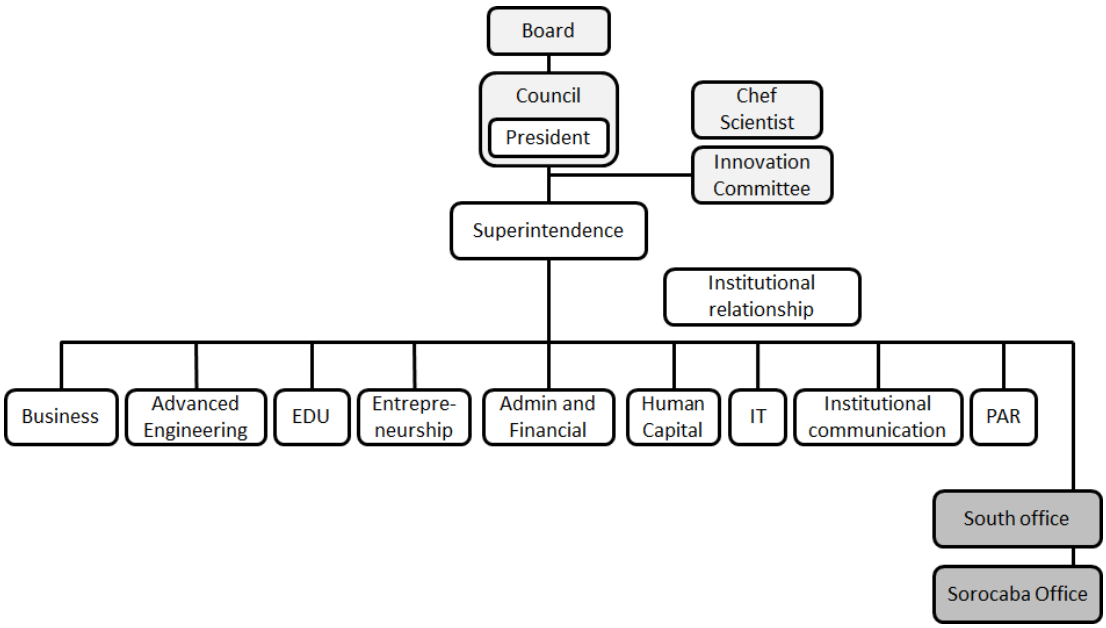
Further, the antecedents proposed in the IBMSW-i could be confirmed by the findings of the systematic literature review. In addition, the combination of such findings allowed the design of Case Study 2 to be better refined with the use of theories of personality, leadership, and project classification. This fact was important to uncover some antecedents in case study 2 because of the comparisons that were allowed by the improved case study design.

5 CASE STUDY 2: COMPANY B

Company B was a software development institute specialized on system development for third parties. In particular, the organization considers its core business the development of innovative solutions for its clients. In addition, the company received twice the award of most innovative research institution in Brazil (2004 and 2010). The organization was based in Recife (Brazil) and was founded in 1996. It had about 500 employees and 4 offices in Brazil.

The organizational structure had more levels and functional unities then the Company A (see Figure 5.1).

Figure 5.1 – Organizational structure



In particular, the software development unit was called “Advanced Engineering” and it was composed of designers, system administrators, system analysts, software engineers, software testers, database administrators, project managers, and the Chief Operation Officer (COO). See that the organizational structure had more vertical levels and much more areas than the Company A.

The projects developed at Company B were spread over several domains, including finance, telecommunication, government, industry, services, and energy.

The details about the design used on the Company B case study and about the participant projects will be provided in the following sections.

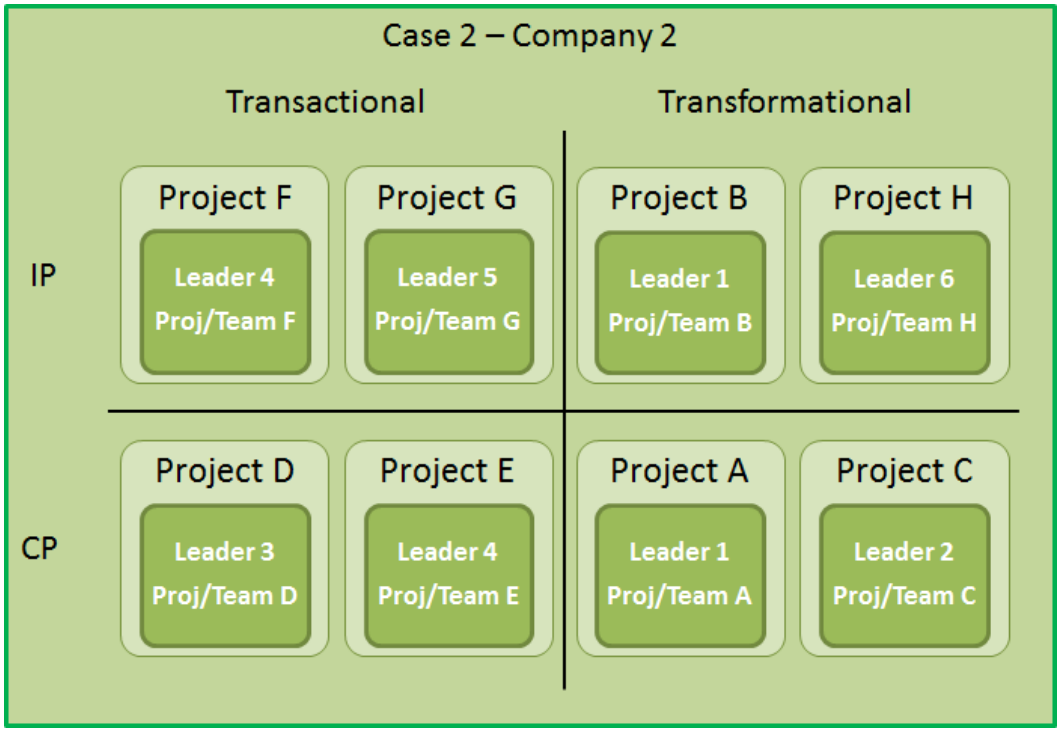
5.1. CASE STUDY DESIGN

The design of Case Study 2 used a mix-method (qualitative and quantitative) approach. It was structured after Case Study 1 results and the literature reviews. The improvements performed and the rationale for them were the following:

- Choice of company B: Case Study 1 showed that the company dynamics and its support for innovation influenced innovative behavior of individuals. Therefore, the choice of company B was performed to obtain a larger company, which was composed of more hierarchical levels, and that provided support for innovation.
- Leadership diversity: Case Study 1 and the SLR found that the leadership style influenced individual's innovative behavior. Then, using the transactional and transformational theories (see section 2.3.2), the project managers from the Case Study 2 were chose in a way to obtain variability of leadership styles.
- Projects diversity: the model from Case Study 1 proposed that some project antecedents influence the software professional's innovative behavior. Therefore, the projects selection in the Case Study 2 was performed to obtain project variability regarding their uncertainty related to marked and technology (horizons as descried in Section 2.3.3).
- Personality traits: Case Study 1 showed that individual personality could be an important antecedent of innovative behavior. In Case Study 2, enhancements were planned to allow the collection of information that could be used to understand the relationship between personality traits and individual's innovative behavior. Thus, both qualitative and quantitative data was collected to allow deep analysis of such antecedent and provide complementary evidences. For this sake, the Big Five Theory was used as theoretical foundation (see section 2.3.1).

  Figure 5.2 depicts the second case study design.

Figure 5.2 – Second Case Study Design



Legend: (IP) Incremental projects; (CP) Challenging projects

In Case Study 2, it was required that half of the projects had to be managed by transformational leaders and the other half by transactional leaders. In addition, half of the projects had to be incremental projects (IP) and the other half had to be challenging projects (CP). Incremental projects were operationalized as those in the H1 horizon and CP were operationalized as those in the H2 and H3 horizons.

The design had the variability required to allow the identification of particularities that emerged from the distinct leadership styles and project aspects. In addition, the company selection and the personality traits data provided the opportunity to investigate the influence of such antecedents on the individual's innovative behavior.

Unity of analysis

In conformance with the first case study, the unity of analysis considered was the individual. Hence, to achieve variability, individuals with low, medium and high innovative behavior were chosen. Participants were chosen based on their manager and technical leader appraisals regarding their innovative behavior. This appraisal was

performed using a structured questionnaire, as will be detailed in the data collection section.

Data Collection

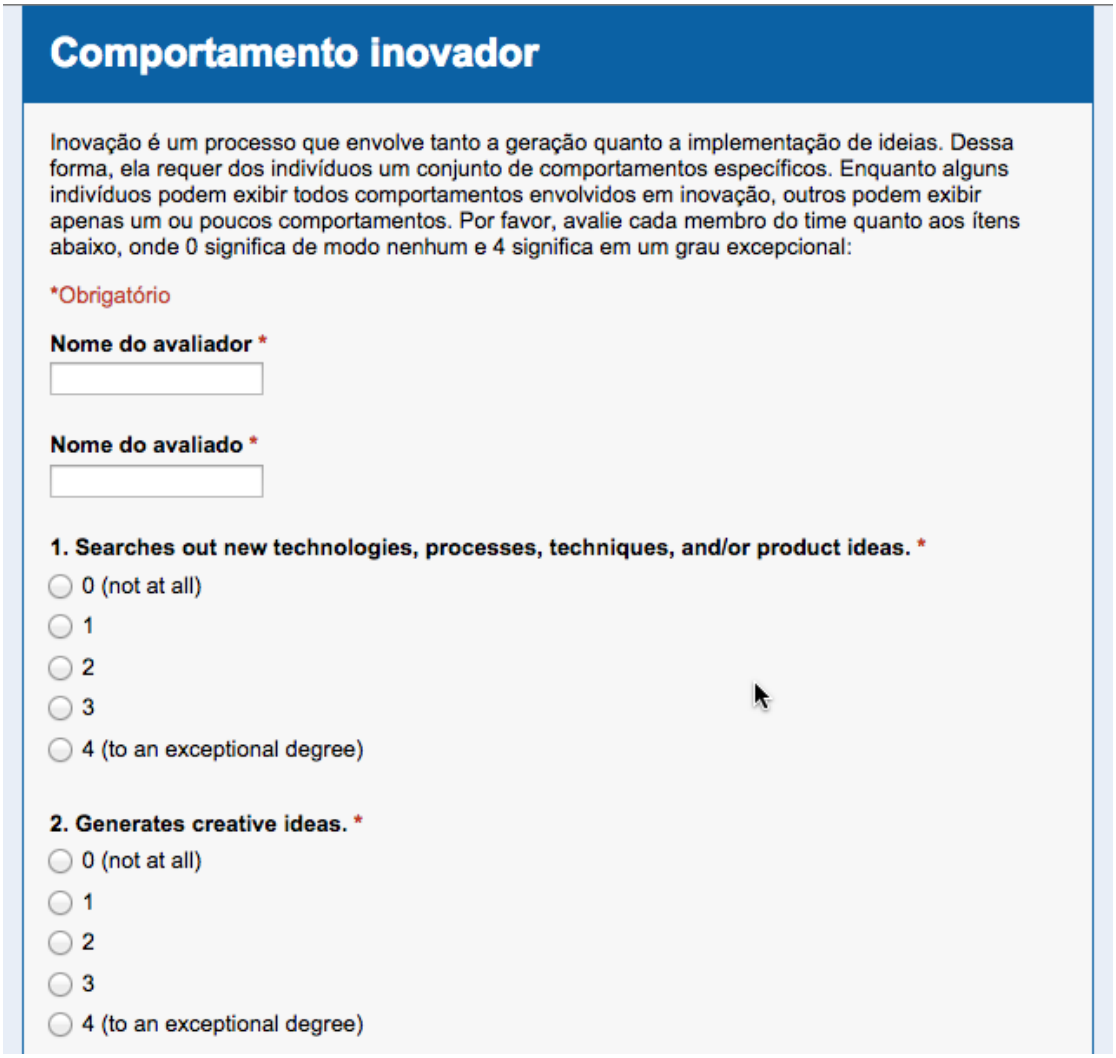
Quantitative and qualitative data were collected on this case study. The qualitative data was collected using the semi-structured guides available on appendix A. Two interview guides were used: one for the project managers and another for the team members. In particular, the managers' interview guide had questions to obtain further information about the team members' behavior. This strategy was used to allow the qualitative confirmation of the quantitative results obtained about the individuals' innovative behavior.

In turn, the individuals' innovative behavior (IB) score was obtained using the questionnaire proposed by Scott and Bruce (1994). Such questionnaire is composed of the following six questions:

1. Searches out new technologies, processes, techniques, and/or product ideas.
2. Generates creative ideas.
3. Promotes and champions ideas to others.
4. Investigates and secures funds needed to implement new ideas.
5. Develops adequate plans and schedules for the implementation of new ideas.
6. Is innovative.

The Figure 5.3 depicts the on-line form used.

Figure 5.3 – On-line form used to assess the individual's IB



The answers were provided according to a likert-5 scale ranging from "(0) not at all" to "(4) to an exceptional degree". For each question, the answer was directly converted to the correspondent number and the six questionnaire items were summed up to compose the final score. Therefore, the final scores ranged from 0 to 24.

Besides, two more quantitative questionnaires were used to collect data. The Multifactor Leadership Questionnaire (MLQ) (Bass and Avolio, 1995) was used to obtain the project managers leadership style, and the NEO-Five Factor Inventory (NEO-FFI) (Costa and McCrae, 1992) was used to identify the individuals' personality.

Finally, the participant's age and gender were collected from the individuals to be used as control variables in the quantitative analysis.

The procedure followed to collect the data will be further detailed in the Section 5.2.

Data Analysis

The qualitative data analysis of the case study was performed using NVivo. The coding strategy was consistent with the one used in the first case. However, an additional analysis was performed using an electronic spreadsheet. After each participant coding, the codes used were classified according to the Table 5.1 below.

Table 5.1 – Codes' classification

	Innovative behavior			Behavior	
Codes	Low	Medium	High	Idea proposal	Implementation
Code A		✓		✓	
Code B					

For the code related to each participant, a mark was put on the intersection between the innovative behavior score (column) of the participant and the code obtained (row). For example, in the Table 5.1 there is a mark indicating that "Code A" emerged from the interview data of an individual with "Medium" innovative behavior score and a mark also was put on the behavior that was influenced by such code. In the Table 5.1, the interview indicated that the "idea proposal" was influenced by the factor represented by "Code A". This strategy was useful to identify the codes that are specific for individuals with high or low innovative behavior. It also allowed the identification of the specific innovative behavior (ideas proposal or implementation) that was influenced by the antecedent.

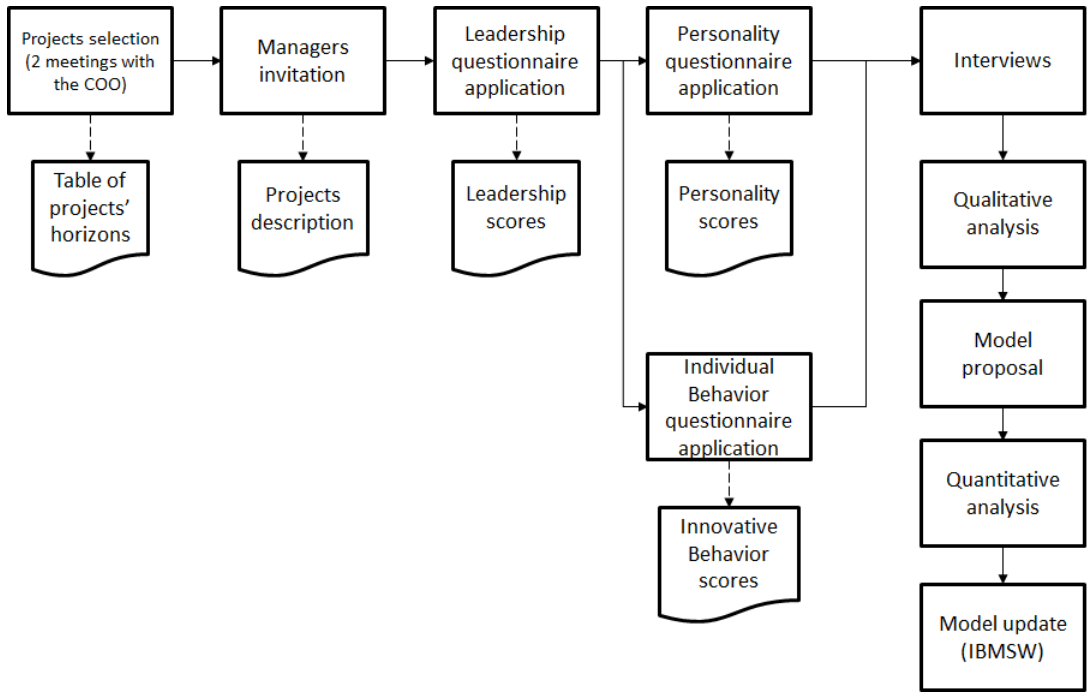
For the case study's quantitative analysis, both Pearson correlation and a multivariable regression model were estimated to verify the existence of relationships between individual's personality traits and innovative behavior scores. The regression's estimation was performed using the innovative behavior score as the dependent variable and the personality traits as the explanatory variables in conjunction with the control variables.

5.2. PROCEDURE

The first step of the case study procedure was to choose the participant company. The company B received twice the award of most innovative research institution in Brazil. Then, because of its innovative profile, it was considered that such company provided support for innovation to its employees.

Once the company was chosen and accepted to participate in this study, the steps illustrated in Figure 5.4 were followed.

Figure 5.4 – Case Study 2 procedure steps



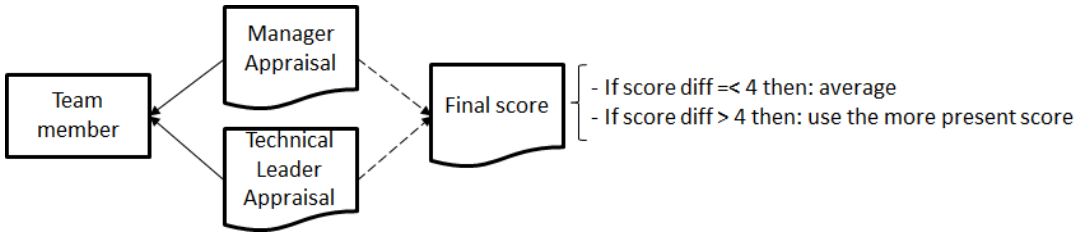
For the projects selection, two meetings were performed with the company's COO. In the first meeting, the study goals and procedures were presented and the projects selection requirements explained. The COO explained that the Company B used the Three Horizons model (Terwiesch and Ulrich, 2009) to classify its projects. He also explained the operationalization of the measures to classify the technical and market aspects. Then, in the second meeting, the COO provided a list of eight projects that met the profile of four H1 projects and four H2/H3 projects. Such list also contained the project managers' information and contacts. Then, the COO contacted the managers to ask for their participation in the study and to introduce the researcher. All managers agreed to participate in the study and filled a form with their project

description and team members' information. In particular, two project managers were responsible for two participant projects. Therefore, six managers participated in the study.

After that, the researcher met with each manager both to present the ongoing study and to apply the MLQ questionnaire. The MLQ self-rating questionnaire was used and a Google Form[5] was created to collect the managers' responses. The MLQ scores were calculated using an electronic spreadsheet.

After all managers have answered the MLQ, they were contacted through e-mail to answer the Scott and Bruce (1994) questionnaire for each team member. This e-mail had information about the on-line procedure to answer such questionnaire (a Google Form also was used to collect the answers) and the managers were asked to introduce the study to the project's technical leader. Then, the technical leaders also were asked to answer Scott and Bruce's questionnaire. Hence, both the manager and the technical leader of each project answered the innovative behavior questionnaire for all team members. The final score for each individual was obtained according to the process illustrated in the Figure 5.5.

Figure 5.5 – Innovative behavior score calculation



Each team member, except the manager and the technical leader, received two scores of innovative behavior: the manager's score and the technical leader's score. If the difference between the scores was equals or lower than 4, then the scores were averaged. However, if the scores difference was higher than 4, which happened with 22% of the individuals, only one score was considered, that was the score from the leader (manager or technical leader) more present in the team's routine. Particularly,

[5] Google Form is a web based tool that allows the creation of on-line surveys. The surveys responses are available on an electronic spreadsheet, which allowed the calculation of the final scores. The Google Form was available at http://drive.google.com. Last access 27-Sep-2014.

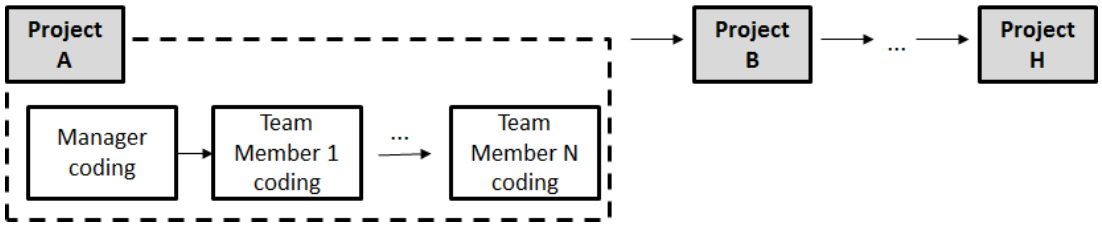
only the manager evaluated the technical leader and, conversely, only the technical leader evaluated the manager. Following this process, a total of six managers and eight technical leaders participated and they provided answers for 56 individuals.

In parallel, the company's human capital department applied the FFM questionnaire. During this application, professional psychologists[6] were in place in order to explain the process and clarify the doubts. Scores of each individual's personality traits were calculated using the official software provided with the questionnaire.

At this point, team members were selected to be interviewed according to their innovative behavior scores. At least three individuals from each project were interviewed and individuals with low, medium and high scores were selected. The project managers were also interviewed. A total of 31 interviews were performed, summing up 25 hours and 40 minutes of audio. All of them were fully transcribed and analyzed.

The construction of the Innovative Behavior Model for Software (IBMSW) was performed grounded on data and considering the individual as part of a project group. Therefore, the coding and qualitative analysis of the interviews were performed entirely for one group before start the process for another group (see Figure 5.6). Within the group, the coding and analysis for the data collected from the project manager was performed before the analysis of the team members' data.

Figure 5.6 – Coding sequence



During the coding of an interview data, the codes were created (or assigned when already existed) and a justification was provided to explain why such factor

[6] It is important to highlight that the human capital professionals who applied the FFM questionnaire had previous experience with such process. This was important to improve the reliability of the results, as suggested by McDonald and Edwards (2007).

influenced the individual's innovative behavior (see Table 5.2). This justification was put next to the code's name in the Table 5.1.

As an example of this process, see the code provided for the team member 3 from the project D and the related justification:

Table 5.2 – Code C2PDTM3_Project Type

Code	Project Type
Text	*"Although our project (D) is an unusual case. [In this project] We do not have freedom, because [when] the client sends a request, we have to attend it [immediately]... [On the other hand], in the project [previous project name] it was a thing we were developing, in which we were client and developers. Therefore, the ideas were proposed by ourselves, and we had much more meetings, the team was bigger, we had more space to propose ideas. "* Original text: *"Embora no nosso projeto (D) é um caso um pouco à parte, um pouco específico. [Nesse projeto] A gente não tem tanta liberdade, porque [quando] vem solicitações do cliente, eles querem alguma coisa, a gente tem que fazer... [Por outro lado], no projeto [nome de um projeto anterior], era uma coisa que a gente tava desenvolvendo, então a gente era cliente e a gente era desenvolvedor. Então, as ideias saíam da gente mesmo, e a gente tinha bem mais reuniões, a equipe era maior, a gente tinha mais abertura pra propor ideia."*
Justification	Some projects are very restrictive to new features and changes (e.g. third parties maintenance projects), then they inhibit ideas. On the other hand, some projects are more open to ideas, such as research projects and the company's own product projects. Therefore, the individuals see more space to propose ideas.

This code was put on the table 5.1, as shown on the Figure 5.7.

Figure 5.7 – Example of the codes put on the table.

Code	Merged code	Explanation	Low	Medium	High	Ideas	Implem.
Project							
Project type	**Project type**	Some projects are very restritive to new feat	√	√	√	√	√
Time to talk about the project and technica		The individual worked on a company in whic		√		√	

Such table contains the initial code in the first column, the final code in the "merged code" column and an explanation about why such antecedent influenced the individual's innovative behavior. On the right side, there were the marks to relate individuals with low, medium and high innovative behavior to the codes that emerged from their interviews. In addition, there were marks to relate such code to the idea proposal or implementation.

As an example of how the codes were merged, see the codes presented in Figure 5.6, which are “Time to talk about the project and technical solutions” and “Project Type”. The “Time to talk about the project and technical solutions” was given to an individual that worked on another company before the Company B. In this previous company, he participated on the development of a company’s own software product. The individual explained that the team always had meetings to talk about the product features and technical solutions. Therefore, on these meetings there was space to propose ideas, because the product was being evolved continuously, once it was owned by the company and did not have a specific client to approve or deny the development. In addition, the same code was assigned to another interview of an individual who worked on a project to develop one Company’s B own product and provided a similar explanation about the existence of meetings to discuss ideas. Therefore, it was considered that the project type in which these individuals worked had space to propose ideas and the meetings were just the moment when the ideas were discussed. Hence, the code “Time to talk about the project and technical solutions” was merged with the “Project Type” code because the antecedent that influenced the individual to propose ideas was the project type.

Finally, the qualitative analysis was finalized with final model construction guided by the Theory of Planned Behavior. Hence, the antecedents coded were organized according to such theory and to the relationships found on the data, explaining which of them influence the attitudes, the perceived norm, the perceived behavioral control and the innovative behavior directly as external aspect.

After the model construction following the explained qualitative analysis, the quantitative analysis was performed. First, the values of innovative behavior score, the personality traits score, the individual’s age, age squared, and gender were tabulated. After that, such data was inserted in the SPSS[7] software to estimate the correlation. Once the correlation was obtained, the R[8] statistical software was used to estimate the multivariable regression. Before the regression estimation, a set of statistical tests and

[7] SPSS is a software package used for statistical analysis. Available at http://www-03.ibm.com/software/products/en/spss-stats-standard/

[8] R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and MacOS. Available at http://www.r-project.org/.

transformations were performed to enhance the multivariable regression model consistency and to eliminate possible bias.

Initially, tests[9] were performed in order to identify the existence of outliers on the data. These outliers are observations that did not follow the data pattern and their removal allows a more precise estimation. Thus, the tests' result indicated the need to remove six observations from the sample.

In addition, a Jarque-Bera test (Bera and Jarque, 1980) was performed in order to verify if the error term had a goodness-of-fit with a normal distribution, which is a prerequisite of an interval estimation. Once the test's result indicated the rejection of the null hypothesis of normality, a box-cox transformation (Box and Cox, 1964) was applied to obtain such error distribution. This transformation enhances the resulting model consistency. Finally, the heteroskedasticity (White, 1980) issues were corrected using the robust matrix of White (HC4) (Cribari-Neto, 2004).

After the execution of the described procedure, the descriptive statistic was obtained as well as the regression result. The following section shall detail the findings of both qualitative and quantitative analysis

5.3. RESULTS

The results of this case study include both the qualitative and quantitative analysis presentation. Initially, an overview of the participant projects will be provided followed by the introduction of the model antecedents found. After that, the quantitative findings will be detailed together with the explanation of how the qualitative data explains such findings. Then, the final model will be presented in the Chapter 6.

The Table 5.3 presents an overview of each selected project.

[9] The function *influence.measures* from the R software was used to verify the existence of atypical observations on the data (outliers). More information about the tests performed by such function is available at https://stat.ethz.ch/R-manual/R-patched/library/stats/html/influence.measures.html (last access 06-Sep-2014).

Table 5.3 – Project's description

Project	Description	# people
Project A	The project objective is to perform corrective maintenance and to evolve a taxi dispatch system.	4
Project B	Develop a software tool that will be used in the client's New Products area in order to improve the internal production process. It is a product lifecycle management (PLM) tool.	9
Project C	The objective is to integrate a new touch screen interface to a client's electronic product.	9
Proiect D	Development of a new web information system for a logistics company.	9
Project E	The project objective it to develop a proof of concept of a mobile application for the automotive industry.	5
Project F	Development of a platform to suggest dynamic content for mobile phone users based on their profile.	7
Project G	Development of a platform to manage the life cycle of mobile products and services, including their sale, acquisition, usage and billing, for telecom companies.	9
Project H	The project was a continuation of a previous project which objective was to develop a 3D visualizer for the client's printing products.	7

The projects A and B had the same manager, and the same happened with the projects F and G. All of the projects were focused on the software development for third parties (other companies).

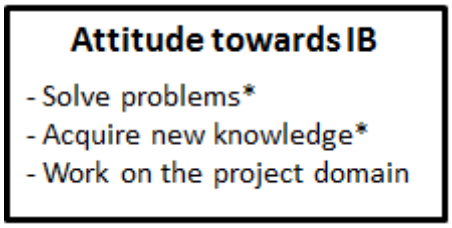
5.3.1. Model Construction from Qualitative Analysis and Synthesis

Regarding the qualitative analysis, the final IBMSW was built following the procedure explained in Section 5.2 and using the foundations of the Theory of Planned Behavior. Thus, the structure provided by such theory guided the definition of the antecedents' relationship. Therefore, five major aspects are involved in the explanation of the individual behavior: the **individual's attitudes toward the behavior**, the **subjective norms**, the **perceived behavioral control**, the **intention** to perform the behavior, and the **external** factors.

All of the antecedents found have their definition detailed in the Appendix C. In this section, the relationship between the antecedents will be presented and they will be further detailed in Chapter 6.

The Figure 5.8 depicts the antecedents related to the individual attitudes towards the behavior. The individual's attitudes are evaluated by their appraisal of the possibility to solve problems, to acquire new knowledge, and to work on the project domain. The asterisks mark (*) on antecedents means that they affected both idea proposal and implementation behavior. The antecedents without asterisks influenced only idea proposal. Further details about such influence will be provided in Chapter 6.

Figure 5.8 – Antecedents influencing the attitude towards IB



The individuals that have more desire to solve problems are more inclined to evaluate positively the performance of innovative behavior, because the idea proposal and implementation are opportunities to solve problems. The following excerpt illustrates such antecedent:

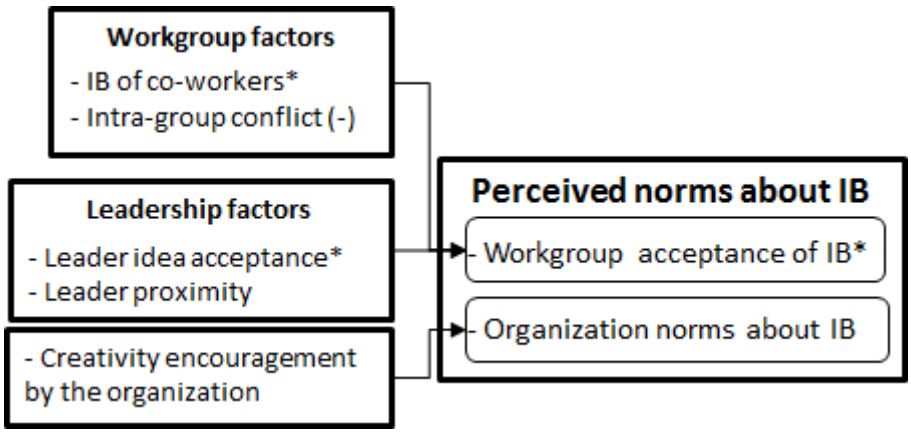
> *"I like to see what I thought, what I proposed, working, solving the problem. It give me satisfaction. I do not think about the promotional side, for me this is a consequence. Promotion, financial, for me this is a consequence. What give me pleasure is to help people solve their problems."* [C1PATM3]

> *"Eu gosto de ver aquilo que eu pensei, que eu sugeri dando certo, resolvendo o problema. Me satisfaz isso. Eu nem penso o lado promocional, isso pra mim é consequência. Promocional, financeiro, isso pra mim é consequência. Me dá prazer em ajudar as pessoas a resolverem o problema delas."*

Similarly, individuals who perceive value in acquiring new knowledge will have a positive attitude towards exhibiting innovative behavior, because the creation of something new or adaptation of an existing solution creates opportunities to learn. In addition, the individuals that like to work in the project domain will have a positive evaluation of the possibility to propose ideas to improve the software, the technology used, or the working methods.

In turn, the antecedents that influence the individual's perception about the group and organization norms about innovative behavior are depicted in Figure 5.9.

Figure 5.9 – Antecedents influencing the perceived norms about IB



See that the innovative behavior of the co-workers, the level of intragroup conflict, the leader acceptance of the individuals' ideas, and the leader proximity, influence the individual's perception about the group's acceptance of innovative behavior. In particular, the intra-group conflict will influence negatively the individual perception of group acceptance. The following excerpt illustrates the innovative behavior of co-workers antecedent.

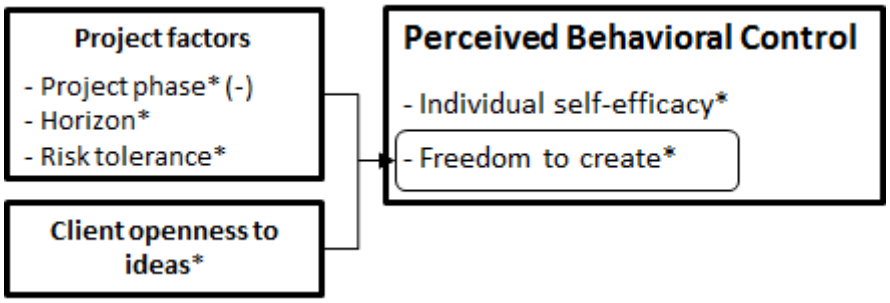
> *"... what gives you freedom to come up with ideas is to have people giving ideas too. Because when you are the unique to propose ideas, you looks like someone who wants to show off. When everybody is proposing ideas, you fells yourselves as part of an active group."* [C2PGTM1]

> *"...o que mais assim me dá liberdade para ter ideia, é ter gente que tenha ideia também. [Por] que quando você é o único que dá ideia, parece que você é o que quer aparecer. Quando todo mundo tá dando ideia, você faz parte do grupo ativo."*

In addition, the creativity encouragement by the organization will influence the individual's perception about the organization norms about innovative behavior.

Another aspect of the model is the individual perceived behavioral control (Figure 5.10).

Figure 5.10 – Antecedents influencing the perceived behavioral control



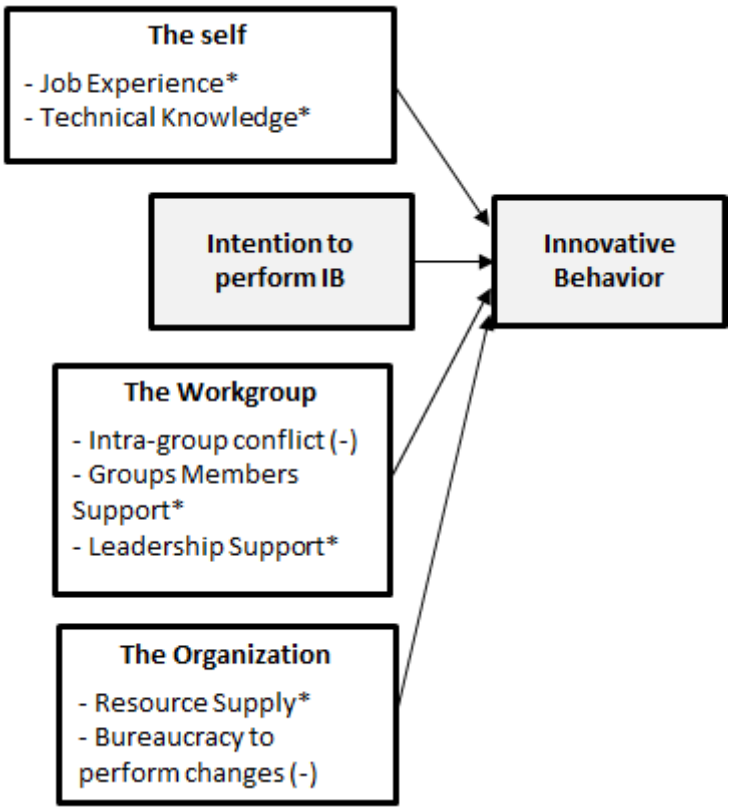
The project's phase, Horizon and risk tolerance together with the client openness to ideas influence the individual's perception of freedom to create. In turn, the freedom to create together with the individual's self-efficacy will represent the individual's perceived behavioral control. The individual self-efficacy antecedent can be illustrated with the following excerpt.

> *"... I did not searched about the incentives. I did not searched to know because I do not have this brilliant mind to propose things, to propose new products." [C2PBTM2]*

> *"...eu não fui nem atrás de saber o incentivo. ... eu não fui nem atrás de saber, até porque eu não tenho mesmo essa mente brilhante de tá propondo coisas, propondo novos produtos."*

Further, the presented factors influence the individual's intention to perform the behavior. However, the innovative behavior also depends on other factors that can be favorable or not to the exhibition of the behavior. These factors influence the actual behavior instead of the intention to perform the behavior. The figure 5.11 illustrates such influence.

Figure 5.11 – Antecedents that influence the IB directly



The Job Experience and Technical Knowledge are antecedent from the individual level. This means that besides the intention, individuals that are have high job experience and strong technical knowledge have more control of the situation at hand to engage in innovative behavior. In addition, team antecedents also influence the innovative behavior in such way. These antecedents are the intra-group conflict, the group members' support and the leadership support. Finally, the organizational antecedents are the resource supply and the bureaucracy. See that the bureaucracy and the intra-group conflict have a negative influence. Then, high level of these antecedents will limit the individual control and inhibit the innovative behavior. The following excerpt illustrates the bureaucracy antecedent.

> *"...I worked in [Company Y] during 1 year. I was a short time. It was a private company with a mentality of a public organization. Too much innovation avoidance. The guys use to think that 'oh.. we have a consolidated process, we do not need to change it'. To change the process it was required a huge effort, bureaucracy, there was a huge change avoidance, and then I decided 'no, I will not split my effort, my energy on this thing'. "* [C2PHTM3]

> *"...eu trabalhei lá na [empresa Y] durante 1 ano. Foi pouco tempo. E era uma empresa privada, muito com a mentalidade de empresa pública. Resistência muito grande à inovação. Os caras partiam do pressuposto de 'ah, nós temos um processo consolidado, a gente não precisa mexer muito nisso'. Para mexer no processo virava uma escala gigantesca, burocrática, de alguém conseguir adotar um novo modelo de algo, entendeu? Então era muito complicado. Então quando percebi que a coisa era muito burocrática, havia uma resistência muito grande, então eu decidi 'não, eu não vou dividir meu esforço, energia agora nisso não'."*

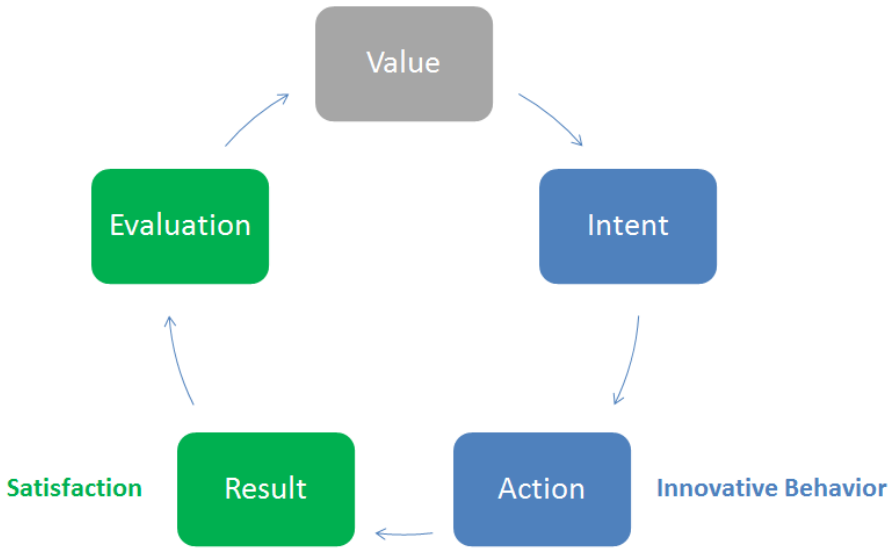
Particularly, there was an antecedent, called **Job Satisfaction with Previous IB**, which was not displayed in the Figure 5.10 due to its temporal characteristic. Individuals from both case studies stated that there was dissatisfaction when they engaged in innovative behavior and no feedback was received, or the organization, leader, or the workgroup, did not considered the idea. Then, their behavior changed and they stopped to exhibit innovative behavior. That is, at some point of time, even when the individual was not satisfied, he proposed ideas and implement them. However, if the factors that influenced her dissatisfaction did not change, such as her leader changing avoidance attitude, the individual changed her behavior and, sometimes, left the company. The following quote illustrates this antecedent influence:

> *"Why I left the [previous company], then? Because there was much more bureaucracy in such company. Although I was working with projects, a lot in the process part, [there was] too much bureaucracy and there was nothing new to do or to use the creativity. On the several episodes when I tried to do new things, and despite of my manager agree with me sometimes, it seems that the company was not prepared to this creative work. When something happened out of the regular process, the people seemed to do not like those things.*
>
> *So, why I came to company B? Because I talked to people, and liked the company... the working method here was very different from the [previous company]."* [C2PCTM1]
>
> Original text:
>
> "*por que eu saí da [other company], então? Lá o trabalho muito mais burocrático, apesar de eu ta trabalhando com projetos, muita na parte de processos, muita burocracia e uma coisa que não tinha muito era fazer coisas novas ou usar mais a criatividade. Nas várias vezes que eu tentei fazer isso, apesar do meu gerente concordar com algumas coisas, parece que a empresa não tava preparada pra ter esse tipo de trabalho mais criativo lá dentro. Quando fugia um pouco do processo, o pessoal parece que já não*

> *achava aquilo legal. Então, quando eu vim pra cá, por quê? Eu conversei com o pessoal, achei que a maneira, o método de trabalho aqui era bem diferente do da [other company], né?*"

Therefore, it seemed to exist an interplay between the innovative behavior and the individual job satisfaction, as illustrated on Figure 5.12.

Figure 5.12 – Innovative Behavior – Satisfaction cycle



Source: adapted from França (2014)

França (2014) also identified this interaction on the study about software engineers' motivation. Importing his proposal and adapting to the context of this research, the individual's perception of the results of an innovative behavior will influence her job satisfaction. Then, on the next appraisal to engage in innovative behavior, the individual satisfaction will figure as an antecedent. For example, if a previous result from an innovative behavior was satisfactory for the individual, her satisfaction will be summed up with the other antecedents' influence. However, if the appraisal of the result of the previous episode was negative, then her dissatisfaction will inhibit the innovative behavior.

5.3.2. Model Refinement from Quantitative Analysis

After the presentation of the qualitative results, some analysis will be performed on the quantitative data. Initially, the leadership style and the horizons were used to choose the participant projects. The table 5.4 details the projects' classification according to the proposed design structure. It also shows the individuals innovative

behavior scores aggregated by project. The aggregated[10] measures used were the average, the standard deviation and the median.

Table 5.4 – Projects' classification

			Individuals Innovative Behavior Scores		
Project	**Horizon**	**Manager Style**	**Average**	**Std. Deviation**	**Median**
Project A	H2	TF	11	6.63	12
Project B	H1	TF	8.58	4.13	9
Project C	H2	TF	8.75	4.85	8
Proiect D	H2	TS	11.79	4.49	13
Project E	H3	TS	14	2.58	14
Project F	H1	TS/TF	14.42	1.89	13
Project G	H1	TS/TF	15.19	4.08	14.5
Project H	H1	TS/TF	12.58	5.16	14.5
			12.54	**5.03**	**13**

Legend: TF = Transformational leadership, TS=Transactional leadership

As can be observed in the table, the leaders from projects F, G (which was the same from F) and H scored high both on transformational and transactional leadership styles. The Table 5.4 shows that the projects E, F, G and H had the scores above the average of all projects together. See that projects F, G and H were managed by TS/TF leaders. This fact suggests that the individuals from projects managed by ambidextrous leaders (Rosing et al., 2011) (see section 2.3.2) are influenced to exhibit more innovative behavior. Combining such evidence with the antecedents found on the qualitative data, it is suggested that the leader proximity antecedent (Figure 5.9) is related to the characteristic of the transactional leader. For example, according to Bass (1985) the transactional leader "*builds the foundation for relationships between leaders and followers in terms of clarifying responsibilities, specifying expectations and tasks requirements*". In turn, the leader idea acceptance and leader support antecedents can be related to characteristics of transformational leaders. These leaders act "*moving the follower beyond immediate self-interests through idealized influence (charisma),*

[10] The managers' innovative behavior scores were removed from this aggregation. Because the analysis of the manager's leadership style influence on the individuals' innovative behavior should exclude the manager innovative behavior score from the aggregation.

inspiration, intellectual stimulation, or individualized consideration" (Rosing, 2011). Thus, they value the individual's new ideas and support their implementation. Therefore, the results suggest that both transactional and transformational leadership characteristics positively influence individual's innovative behavior, as proposed by Rosing (2011).

The exception of this finding is the project E, in which the members' also scored higher than the average. This could be explained by the fact that such project was the most challenging (Horizon H3). Thus, the project characteristics, which were very open to idea proposal and implementation, influenced the individuals' behaviors.

Regarding the analysis about the relationship of the individual's personality and innovative behavior, the descriptive statistic is detailed on Table 6.1. It is important to remember that the possible scores for the personality traits range from 0 to 100 and the innovative behavior score range from 0 to 24.

Table 5.5 – Descriptive statistic

	n	**e**	**o**	**a**	**c**	**inov**	**age**
Min.	22.00	35.00	36.00	32.00	24.00	2.0	21.00
1st Qu.	33.00	45.00	42.00	44.00	50.00	10.0	27.00
Median	42.00	54.00	49.00	53.00	54.00	13.0	30.00
Mean	41.94	53.45	50.25	52.38	54.15	12.9	31.23
3rd Qu.	48.00	60.00	54.00	61.00	60.00	16.0	34.00
Max.	68.00	77.00	73.00	71.00	72.00	24.0	48.00

Legend: n: neuroticism, e: extraversion, o: openness to experience, a: agreeableness, c: conscientiousness, inov: innovative behavior.

Some aspects are important to highlight. See that the participants' age mean is 31.23 and the 3rd quartile is 34. Therefore, considering the standard professional career ranging from age 22 to 65, the study's participants are professionally young. Further, only nine women participated from this study (13% of the total 66 participants). The percentage of women in the entire sample of participants is consistent with the percentage of women in the company, according to data from the HR department of Company B.

In addition, the innovative behavior mean was 12.9, the median 13, and the minimum and maximum 2 and 24, respectively.

In order to verify a possible relationship between the variables, the correlation matrix presented on Table 6.2 was analyzed.

Table 5.6 – Correlation matrix

	n	**e**	**o**	**a**	**c**	**inov**	**age**	**age²**
n	1,000	-0,040	-0,019	-0,319**	-0,403**	0,087	0,040	0,048
e		1,000	0,252*	0,095	0,039	-0,107	-0,042	-0,036
o			1,000	0,023	-0,064	0,007	-0,010	-0,011
a				1,000	0,286*	-0,196	-0,152	-0,141
c					1,000	0,262*	0,178	0,172
inov						1,0000	0,332**	0,315*
age							1,000	0,992

(* p < 0.05 e ** p < 0.01)

Legend: n: neuroticism, e: extraversion, o: openness to experience, a: agreeableness, c: conscientiousness, inov: innovative behavior.

Focusing on the innovative behavior variable correlations, the result showed that conscientiousness and agreeableness traits, and the individual's age are the higher correlated (with agreeableness being negative correlated). The correlation between the innovative behavior and the individual age can be explained by the fact that older professionals are more experienced than the younger. It is particularly true for the case study performed, because all the participants worked their entire professional career in the software engineering area. Therefore, as proposed by the job experience antecedent, experienced professionals are more innovative.

In addition, the correlations between the innovative behavior and the personality traits conscientiousness and agreeableness provided an interesting finding that could be deeper analyzed after the multivariable regression results, see Table 6.3.

Table 5.7 – Multivariable regression test result

	Estimate	**Std. Error**	**t value**	**Pr(>|t|)**
(Intercept)	7.802502	4.789637	1.6290	0.110966
n	0.030219	0.035999	0.8394	0.406088
e	-0.057090	0.039401	-1.4489	0.154961
o	-0.004721	0.055398	-0.0852	0.932501
a	-0.098710	0.033914	-2.9106	0.005808**
c	0.145555	0.054944	2.6491	0.011408*

Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**

The results shows the conscientiousness trait is statistically significant (on the 5% level) and positively correlated to the innovative behavior and the agreeableness trait is statistically significant (on the 1% level) and negatively correlated to the innovative behavior. It means that the variation of 10 unities of the conscientiousness trait is related to a 1.4 variance on the innovative behavior score. Following the same rationale, a variation of 10 unities on the agreeableness trait is related to a negative variation of 0.9 unities on the innovative behavior score.

The observed relationship between the personality traits with the individual's innovative behavior did not explain completely the innovative behavior. It is important to remember that such regression estimation considered only the personality traits as independent variable instead of the complete IBMSW. Such possibility was suggested after the results of Case Study 1. However, as expected after the qualitative results of Case Study 2, much more antecedents influence such behavior and the influence of the personality might not happen directly on the innovative behavior. However, these quantitative results for personality suggests that the conscientiousness and agreeableness traits influence the individual innovative behavior in some way that will be explained below.

The quantitative findings were complemented by qualitative evidences, which explained how the personality traits could be related to the innovative behavior. Regarding the conscientiousness trait, see on Figure 5.7 that the attitude to acquire new knowledge and to solve problems was related positively to innovative behavior. Such characteristics were observed on individuals with high scores of the conscientiousness trait. Therefore, it suggests that in fact a relationship exists and it will be further discussed in the Chapter 6.

Regarding the agreeableness trait, a qualitative analysis with the individuals that scored high on innovative behavior revealed that many of them reported a situation in which they had to implement some idea without the team approval and support. That is, they behave against the perceived norms about innovative behavior. The following excerpt exemplifies this case.

> *"I changed it anyway to correct, but it caused conflict in the workgroup, and for a while the our relationship was in trouble. However, after a period the people understood that someone had to*

> *monitor what was being done at that moment and in the near future. It was hard, but the life is like this"* [C2PATM2]
>
> Original text:
>
> *"eu fui lá e modifiquei mesmo pra ficar da forma certa e gerou atrito na equipe e por um tempo a coisa ficou um pouco complicada, mas depois as pessoas entenderam que alguém tinha que ficar olhando para o que tava sendo feito agora e um pouquinho mais na frente... Foi difícil, mas a vida é assim"*

Therefore, the individuals with low agreeableness are not inhibited to propose ideas and they do not abandon an idea in order to avoid behaving against the workgroup perceived norm. On the other side, individuals with high agreeableness usually avoid actions that may result in conflicts. Then, these individuals do not propose ideas or implement them without co-workers approval and support.

Then, because there were found qualitative evidences about the quantitative findings for the agreeableness trait, this antecedent also was added to the final model.

It is important to highlight that the quantitative results for the personality relationship, at some extent, are divergent from the findings presented by Batey and Furnham (2006) review, which pointed the extraversion and openness to experience traits as the most related to creativity. However, note that an important aspect can be pointed as the source of such difference. As these authors proposed, the literature findings relating personality and creativity provided different results because the measures used for the creativity variable usually were not the same. In particular, the present study used the innovative behavior as the dependent variable instead of creativity. Therefore, the major difference is explained by this fact. The innovative behavior measure is composed of opportunity seeking, creativity, promotion and implementation aspects. Therefore, the result found suggests that when implementation aspects take place, individuals with high conscientiousness and low agreeableness exhibits more innovative behavior.

In addition, the results found go along with the proposed by Batey and Furnham (2006) that each domain has its particularities. They proposed that the personality traits that activate the creativity on each domain are different. See their exemplification of this proposal:

> *For example, the creative salesperson most likely needs to be extroverted, the artist most likely needs to be somewhat neurotic, and the scientist most likely needs to be conscientious.* (Batey and Furnham, 2006)

Therefore, it is proposed that the innovative behavior antecedents also are domain dependent. Hence, this is one more aspect that reinforced the importance of understand the antecedents of innovative behavior specifically for the software development endeavor.

The following section will present the limitations of this case study before the presentation of the final IBMSW in Chapter 6.

5.4. LIMITATIONS

The first limitation of this case study was that the leadership style assessment was performed according to the managers' self-evaluation. This possibility is provided by the LMQ (Bass and Avolio, 1995), once it already has the self-rating questionnaire. However, the subordinates' evaluation could have provided important information for data triangulation improving the study's internal validity.

Also related the leadership style, the leaders from project F, G and H (same leader from F and G) scored high on transformational and transactional dimensions. Therefore, the analysis performed for them considered they as ambidextrous leaders (Rosing et al., 2011).

Furthermore, it was not possible to interview the project manager from project C due to her work constraints. However, the technical leader of this project was interviewed and he provided answers to questions about the team members' innovative behavior.

Another limitation of this study was that some projects did not have individuals with low, medium and high scores of innovative behavior. Therefore, it may also have limited the identification of factors that inhibit or foster the professionals' innovative behavior.

Besides, all the participant projects were on the development of a system for a third part company. Therefore, the antecedents identified may reflect more this kind of projects than projects for the development of a company's own product. For example, as

could be identified on interviews with professionals that previously worked on companies developing own products, these professionals perceived space to propose innovation during all the project development and there were planned activities to motivate idea discussion. Therefore, on these projects, the phase may not influence the individual's innovative behavior or it may have inverse influence, because after a period of time in the project the individual have more information about the product area and technology, which could give her more resources to propose new ideas. Then, the study of these projects may provide further insights and new antecedents to the IBMSW.

5.5. SUMMARY

This chapter presented Case Study 2 and the antecedents found. In addition, a complete link explaining how the antecedents were extracted from the data was provided which allows the model construction process validation by other researches.

Besides the use of the Theory of Planned behavior foundations, other three major changes from the initial model were identified: the individuals' antecedents could be detailed, the client antecedent was added, and the project antecedents could be refined. In addition, minor changes were performed on the team, leader and organizational level. Further, the interplay between the innovative behavior and the individual satisfaction also was explained.

Finally, an interesting relationship between the individuals' personality and innovative behavior could be identified. The results showed that the conscientiousness trait was significantly and positively correlated to the innovative behavior. Further, qualitative data provided explanatory evidences of such relationship. The agreeableness trait also was significantly correlated to the innovative behavior, albeit negatively. Therefore, individuals with low scores on this trait will behave more innovatively. This result also could be confirmed with the analysis of the qualitative data from Case Study 2.

6 INNOVATIVE BEHAVIOR MODEL FOR SOFTWARE: HYPOTHESIS AND NOVELTIES

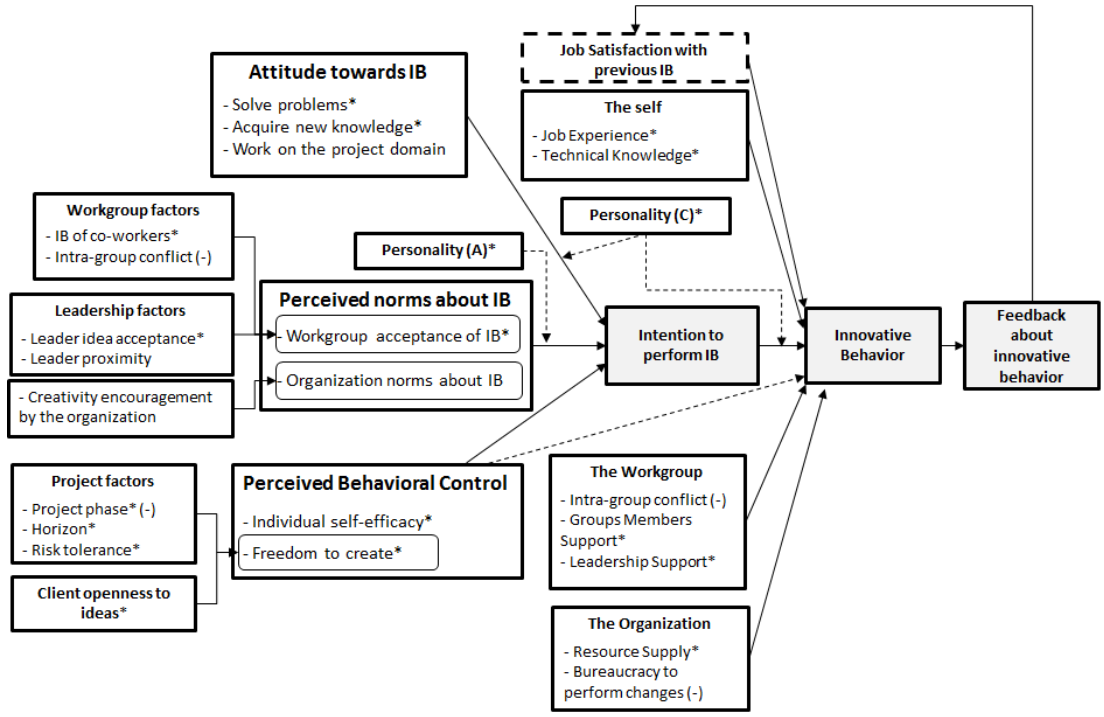
The intent of a normative model is to identify the factors that most powerfully enhance or depress an outcome and to do so in a way that increases the possibility that constructive change can occur (Hackman, 1987). Therefore, the proposed model conceptualizes which are the antecedents that incentive or inhibits the software development professionals to perform innovative behavior.

Particularly, new antecedents of innovative behavior were identified in our study and some of them seem to be specific for the software engineering area. Therefore, it shows the importance of analyze the specificities of each industry when dealing with the individual's innovative behavior. The following sections will details the proposed model for the software engineering are, compare it to the other existing models, and then highlight the study's overall contributions.

6.1. THE IBMSW

The final Innovative Behavior Model for Software (IBMSW) is presented on Figure 6.1.

Figure 6.1 – The Innovative Behavior Model for Software (IBMSW)



The model shows that antecedents related to the individual's attitude towards innovative behavior, perceived norms about innovative behavior, and perceived behavioral control influence the individual's intention to perform innovative behavior. In turn, behavior intention influences the actual innovative behavior together with external factors. Further, the feedback received by the individual about the innovative behavior performed will influence the individual's jobs satisfaction, which also will influence her future innovative behavior appraisal. In particular, the job satisfaction box is dashed to highlight that its interpretation should be made considering such temporal characteristic.

Besides the presented antecedents, the agreeableness personality trait moderates the relationship between the perceived norms about innovative behavior and the intention to perform the behavior. Saying in other words, the agreeableness trait is related the individual's motivation to comply with the perceived norm. As discussed in the Chapter 5, the quantitative analysis showed that such trait is negatively related to the innovative behavior. Further, the qualitative analysis provided evidences that reinforced the moderation role of this trait.

Further, the conscientiousness trait moderates the relationship between the intention and the innovative behavior, as well as the relationship between the individual's attitudes and the intention. The Big Five Theory proposes that individuals with high conscientiousness pose a tendency to be goal oriented and show aim for achievement. Considering the existence of such tendency, it was identified in the Company B that there was an annual evaluation of the individual performance. In that evaluation, there was a specific criterion to evaluate the individual's innovative behavior[11]. Therefore, it means that the individual was told explicitly by the organization that the innovation is a goal that should be achieved. Thus, individuals with high conscientiousness will pursuit such goal. Hence, the influence of the intention to perform innovative behavior on the innovative behavior will be empowered when high levels of conscientiousness were observed. Further, the influence of the attitudes proposed on IBMSW also will be empowered when high levels of conscientiousness were observed. Because when the conscientiousness individual valuates an attitude as desirable, she will consider it as a goal to be achieved.

Furthermore, the moderating role of individual's personality traits also were studied and supported on other domains (e.g. Rhodes, Courneya and Hayduk, 2002).

Regarding the influence of the model antecedents on the innovative behavior dimensions (idea proposal and implementation), the asterisks (*) in the model antecedents indicates which of them influence both the idea proposal and the implementation behavior. Particularly, it was observed in the software engineering domain that for the implementation of some idea usually it is required that the client, the workgroup or the leader approve and prioritize (scheduled) such idea to be implemented. Hence, sometimes the implementation behavior can be strongly inhibited by such particularity. However, when such approval is not required or when the individual exhibits high levels of some antecedents, they used to exhibit the implementation behavior without support and/or using their own time. These

[11] The creativity term, instead of innovative behavior, was used by the company and it was defined as "The capacity to develop creative solutions and innovative and realistic approaches to solve problems, or to the continuous improvement of the area/company's products and processes". Therefore, such definition is composed of idea proposal and implementation aspects, as the innovative behavior definition does.

antecedents are the attitudes to solve problems and to acquire new knowledge, the individual self-efficacy, the individual job experience, and technical knowledge.

Once presented the model overview, the IBMSW's hypotheses will be proposed together with the related explanation about how each antecedent influence the individual's innovative behavior.

Attitude towards innovative behavior

Three individual's attitudes influence the individual's intention to perform innovative behavior. The following hypothesis will explain how it happens.

H1. The individual's evaluation of the attitude to solve problem is positively related to her intention to perform innovative behavior.

The individuals with high innovative behavior use to cite the constant desire to solve problems as a force that pushes them to both propose ideas and implement them. When these individuals perceived that something would be improved, they investigated possible problems in order to propose and implement solutions for them. Further, they considered problem solving as an important part of their role and assignment. On the other hand, individuals without such desire to solve problems only acted when they were asked to or when the problem was explicit and impeditive.

H2. The individual's evaluation of the attitude to acquire new knowledge is positively related to her intention to perform innovative behavior.

The innovation endeavor usually requires the development of something new or the adaptation of an existing solution to a specific need. Then, it creates opportunities to learn in order to find and propose a solution, or to implement an idea. Further, individuals that liked to learn new things usually were exposed to novelties and, thus, had more resources to propose solutions. In addition, once an idea was proposed, its implementation required the learning of a new technology or method. Then, individual's that valued the attitude to acquire new knowledge would exhibit more intention to perform innovative behavior.

H3. The individual's evaluation of the attitude to work in the project domain is positively related to her intention to perform innovative behavior.

The individual affinity to the project domain is related to the level of her intention to perform innovative behavior because for her it is easier to propose new solutions. On the other hand, when the individual disliked working in the project domain it would be harder to propose ideas. The level of difficulty that explained such relationship seemed to be embedded in the fact that the individual did, or did not, have motivation and background to propose ideas. The study's data did not provided evidences that could be used to obtain a deeper understanding of such relationship.

Perceived norms about innovative behavior

The individual perceived norms about innovative behavior is the personal beliefs about what referent others expect from her regarding innovate behavior. In the IBMSW, the perceived norms are represented by the group acceptance of innovative behavior and the organization norms about innovative behavior. Thus, the following hypothesis (H4 and H5) were suggested about such influence.

H4. The individual perception about the group acceptance of innovative behavior is positively related to her intention to perform innovative behavior.

H5. The individual perception about the organization norms about innovative behavior is positively related to her intention to perform innovative behavior.

Further, it was suggested that teamwork, leadership and organizational antecedents influenced such individual perception. The following hypotheses explain how it happens.

H6. The innovative behavior of the co-workers is positively related to the individual's perception about the group acceptance of innovative behavior.

When the co-workers participated proposing ideas and implementing them, the individual perceived that the group was open to idea proposal and implementation. Therefore, she would evaluate that performing innovative behavior was accepted by the group.

H7. The intra-group conflicts are negatively related to the individual's perception about the group acceptance of innovative behavior.

The individual did not perceive a positive group acceptance of innovative behavior when the conflicts were frequent and detrimental. Two possible explanations could be provided about this hypothesis.

H7 – explanation 1: when the conflicts are frequent, the individual does not want to cause even more conflict that could arise from the group discussions about the new proposed ideas.

H7 – explanation 2: conflicts make the individual to perceive that the group would never accept her ideas because of the frequent divergences.

Further, adding to this hypothesis and the two possible explanations, there is an alternative competing hypothesis about the intra-group conflict that is explained in H19. Once there was only one project in which conflicts were identified, the analysis about the influence of such antecedent could not be conclusive. Thus, this competing hypothesis (H19) and its explanations were proposed and left open for further investigation.

H8. The leader idea acceptance is positively related to the individual's perception about the group acceptance of innovative behavior.

In general, leaders have more power in the workgroup and/or their opinions are specially considered by the individuals in the workgroup. Therefore, the individual's perception about the group acceptance of innovative behavior was positively influenced by the leader openness to individual's ideas. That is, when the leader accepted ideas, the perception would be positive. However, when the leader avoided changes, the perception will be that the work-group does not is open to ideas.

H9. The leader proximity is positively related to the individual's perception about the group acceptance of innovative behavior.

The individual perceived more space to propose ideas when there was a closer relationship with her leader. In turn, when the leader was not close, the individual was inhibited to propose ideas because both leader and follower spent a short time together and this time usually was reserved to perform some planned task. In addition, the individual filtered her ideas due to the fear of proposing something wrong or useless. Therefore, the channel to discuss ideas was closed.

H10. The creativity encouragement by the organization is positively related to the individual's perception concerning the organization norms about innovative behavior.

The individual perceived the organization acceptance of innovative behavior according to the space provided by the organization to idea proposal, throught its declarations about creative work, as well as according to the extent the organization was prepared to receive these ideas. Thus, the individual would perceive the organizational norms as receptive to innovative behavior whenever the organization encouraged the creativity.

Perceived Behavioral Control

The perceived behavioral control is the extent the individual believe that she can perform a behavior if she is inclined to do so. In the IBMSW, these perceptions were captured through the perceived individual self-efficacy and the perceived freedom to create. Further, the individual intention to perform the behavior is related to her perceived behavioral control. Hence, it is proposed the following hypothesis.

H11. The individual's self-efficacy is positively related to the individual's intention to perform innovative behavior.

When the individual believed she was capable to propose good ideas and implement them, she would perceive that it was possible to perform innovative behavior. Thus, the individual would have the intention to perform such behavior.

H12. The individual's perception of freedom to create is positively related to the individual's intention to perform innovative behavior.

The individual usually evaluated the existing space for idea proposal and implementation. That is, how easy or difficult it was to have the ideas approved considering project and client constraints. Then, the more freedom to create was perceived, the bigger would be her intention to propose ideas and implement them.

Particularly, the individual's perception of freedom to create was influenced by the project's phase, horizon, and risk tolerance, as well as by the client openness to ideas. Thus, the following hypotheses explains such influence.

H13. As the project advances to later stages of development the individual's perception of freedom to create decreases.

The project phases identified in the software engineering area were the conception, development, and maintenance. The conception is the initial phase, while the maintenance[12] is the later phase. Then, the individuals reported that in the conception phase it was easier to incorporate changes (novelties) in the software. Therefore, in such phase they had more freedom to create. On the other hand, when the project was on the later phases, it was harder to incorporate novelties. Hence, there was a perception that the ideas were much more difficult to be accepted and implemented to be incorporated.

H14. The project with higher uncertainty horizons ware positively related to the individual's perception of freedom to create.

The project horizons are classified as H1, H2 and H3. The project uncertainties are higher in H3 projects than in H2, and higher in H2 than in H1. The project uncertainties are related to the extent that experimentations are required to find the best solution. Therefore, uncertain projects have its scope more open than controlled projects. They are open in the sense that several solutions (technical, process, methods) can be provided to solve a single, maybe complex, problem. Thus, the higher was a project uncertainty horizon, the more the individual perceived freedom to create. That is, to propose ideas and implement these ideas. Regarding the implementation behavior, it was identified that the individual had more freedom to experiment using prototypes on more uncertain projects, because the final solution was unknown a priori.

H15. The project risk tolerance is positively related to the individual's perception of freedom to create.

The individual's perceives more freedom to create when it was possible to fail without ruin the project. On the other hand, when the project required risk avoidance, the individual would perceive that only conservative solutions should be used. Such perception influenced both idea proposal and implementation. Regarding

[12] The maintenance phase is when the software is been used and it still receives updates to fix defects, or to introduce new features.

implementation, the individual would be more inclined to implement something when the risk tolerance was higher because the resources (e.g. time) available were not scarce. Then, it allowed experimentation.

H16. The client openness to ideas is positively related to the individual's perception of freedom to create.

In general, the client was responsible by the final decision of what can be implemented for the software. Therefore, the individual perception of freedom to create would be influenced by the constraints imposed by the client for the solution that should be implemented. When the client imposed several constraints and did not accept the individuals' ideas, the individual would feel worthless to propose ideas and expend time implementing them without the client pre-approval. On the other hand, when the client was open to ideas and discussed the final solution with the individuals, they would perceive that there was space to ideas and experimentation.

External factors

Besides the antecedents that influence the individual intention to perform the behavior, external factors will impede, or support, the individual to perform the intended behavior. These factors are related to the individual herself, the workgroup, and the organization.

H17. The individual job experience is positively related to the individual's innovative behavior.

The individual with more job experience had more capacity to propose ideas to solve a problem and implement them, because she was exposed to similar situations before. Thus, on the situation at hand, the experienced individual had more practical knowledge to deal with the problem. Therefore, the individual innovative behavior would be influenced positively by her job experience.

H18. The individual technical knowledge is positively related to the individual's innovative behavior.

The individual with more technical knowledge had more capacity find a solution for a problem. Therefore, she had more subsides to propose ideas and implement them.

Observe that even when the individual had the intention to propose ideas and implement them, she needed to have a minimum theoretical or practical knowledge about the problem that was being faced or the solution that would be proposed. Without such knowledge, it was impossible to understand the problem or propose and implement the solution.

H19. The intra-group conflicts are negatively related to the individual's innovative behavior.

The existence of several intragroup conflicts would inhibit the individual to perform innovative behavior because even when there was the intention to perform, the individual could convince the workgroup to accept the idea or to implement it.

This is a competing hypothesis of H7 as explained above.

H20. The group members' support is positively related to the individual's innovative behavior.

There is a high level of interdependence among the tasks and the produced artifacts in the software development. Further, usually there is more than on solution for a problem, and the endeavor to find the best one may require more effort than one individual can afford by herself. In addition, it may require specific knowledge that requires co-workers help to conceive and implement it. Therefore, when the group members assisted the individual, she was more capable to find a good solution, and then propose it, as well as to get the approval of the co-workers, leader and other stakeholders. In addition, receiving such assistance she had more chance to overcome the difficulties on its implementation.

H21. The leadership support is positively related to the individual's innovative behavior.

The project leaders (technical or managerial) usually were the responsible for the major decisions and for the project planning. In addition, they usually were the technical or managerial reference for the team members. Therefore, the support they provided to the individual was important to help overcoming the challenges as well as to get resources (e.g. time, hardware, books) to search for a good solution, or to implement the ideas proposed.

H22. The resource supplied by the organization is positively related to the individual's innovative behavior.

In software engineering work, the resources required usually are a specific hardware, software, reference literature, and, mostly, time. When the individual did not have a required resource and the organization did not provide it, the possibility to find a solution, or to implement it, was reduced or unfeasible. For example, when the individual proposed an idea, but the organization did not provide time to implement it, she would be unable to do so, or would have to do it on her own time. Therefore, the resource supply, when required, was positively related to the individual's innovative behavior.

H23. The organization bureaucracy to perform change is negatively related to the individual's innovative behavior.

The bureaucracy imposed by the organization to perform changes inhibited the individual to propose ideas, because she felt it was very difficult to get approval and to promote changes. Therefore, the more bureaucracy to perform change was observed, the less the individual was capable, and motivated, to propose ideas.

Finally, as explained in the beginning of this section, the personality traits would moderate the perceived norms about innovative behavior, the individual's attitudes towards innovative behavior and the intention to perform innovative behavior. Thus, the following hypotheses are proposed.

H24. The influence of the perceived norms about innovative behavior on the intention to perform innovative behavior is moderated by the individual agreeableness personality trait.

The moderation happens in the sense that the individual with high agreeableness personality trait is more susceptible to the perceived norms.

H25. The influence of the individual attitudes towards innovative behavior on the intention to perform innovative behavior is moderated by the individual conscientiousness personality trait.

The individual with high conscientiousness personality trait have the influence of the attitude on the intention empowered.

H26. The influence of the intention to perform innovative behavior on the innovative behavior is moderated by the individual conscientiousness personality trait.

The individual with high conscientiousness personality trait have the influence of the intention on the innovative behavior empowered.

Although it was not the objective of this study to propose the strength of the model's factors, it could be observed that the each antecedent influenced the individuals' innovative behavior at a different degree. I.e., some individuals were more influenced (susceptible) by some factors than by others. This can be explained by the moderation performed by the individual's personality. For example, the individuals with high scores of innovative behavior seemed to be less influenced by the existence of freedom to create than their colleagues because they were always searching for new ways to improve the software technical aspects or the development process. Hence, they did not wait to act only when the problems arose or when they were told to do so. Therefore, they were less influenced by the freedom to create factor than their co-workers were.

Such analysis about the strengths of each antecedent represents an opportunity for future studies, once the factors that exert more influence could be prioritized when considering the definition of an action plan to implement the required conditions that allow the innovative behavior to flourish.

After the presentation of the IBMSW provided above, the following section will details the similarities and differences from the proposed model and the previous ones.

6.2. COMPARING INNOVATIVE BEHAVIOR MODELS

The previous literature models (Scott and Bruce, 1994; West, 2002; Åmo, 2005) were built mainly based on theoretical and quantitative studies. The only exception is the study performed by Åmo (2005), which resulted in one of the four papers that composed his model. His study performed interviews with four people from three organizations. Therefore, the first difference from the previous models to the IBMSW is the richness of details provided by our model. Once IBMSW was constructed based on rich qualitative data and specifically for the software engineering industry, more antecedents could be identified. In addition, because of the research method used, it was

possible to explain empirically how each antecedent influence the individual's innovative behavior.

Each previous model and the IBMSW will be compared below.

Comparing Susan Scott and Reginald Bruce's model with IBMWS

Several equivalencies between Scott and Bruce's (1994) model and the IBMSW could be found. The rationale to consider such equivalencies is:

- The Scott and Bruce's career stage antecedent and the IBMSW's individual job experience and technical knowledge antecedents have some similarity.
- The leader-member exchange from Scott and Bruce's model and the leader proximity from the IBMSW are related to the quality of relationship between leader and follower.
- The leader role expectation from Scott and Bruce also was found similarly on the IBMSW, which was the leader idea acceptance antecedent.
- The support for innovation proposed by Scott and Bruce is related to the climate of support. Then, it relates to the creativity encouragement by the organization on the IBMSW model.

However, two antecedents were not analyzed on this study: the intuitive problem solving and the systematic problem-solving styles. In the place of such individual level antecedents, the IBMSW contains individual's attitudes, personality, and job characteristics.

Comparing Michael West's model with IBMSW

Comparing West's model (2002) and the IBMSW, the main difference, which limits the direct comparison, is the level of analysis used on each model. Different from IBMSW, West proposed antecedents on the level of **group tasks**, **group knowledge diversity and skills**, **group process** and **external demands**.

West model propose that to foster innovation the group should have autonomy and its tasks should meet the requirements of completeness, varied demands,

opportunities for social interaction, opportunities for learning, and development opportunities. These antecedents will be analyzed following.

- **Autonomy** – it was similarly proposed by the IBMSW through the freedom to create antecedent. In conformance with the autonomy the freedom to create antecedent also involve *how* the task can be performed. However, it also adds the dimension of *what* should be done. Therefore, the two model antecedents were considered similar.
- **Tasks requirements (learning opportunities and varied demand)** – these requirements were identified in the IBMSW as well. Both were represented on the Acquire new knowledge antecedent, which was created both to represent the opportunity to learn, the individual's curiosity and her preference to work on varied tasks instead of the on repetitive tasks. Thus, learning is the central point of both concepts.
- **Opportunity of social interaction** - the IBMSW proposes the group members' support, leader proximity, and leader support antecedents. When such factors are in place, they provide opportunities of task related interactions between the individual and her colleagues. Therefore, although the opportunity of social interaction proposed by West also was not found in our study, task related interaction is represented on the IBMSW by these antecedents.

However, for the requirements task completeness and development opportunities proposed by West, no relationship could be found.

On the **group knowledge diversity and skills**, West proposes the following:

> *"In some circumstances, knowledge diversity predicts group innovation but we do not know what types of diversity stimulate innovation and under what circumstances. I suggest that requisite knowledge diversity (the amount of knowledge diversity necessary for task performance and to create variety in, and flexibility of, cognitive responses and to encourage constructive controversy) will lead to innovation. Requisite diversity will increase the more complex is the group's task. However, when diversity begins to threaten the group's safety and integration, then creativity and innovation implementation,*

> *respectively, will suffer. … The challenge is to create sufficient diversity within the team without threatening their shared view of their task and their ability to communicate and work effectively together."* (West, 2002)

The main outcome of a group knowledge diversity and skill according to West is the increase on the amount of knowledge to create variety of ideas. This outcome is obtained thought the discussion of ideas among the team members and requires an environment without personal conflicts. Such concepts can be related to the IBMSW's team antecedents "Co-workers innovative behavior", "Group members support", "Leader support", and "Intra-group conflicts".

Regarding the **external demands** antecedents, West defines it as the group's external context elements, such as the organizational climate, support system, environmental uncertainty, time pressure. The organizational climate and the support systems are represented in the IBMSW using the antecedent creativity encouragement by the organization, and the resource supply. The environmental uncertainty is represented on the project horizon antecedent. In addition, the time pressure is represented in the resource supply as it was discussed in such antecedent hypothesis.

On the group processes proposed by West, some of the outcomes expected when executing such processes are present on IBMSW:

- Clarifying and ensuring commitment to group objectives – The expected outcome on such process is the commitment of the individual to the goals objectives. It is partially related to the individual's goal orientation obtained through the influence of her attitudes moderated by the conscientiousness trait in the IBMSW. In addition, the IBMSW specifies which are the attitudes that influence the individual in the software development industry. Therefore, there exists a relationship of the West and the IBMSW antecedents.

- Participation in decision making – This process outcome can be related to the leader acceptance of ideas the IBMSW;

- Managing conflict effectively – This process outcome can be related to the intra-group conflicts proposed by the IBMSW;

- Minority influence – This process outcome can be related to the workgroup acceptance of innovative behavior on the IBMSW;

- Supporting innovation – This process outcome can be related to the leadership support and the creativity encouragement by the organization proposed on IBMSW;

- Developing intragroup safety - This process outcome can be related to the intra-group conflicts proposed by the IBMSW;

West's model proposed processes "reflexivity" and "integration skills" could not be related to IBMSW's antecedents, once there was no evidence that could support such relationship.

Comparing Bjørn Åmo's model with IBMSW

Finally, comparing Bjørn Åmo's model (2005) with the IBMSW, several similarities and differences were identified. Both models proposes that there exists an influence of the individual characteristics and of the organizational characteristics on individual's innovative behavior. However, the antecedents proposed by each model are different. The comparison of each Åmo's antecedent and the IBMSW is detailed following.

- Organization Strategy – while Åmo's model propose a high level antecedent, that is the organization strategy, the IBMSW propose lower level antecedent which is the creativity encouragement by the organization. Once Åmo considers the organization strategy as "the extent to which the employers encourages the employees to contribute with new ideas and their implementation", it is possible to consider that both models are similar on proposing such antecedents.

- Organizational desire expressed by management – it is proposed on Åmo's model that the managers play a major role in communicate the organizational strategy to employees. It was measured by him using questions that ask at what extent the manager request individual's opinion, give opportunities to discuss about work improvements, and encourages to think in a better way. Therefore, this antecedent can be related to the leader idea acceptance and leadership support on the IBMSW.

- Culture in the working group – Åmo's model proposed that the colleagues influence individual's behavior in the extent they also work on improvements, they consider improvements as important and they are concerned about it. Therefore, it is possible to relate this antecedent with the co-workers innovative behavior and the workgroup acceptance of innovative behavior on the IBMSW.

- Individual's level of specialization in the job function and Individual's age – these antecedents proposed on Åmo's model can be directly related to the technical knowledge and job experience antecedent proposed on the IBMSW.

- Individual's eagerness for learning – this antecedent can be directly related to the attitude of acquire new knowledge antecedent from the IBMSW.

- Embedded learning potential – this antecedent proposes that the individual's work should have embedded learning opportunities to foster innovative behavior. In the IBMSW the project horizon is related to this antecedent in the sense that more uncertainty provides more learning opportunities to overcome the challenges. However, despite this link between them, it is important to have in mind that the horizon is a broader definition for project classification. Thus, the classification of a project carries the level of uncertainty embedded in its execution, which, in turn, provides more, or less, learning opportunities.

The antecedents related to organization size, employee hierarchy, individual's proactive personality, individual's intrapreneurial personality, and the innovation fitness with organizational goals proposed by Åmo's model could not be related to IBMSW's antecedents, because there was no evidence that could support such relationship.

The table 7.1 presents all the antecedents proposed by the IBMSW and literature models as well as it relates in which model they are proposed. The "P" mark on the conscientiousness antecedent related to the West's model means that learning opportunities and the varied demands concepts are part of the higher-level concept conscientiousness from the IBMSW.

Table 6.1 – Comparing the innovative behavior models

Antecedent	IBMSW	Scott and Bruce	West	Åmo
Individual				
Conscientiousness	X		P	
Agreeableness	X			
Self-efficacy	X			
Job experience	X	X		X
Technical knowledge	X	X		X
Solve problems	X			
Acquire new knowledge	X		X	X
Work on the project domain	X			
Intuitive problem-solving style		X		
Systematic problem-solving style		X		
Hierarchical position				X
Proactive personality				X
Intrapreneurial personality				X
Leadership				
Leader proximity	X	X	X	
Leader idea acceptance	X	X	X	X
Leaderhip support	X		X	X
Organization				
Creativity encouragement by the organization	X	X	X	X
Resource supply	X		X	
Bureaucracy to perform changes	X			
Organization norms about IB	X			
Size				X
Team				
Innovative behavior of co-workers	X		X	X
Intra-group conflicts	X		X	
Group members support	X		X	
Workgroup acceptance of IB	X		X	X
Project				
Project phase	X			
Horizon	X		X	X
Risk tolerance	X			
Client				
Openness to ideas	X			
Task				
Freedom to create	X		X	
Completeness			X	
Development opportunities			X	

External Demands				
Treats and uncertainty			X	
Process				
Reflexivity			X	
Integration skills			X	
Innovation itself				
Fitness with organizational goals				X

Legend: (X) The antecedents is in the model, (P) The high level antecedent is not present in the model. However, the model proposes an antecedent that is part of the higher level antecedent.

Comparing the previous models with the IBMSW, several similarities were found. These findings reinforce the influence of such antecedents on individual's innovative behavior. In addition, some antecedents proposed on the literature models were not identified on the IBMSW neither on the other literature models. This may happened because such antecedents do not influence the innovative behavior of the software development industry and are specific to certain fields or tasks. Therefore, further investigation should be performed on such antecedents to provide explanatory power and complementary evidences. Finally, the IBMSW identified several antecedents that were not proposed on the literature models. Therefore, their identification represents an important finding for study of the innovative behavior in the software industry. The next section details the contributions of the IBMSW.

6.3. THE IBMSW CONTRIBUTIONS

Summarizing the findings of this thesis, the IBMSW contributed both by providing explanatory power for previous literature antecedents as well as identifying new ones. A total of fifteen antecedents presented in the literature were also identified in the software development industry. Therefore, this study provided complementary evidence as well as explanation of how the influences of these antecedents happen in practice. In addition, this result improved the external validity of the IBMSW findings.

Further, the identification of new antecedents that influence the individual's innovative behavior on software industry confirms the importance of the investigation performed. The IBMSW firstly introduced the influence of the individual's attitudes towards the innovative behavior, namely, the desire to solve problems, the intention to acquire new knowledge, and the affinity to work on the project domain. It also introduced the moderation of the personality traits agreeableness and conscientiousness.

Further, other antecedents were proposed, such as the individual's self-efficacy, bureaucracy to perform changes, the organization norms about innovative behavior, the client openness to ideas, and all the projects' antecedents. In addition, it was also proposed the existence of a loopback of influence from the feedbacks the individual receives about an innovative behavior on her job satisfaction, which, in turn, will influence her innovative behavior on future situations.

From the overall model, four aspects deserve further discussion.

The personality traits findings were based both on qualitative and quantitative evidences. Thus, from one side the quantitative results provided complementary evidence for the qualitative result. From the other side, the qualitative result provided explanation for the quantitative result, improving the internal validity of this finding.

In addition, the model uncovered the existence of an apparent contradiction related to the opportunity versus the capability to perform innovative behavior on projects of software development for third parties (outsource projects). The results showed that at the beginning of such projects, the team members might not have previous experience with the project technologies or the market (domain). Hence, in the beginning of the project the individual usually have limited knowledge about the technical aspects and the users' needs, which requires spending time on learning. However, the concept phase is when the individual perceives, and actually has, more freedom do create. Thus, it exists a mismatch of knowledge and skills (low knowledge) with the freedom to create (high freedom). Further, this mismatch continues during the project execution, because, as the project progresses, the individual gains knowledge about the domain (high knowledge), but in the later phases the freedom to create is reduced (low freedom). Therefore, it exists a contradiction on this type of projects in the sense that in the phases of the project when there is more opportunity to perform innovative behavior, the individuals have less capability to do so, and the converse becomes true as the project progresses.

Further, when the projects have low risk tolerance and/or the time or budget is scarce, it was observed that the individuals are focused on delivery the minimal solution that meet the project scope. Therefore, the individual's perceive less freedom to create and, indeed, perform less innovative behavior. This aspect poses a challenge for the outsourcing software companies who want to foster the innovative behavior. Because

the pressure to reduce the risk, delivery time, and costs in order to obtain higher profits inhibits the individuals' innovative behavior.

Finally, the second case study provided evidences that ambidextrous leaders positively influence the individual's innovative behavior.

6.4. SUMMARY

This chapter presented the final Innovative Behavior Model for Software and the hypotheses related to it. In addition, the explanations about how each antecedent influenced the individual's innovative behavior were also provided.

Further, the models presented in the literature were compared with the IBMSW, which allowed the identification of complementary evidences as well as highlighted the existence of antecedents that are specific for the software industry.

Finally, the contributions of the IBMSW were discussed, which confirmed the relevance of the findings of this thesis.

7 CONCLUSION

The employees' innovative behavior is the seed of ideas and the action that push them towards innovation (Jong and Hartog, 2007; Scott and Bruce, 1994). Therefore, the development of a model to explain how such behavior can be fostered, or inhibited, has emerged as an opportunity to provide theoretical foundations for the construction of action plans to put the required conditions in place. In particular, the activation of such behavior seems to be different for each endeavor (Batey and Furnham (2006)), and hence, for each industry.

The main goal of this thesis was to study the innovative behavior in the real software development industry and collect empirical evidence towards the construction of an explanatory model of innovative behavior in this context. This thesis contributes to close the existing gaps in the research about innovative behavior in two complementing ways. First, by building a model based on rich qualitative data that was enhanced and refined by quantitative data. Second, by focusing on the practice of software development in real industrial settings in two different countries, which increases external validity of the findings.

7.1. SUMMARY OF THIS RESEARCH

The methodological framework of this research was elaborated with the objective of enable a deep understanding of the phenomena in order to provide qualitative explanations of how the individuals' innovative behavior is influenced by the antecedents. Therefore, two cases studies were performed, complemented by the analysis of 80 articles resulting from a systematic literature review.

The first case study was conducted on a small Canadian software firm, involving 2 projects and 6 participants. This case study together with a systematic literature review, provided the initial model and the basis for a better structuration of the second case study.

The second case study was conducted on a large Brazilian software firm, involving 8 projects and over 60 participants. Thirty-three interviews were performed summing up 25 hours and 40 minutes of audio recording. In addition, 184 quantitative responses were obtained regarding personality (66), leadership style (15) and innovative

behavior (103). From the second case study, the final model was constructed using qualitative and quantitative analysis.

7.2. NOVEL CONTRIBUTIONS OF THE IBMSW

The combination of the results of the two case studies and the systematic review provided the empirical evidence that supported the construction of the IBMSW. This model presented a novel understanding of the phenomenon of innovative behavior in software development and proposed that this behavior is influenced by several factors from the organization, the leader, the team, the project, the client, the task, and the individual's characteristics and personality.

In summary, the IBMSW provided the following contributions for the research and practice of software engineering and innovation management in software development:

- The model proposed several new antecedents that were not identified in the existing literature as well as confirmed some of the previous models antecedents;
- The model provided explanatory power for the innovative behavior antecedents;
- The moderation effect of the individual's personality and the innovative behavior was identified and positioned in the relationships described in the model;
- The effect of feedback from earlier innovative behavior on the satisfaction of the individual and the effect of satisfaction on future innovative behavior was identified. This feedback loop explained why certain individuals exhibit innovative behavior at some point in time and this behavior stops as time progresses;
- Antecedents from the project and the client were identified as specific aspects of the software development industry. Such antecedents allowed the identification of a important contradictions related to the opportunity versus the capability of performing innovative behavior in software projects developed for external clients (outsourcing projects).

- Evidences pointed that ambidextrous leaders positively influence the individual's innovative behavior.

7.3. FUTURE WORK

Regarding the opportunities to improve the current knowledge about the innovative behavior, the following future studies are proposed:

- The execution of a longitudinal study combining both quantitative and qualitative analysis may provide further insights about the phenomena, as well as provide complementary evidences for the IBMSW. In particular, such study could provided a deeper understanding of the influence of feedback on satisfaction, and its influence on future innovative behavior, As an example of such study, the researcher can collect longitudinal data from software engineers during a period in order to measure how the variation of the proposed antecedents influence the individuals' innovative behavior;

- Build diagnostic tools to map the state of a company, project or team regarding the proposed innovative behavior antecedents;

- Perform a deeper analysis about the role of individuals' motivation as antecedent or mediator of innovative behavior;

- Develop a case study with companies that software projects for their own products, once evidences showed that such projects provide different opportunities for continuous improvement and, thus, innovative behavior;

- Perform quantitative studies in order to identify the strength of influence of the IBMSW antecedents.

7.4. PUBLISHING THE FINDINGS

Finally, regarding the publication of our research results, the SLR's result has been submitted for an international journal. In addition, in order to communicate the findings and collect the community feedback, the results will be compiled in three new articles. The first one will focus on the findings about the personality traits, the second will present the entire IBMSW model, and the third will focus on the project aspects of

the IBMSW to highlight the importance of building new business model or processes to allow the innovative behavior to flourish on outsourcing projects.

REFERENCES

Ahuja, G.; LAMPERT, C. (2001) **Entrepreneurship in the large corporation: a longitudinal study of how established firms create breakthrough inventions**. Strategic Management Journal, v. 22, n. 6-7, p. 521-543. Disponível em: <http://doi.wiley.com/10.1002/smj.176>. Acesso em: 9/7/2011.

Ajzen, I. (1991) The theory of planned behavior. **Organizational Behavior and Human Decision Processes**, V. 50, pp. 179–211

Ajzen, I. (2012) **The theory of planned behavior**. In Lange, P., Kruglanski, A., Higgins, E. Handbook of theories of social psychology, Sage, London:UK, V.1, pp.438-459

Ajzen, I.; Fishbein, M. (1980) **Understanding attitudes and predicting social behavior**. Englewood-cliffs, NJ:Prentice-Hall

Akgun, A.; Byrne, J.; Lynn, G.; Keskin, H. (2007) **Team stressors, management support, and project and process outcomes in new product development projects**. Technovation Vol. 27, pp. 628-639

Akgun, A.; Lynn, G.; Byrne, J. (2006) **Antecedents and consequences of unlearning in new product development teams**. Journal of Product Innovation Management, Vol. 23, pp. 73–88

Amabile, T.; Conti, R.; Coon, H.; Lazenby, J.; Herron, M. (1996) **Assessing the work environment for creativity**. Academy of Management Journal, v. 39, n. 5, p. 1154-1184, Disponível em: <http://connection.ebscohost.com/an/9707300678>. Acesso em: 24/9/2011

AMABILE, T.; Khaire, M. (2008) **Creativity and the Role of the Leader**, Harvard Business Review, Oct., p. 100-109

Åmo, B. (2005) **Employee innovation behavior**, Bodø Graduate School of Business, Bodø:Norway, NO-8049

Avolio, B.; Bass, B. (2004) **Multifactor Leadership Questionnaire: manual ans sample set**, Third Edition, Mind Garden.

Axtell, C.M.; Holman, D.J.; Unsworth, K.L.; Wall, T.D.; Waterson, P.E. e Harrington, E. (2000) **Shopfloor innovation: facilitating the suggestion and implementation of ideas**, Journal of Occupational & Organizational Psychology, Vol. 73, pp. 265-85

Baer, M.; Oldham, G. R.; Cummings, A. (2003) **Rewarding creativity: When does it really matter**, The Leadership Quarterly, V. 14, p. 569–586

Batey, M; Furnham, A. (2006) **Creativity, Intelligence and Personality: a Critical Review of the Scattered Literature**. Genetic, Social, and General Psychology Monoghraps,v. 132, n. 4, p. 355-429.

Bandura, A. (1977) **Self-efficacy: toward a unifying theory of behavioral change**. Psychological Review, v. 84, n. 2, p. 191-215

Bandura, A. (1997) **Self-efficacy: The exercise of control**. New York, NY: W. H. Freeman

Bartol, K.; Liu, W.; Zeng, X.; Wu, K. (2009). **Social exchange and knowledge sharing among knowledge workers: The moderating role of perceived job insecurity**. Management and Organization Review, Vol. 5, pp. 223–240.

Bass, B. M. (1985) **Leadership and performance beyond expectations**, New York: Collier Macmillan

Bass, B. M.; Avolio, B. J.; (1995) **MLQ, Multifactor Leadership Questionnaire**, 2nd ed. Redwood City, CA: Mind Garden

Batey, M.; Furnham, A. (2006) **Creativity, intelligence and personality: A critical review of the scattered literature**. Genetic, General and Social Psychology Monographs, Vol. 132, pp. 355–429.

Beck, Kent; et al. (2001). **Manifesto for Agile Software Development**. Agile Alliance. Available at http://agilemanifesto.org/. Last access 28 August 2014.

Bera, A.; Jarque, C. (1980) **Efficient test for normality, heterocedasticity and serial independence of regression residuals**. Econometric letters, V. 6, p. 255-259

Box, G. E. P.; Cox. D. R. (1964) **An analysis of transformations**. Journal of the royal statistical society (B). V. 26, n. 2, p. 211-252.

Burns, J. (1978) **Leadership**, New York, NY: Harper & Row

Carmeli, A.; Meitar, R.; Weisberg, J. (2006) **Self-leadership skills and innovative behavior at work**. International Journal of Manpower, V. 27, n. 1, pp. 75-90,

Cingöz, A.; Akdogan, A. (2011) **An empirical examination of performance and image outcome expectation as determinants of innovative behavior in the workplace**. In: 7th International Strategic Management Conference, Procedia - Social and Behavioral Sciences, V. 24, p. 847–853, Elsevier

Costa, P. T., Jr.; McCrae, R. R. (1992) **The NEO Personality Inventory (NEO PI-R) and NEO Five-Factor Inventory (NEO-FFI) professional manual**. Odessa, FL: Psychological Assessment Resources.

COOPER, R.G. (1990) **Stage-Gate Systems: A New Tool for Managing New Products**. Business Horizons, v.33, n. 3, p. 44-53

Cribari-Neto, F. (2004) **Asympitotic inference under heteroskedasticity of unknown form, Computational statistics & Data analysis**, V. 45, p. 215-233

Cruz, S.; Fabio Q. B. da Silva, Cleviton V. F. Monteiro, Pedro C. F. Santos, Isabella R. M. Dos Santos (2011) **Personality in software engineering: preliminary findings from a systematic review**, in: Proceedings of the 15th Annual Conference on Evaluation and Assessment in Software Engineering (EASE 2011), Durham, 2011. doi:10.1049/ ic.2011.0001

Da Silva, F.; Cruz, S.; Gouveia, T.; Capretz, L.; (2013**) Using meta-ethnography to synthesize research: A worked example of the relations between personality and software team processes**. In: Proceedings of IEEE International Symposium on Empirical Software Engineering and Measurement, Baltimore, Maryland. DOI 10.1109/ESEM.2013.11

Drath, W. H.; McCauley, C. D.; Palus, C. J.; Velsor, E. V.; O'Connor, P. M. G.; McGuire J. B. (2008) **Direction, alignment, commitment: Toward a more integrative ontology of leadership**. The Leadership Quarterly, V. 19, p. 635–653

Dorenbosch, L.; van Engen, M; Verhagen, M. (2005), **On-the-job innovation: the impact of job design and human resource management through production ownership**. Creativity and Innovation Management, Vol. 14 No. 2, pp. 129-41.

Dos Santos, I. (2013) **Os efeitos da liderança sobre o comportamento inovador dos liderados na indústria de software: uma revisão sistemática da literatura**. Dissertation (Master in Computer Science) – Informatics Center, Federal University of Pernambuco, Recife.

Dos Santos, I.; Monteiro, C.; da Silva, F.; Capretz, F.; Lopes, R. (2014) **The Influence of Leaders on Followers' Innovative Behavior in the Software Industry: A Systematic Literature Review**. The leadership Quarterly (article submitted for evaluation on 13-Aug-2014)

Easterbrook, S.; Aranda, J. **Material do curso de Engenharia de Software Experimental**. In: 7th International Advanced School on Empirical Software Engineering, Lake Buena Vista, Florida, 2009

Eisenhardt, K. (1989) **Building Theories From Case Study Research. The Academy of Management Review**, V.14 (4), p.532-550.

Elkins, T.; Keller, R. T. (2003) **Leadership in research and development organizations: A literature review and conceptual framework**. The Leadership Quarterly, V. 14, p. 587–606

Farr, F.; Ford, C; (1990) **Individual innovation**, in West, M.A. and Farr, J.L. (Eds), Innovation and Creativity at Work: Psychological and Organisational Strategies, Chichester: Wiley

Ford, C. M. (2000) **Creative developments in creativity theory**. Academy of Management Review, V. 25, p. 284–289.

Furnham, A.; Bachtiar, V. (2008) **Personality and intelligence as predictors of creativity**. Personality and Individual Differences, V. 45, p. 613–617.

GARCIA, R., CALANTONE, R. (2002) **A critical look at technological innovation typology and innovativeness terminology: a literature review**. The Journal of Product Innovation Management, v.19, p. 110-132

Gehani, R. R. (2011) **Individual Creativity and the Influence of Mindful Leaders on Enterprise Innovation**. Journal of Technology Management & Innovation, V. 6 (3), p. 82-92, ISSN: 0718-2724

Gelade, G. (1997) **Creativity in Conflict: The Personality of the Commercial Creative**. The Journal of Generic Psychology, v. 158, n. 1

George J.; Zhou J. (2001) **When openness to experience and conscientiousness are related to creative behavior**. Journal of Applied Psychology, v.86, n.3, p. 513-524

Gong, Y.; Huang, J. -C.; Farh, J. -L. (2009) **Employee learning orientation, transformational leadership, and employee creativity: The mediating role of employee creative self-efficacy**. The Academy of Management Journal, V. 52, n.4, p. 765–778

Gumusluoglu, L.; Ilsev, A. (2009) **Transformational leadership, creativity, and organizational innovation**. Journal of Business Research, V. 62, p. 461–473, doi:10.1016/j.jbusres.2007.07.032

Hackman JR. (1987) **The design of work teams**. In Lorsch J Handbook of organizational behavior Englewood Cliffs, NJ: Prentice-Hall

Hoda, R. (2011) **Self-Organizing Agile Teams: A Grounded Theory**. Victoria University of Wellington, PhD Thesis

Hunt, J. G.; Stelluto, G. E.; Hooijberg, R. (2004) **Beyond romance and analogy: Orchestra conductors as leaders of creative musicians**. The Leadership Quarterly, V. 15, p. 145–162, doi:10.1016/j.leaqua.2003.12.009

Janssen, O. (2000) **Job demands, perceptions of effort-reward fairness, and innovative work behavior**. Journal of Occupational & Organizational Psychology, Vol. 73, pp. 287-302.

Janssen, O. (2001) **Fairness perceptions as a moderator in the curvilinear relationships between job demands, and job performance and job satisfaction**. The Academy of Management Journal, V. 44, n. 5, pp. 1039-1050

Janssen, O.; Van Yperen, N. W. (2004) **Employees' goal orientations, the quality of leader-member exchange, and the outcomes of job performance and job satisfaction**. Academy of Management Journal, V. 47 (3), pp. 368-384

Jansen, P.; Vera, D.; Crossan, M. (2009) **Strategic leadership for exploration and exploitation: The moderating role of environmental dynamism**. The Leadership Quarterly, V. 20, N.1, p. 5–18

JIMÉNEZ-ZARCO, A.; MARTÍNEZ-RUÍZ, M.; GONZÁLEZ-BENITO, Ó. (2006) **Performance measurement system (pms) integration into new product innovation: a literature review and conceptual framework**. Academy of Marketing Science Review, v. 9. Disponível em: <http://www.amsreview.org/articles/zarco09-2006.pdf>. Acessado em: 29 de Fev de 2009

JONG, J. P. J.; Den Hartog, D. N. (2007) **How leaders influence employees' innovative behavior**. European Journal of Innovation Management, V.10, p. 41-64, DOI 10.1108/14601060710720546

Jung, D.; Avolio, B. (1999). **Effects of leadership style and followers' cultural orientation on performance in groups and individual task conditions**. Academy of Management Journal, Vol. 42, pp. 208–218.

Jung, D.; Sosik, J. (2002). **Transformational leadership in work groups: The role of empowerment, cohesiveness, and collective-efficacy on perceived group performance**. Small Group Research, Vol. 33, N.3, pp. 313–336.

Kahai, S. S.; Sosik, J. J.; Avolio, B. J. (2003) **Effects of leadership style, anonymity, and rewards on creativity-relevant processes and outcomes in an electronic meeting system context**. The Leadership Quarterly, V. 14 (4–5), p. 499–524

Kanter, R.M. (1983) **The change masters: Corporate entrepreneurs at work**. New York: Simon & Schuster.

Kim, J.; Wilemon, D.; (2001) **Managing stress in product development projects**. In: Khalil, T., Lefebvre, L., Mason, R. (Eds.), Management of Technology: The Key to Prosperity in the Third Millennium. Amsterdam: Pergamon, pp. 381–395.

Kim, T.; Hon, A; Lee, G. (2010) **Proactive Personality and Employee Creativity: The Effects of Job Creativity Requirement and Supervisor Support for Creativity**. Creativity research journal, Vol. 22, N. 1, pp. 37-45, (DOI: 10.1080/10400410903579536)

King, N., Anderson, N., & West, M.A. (1992) **Organizational innovation: A case study of perceptions and processes**. Work and Stress, V. 5, pp. 331–339

King, L.; Walker, L.; Broyles, S. (1996) **Creativity and the five factor model**. Journal of Research in Personality, Vol. 30, pp. 189–203

KITCHENHAM, B. A.; CHARTERS, S.; BUDGEN, D. et al. **Guidelines for performing Systematic Literature Reviews in Software Engineering**. Keele, Staffordshire, UK: [s.n.]. , 2007

Koen, P. A.; Ajamian, G. M.; Boyce, S.; Clamen, A.; Fisher, E.; Fountoulakis, S.; Johnson, A.; Puri, P.; Seibert, R.; **Fuzzy Front End: Effective Methods, Tools and Techniques**, in Belliveau, P.; Griffin, A.; Somermeyer, S. (Eds.) The PDMA ToolBook for New Product Development, New york: John Wiley & Sons, 1996

Krause, D.E. (2004) **Influence-based leadership as a determinant of the inclination to innovate and of innovation-related behaviors: an empirical investigation**, Leadership Quarterly, Vol. 15 No. 1, pp. 79-102

Lee, J. (2008) **Effects of leadership and leader-member exchange on innovativeness**. Journal of Managerial Psychology, Vol. 23, No. 6, pp. 670-87

Liu, J.; Liu, X.; Zeng, X. (2011) **Does transactional leadership count for team innovativeness?: The moderating role of emotional labor and the mediating role of team efficacy**, Journal of Organizational Change Management, Vol. 24, N. 3, pp. 282-298

Liu, Y.; Phillips, J. (2011) **Examining the antecedents of knowledge sharing in facilitating team innovativeness from a multilevel perspective**. International Journal of Information Management, Vol. 31, pp. 44-52

Lee, J. (2008). **Effects of leadership and leader–member exchange on innovativeness**. Journal of Managerial Psychology, V. 23 (6), p. 670–687.

Lynn, G. (1998) **New product team learning: developing and profiting from your knowledge capital**. California Management Review, Vol. 40, pp. 74–93.

McCrae, R. (1987) **Creativity, Divergent Thinking, and Openness to Experience**. Journal of Personality and Social Psychology In the public domain, V. 52, n.6, p. 1258-1265.

McDonald, B. S.; Edwards, H. M. (2007) **Who Should Test whom?**, Communications of the ACM, V.50, n. 1, pp. 67-71

Madjar, N.; Oldham, G.; Pratt, M. (2002) **There's no place like home? The contributions of work and nonwork creativity support to employees' creative performance**. Academy of Management Journal, Vol. 45, pp. 757–767

Manz, C. C.; Bastien, D. T.; Hostager, T. J; Shapiro, G. L. (1989) **Leadership and innovation: A longitudinal process view**. In Van de Ven, A. H.; Angle, H. L.; Poole, M. S. (Eds.), Research on the management of innovation: The Minnesota studies, New York: Oxford University Press, p. 613–636

MERRIAM, B. S. **Qualitative Research: A Guide to Design and Implementation**. San Francisco: Jossey-Bass, 2009

Monteiro, C. V. F.; Arcoverde, D. F.; Da Silva, F. Q. B.; Ferreira, H. S. (2010) **Software Support for the Fuzzy Front End Stage of the Innovation Process: a Systematic Literature Review**. In: International Conference on Management of Innovation and Technology, 2010. Proceedings of 5th International Conference on Management of Innovation and Technology

Mumford, M. D.; Connelly, M. S.; Gaddis, B. (2003) **How creative leaders think: Experimental findings and cases**. The Leadership Quarterly, V. 14, p. 411–432

Mumford, M.D.; Licuanan, B. (2004) **Leading for innovation: conclusions, issues, and directions**, Leadership Quarterly, Vol. 15 No. 1, pp. 163-71

Mumford, M. D.; Scott, G. M.; Gaddis, B. (2003**) Leadership in scientific organizations**. In J. Hurley (Ed.), The organizational aspect of scientific effectiveness (p. 69–100). Dordrecht, The Netherlands: Kluwer

Mumford, M. D.; Scott, G. M.; Gaddis, B.; Strange, J. M. (2002) **Leading creative people: Orchestrating expertise and relationships**. The Leadership Quarterly, V. 13 (6), p. 705–750.

Northouse, P. G. (2004). **Leadership: Theory and practice** (3rd ed.). Thousand Oaks: Sage.

Oke, A.; Munshi, N.; Walumbwa, F. O. (2009) **The Influence of Leadership on Innovation Processes and Activities**. Organizational Dynamics, Vol. 38, No. 1, p. 64–72, doi:10.1016/j.orgdyn.2008.10.005

Oldham, G. and Cummings, A. (1996) **Employee creativity: Personal and contextual factors at work**. Academy of Management Journal, Vol. 39, pp. 607–634.

ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD). **Oslo Manual: The Measurement of Scientific and Technological Activities — Proposed Guidelines for Collecting and Interpreting Technological Innovation Data**, [S.l.:s.n], 3rd Edition, 2005

Patterson, F. (2002) **Great Minds Don't Think Alike? Person-Level Predictors of Innovation at Work**. International Review of Industrial and Organizational Psychology, Vol. 17 (eds C. L. Cooper and I. T. Robertson), John Wiley & Sons Ltd, West Sussex, England.

Petticrew, M.; Robert, H. (2006) **Systematic Reviews in the Social Sciences: A Practical Guide**, Blackwell, Massachusetts, ISBN 978-1-4051-2110-1

Reiter-Palmon, R.; Illies, J. J. (2004) **Leadership and creativity: Understanding leadership from a creative problem-solving perspective**. The Leadership Quarterly, V. 15, n. 1, p. 55–77. doi:10.1016/j.leaqua.2003.12.005

Rhodes, R.; Courneya, K.; Hayduk, L. (2002) **Does personality moderate the theory of planned behavior in the exercise domain?**. Journal of sport & exercise phychology, V. 24, pp. 120-132

Rosing, K.; Frese, M.; Bausch, A. (2011) **Explaining the heterogeneity of the leadership-innovation relationship: Ambidextrous leadership**. The Leadership Quarterly, V. 22, n.5, p. 956-974, doi:10.1016/j.leaqua.2011.07.014

Scott, S.G.; Bruce, R.A. (1994) **Determinants of innovative behavior: a path model of individual innovation in the workplace**, Academy of Management Journal, Vol. 38, pp. 1442-65.

SEAMAN, C.B.; (1999) **Qualitative methods in empirical studies of Software Engineering**. IEEE Transactions on Software Engineering, v. 25, n. 4, p. 557–572

Shalley, C.; Gilson, L. (2004) **What leaders need to know: A review of social and contextual factors that can foster or hinder creativity**. The Leadership Quarterly , V. 15, p. 33–53. (doi:10.1016/j.leaqua.2003.12.004)

Shalley, C.; Gilson, L.; Blum, T. (2000) **Matching creativity requirements and the work environment: Effects on satisfaction and intent to turnover**. Academy of Management Journal, Vol. 43, pp. 215–224.

Shamir, B. (1990) **Calculation, value, and identities: Collectivistic work motivation**. Human Relations, Vol. 43, pp. 313–332

Shin, S; Zhou, J (2003) **Transformational Leadership, Conservation, and Creativity: Evidence from Korea**. The Academy of Management Journal, Vol. 46, N. 6, pp. 703 – 714.

SILVA, F. Q. B. DA; SANTOS, A. L. M.; SOARES, S. et al. (2011) **Six years of systematic literature reviews in software engineering: An updated tertiary study**. Information and Software Technology, V. 53 (9), p. 899-913.

Srivastava, A.; Bartol, K.; Locke, E. (2006). **Empowering leadership in management teams: Effects on knowledge sharing, efficacy and performance**. Academy of Management Journal, Vol. 49, N. 6, pp. 1239–1251

Sosik, J. J.; Avolio, B. J.; Kahai, S. S. (1997) **Effects of leadership style and anonymity on group potency and effectiveness in a group decision support system environment**. Journal of Applied Psychology, V. 82(1), p. 89–103

Sosik J. J.; Kahai S. S.; Avolio B. J. (1998) **Transformational leadership and dimensions of creativity: motivating idea generation in computer-mediated groups**. Creativity Research Journal, V. 11 (2), p. 11–121

Spreitzer, G. M. (1995). **Psychological Empowerment in the Workplace: Dimensions, Measurement, and Validation**. Academy of Management Journal, 38, 1442–1465. doi:10.2307/256865

Strauss, A. C; Corbin, J. M. (2007) **Basics of Qualitative Research, Second Edition: Techniques and Procedures for Developing Grounded Theory**. Sage Publications, Inc; 3rd edition, ISBN: 978-1412906449

Tett, R. P., & Guterman, H. A. (2000). **Situation trait relevance, trait expression, and cross-situational consistency: Testing a principle or trait activation**. Journal of Research in Personality, Vol. 34, pp. 397–423

Tierney, P.; Farmer, S. M.; Graen, G. B. (1999) **An examination of leadership and employee creativity: the relevance of traits and relationships**, Personnel Psychology, V. 52, p. 591–620

Utman, C. H. (1997). **Performance effects of motivational state: a meta-analysis**. Personality and social psychology review an official journal of the Society for Personality and Social Psychology Inc, Vol. 1, 170–182

Vinarski-Peretz, H; Binyamin, G; Carmeli, A (2011) **Subjective relational experiences and employee innovative behaviors in the workplace**. Journal of Vocational Behavior, Vol.78, pp. 290-304

West, M.A. (1996) **The handbook of work group psychology**. Chichester: John Wiley

West, M.A. (2002) **Sparkling fountains or stagnant ponds: an integrative model of creativity and innovation implementation in work groups**. Applied Psychology: An International Review, Vol. 51, No. 3, pp. 355-87

West, M. A.; Borrill, C. S.; Dawson, J. F.; Brodbeck, F. (2003) **Leadership clarity and team innovation in health care**. The Leadership Quarterly, V. 14, p. 393–410

White, H. (1980) **A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity**. Econometrica: Journal of the Econometric Society, p. 817–838.

Yin, R. K. (2009) **Case Study Research: Design and Methods** – 4th ed., Applied Social Research Methods Series, V. 5. SAGE Publications. ISBN: 978-1-4129-6099-1

Yuan, F.; Woodman, R. W. (2010) **Innovative behavior in the workplace: the role of performance and image outcomes expectations**, Academy of Management Journal, V. 53 (2), p. 323-342

Zaccaro, S.; Blair, V.; Peterson, C.; Zazanis, M. (1995). **Collective efficacy**. In J. Maddux (Ed.), Self-efficacy, adaptation, and adjustment: Theory, research, and application, New York: Plenum Press, pp. 305–330.

Zhang, A. Y.; Tsui, A. S.; Wang, D. X. (2011) **Leadership behaviors and group creativity in Chinese organizations: The role of group processes**. The Leadership Quarterly, V. 22, p. 851–862, doi:10.1016/j.leaqua.2011.07.007

Zhang, X.; Bartol, K. (2010) **Linking empowering leadership and employee creativity: the influence of psychological empowerment, intrinsic motivation, and creative process engagement**. Academy of Management Journal, Vol. 53, N. 1, pp.107–128

Zhou, J. (2003) **When the presence of creative coworkers is related to creativity: Role of supervisor close monitoring, developmental feedback, and creative personality**. Journal of Applied Psychology, Vol. 88, pp. 413–422.

Appendix A

This appendix contains the data collection instruments for the case studies, which are two semi-structured interview guides for each case study, one for the leaders and one for the team members, and the observation form from the first case study.

Case Study 1

Interview Guide for Leaders

Innovative Behavior

HASE-InnovativeBehavior-Script-Leaders

Grupo de Pesquisa	Human Aspects in Software Engineering (HASE)
Website	www.haseresearch.com
Projeto de Pesquisa	Comportamento inovador em engenheiros de software
Identificação do Projeto	HASE-Innovative-Behavior
Organização de Pesquisa	Centro de Informática – UFPE
Website	www.cin.ufpe.br
Pesquisador Responsável	Professor Fabio Q. B. da Silva
Contato	fabio@cin.ufpe.br
Pesquisadora	Cleviton Monteiro
Contato	cvfm@cin.ufpe.br

PARTICIPANT INFORMATION

Name	
E-mail	
Position	
ID	

PRESENTATION

- Greetings and introduction
- Thank the participant
- Is it ok to record the interview? Record data and company name.
- Could you please tell me your full name?

INTRODUCTION

The long term objective of our research is to build a theory about what influences the individual innovative behavior in the software engineering. We believe that such theory is essential to inform and support improvements on leaders and team members' practices towards innovation.

We would be very gratefull for your input to this research. This would include participating in this interview and also answering one survey questionnaire. As a retribution for our participation, we will provide your company an analysis of strengths and potential fragilities of the practices related to innovative behavior. This information may be useful for you and your team as you look for opportunities to improve.

All your responses will be kept strictly confidential. Your participantion is voluntary. You will not, in any way, be penalized if you choose not to participate in the study, ok? Do you have any questions regarding this interview?

ABOUT THE ANSWERS

There are no right or wrong anwers for most of the questions in this interview. My goal is to colect your impressions, opinions, and feelings about the various subjects addressed. So, please answer the questions as exponteneous and honestly as possible, knowing that your answers will not be, in any way, disclosed to other individuals inside or outside your company.

May we start?

QUESTIONS

Leader Background - LDRBKG			
Factor	**ID**	**Questions**	**Type**
BKG	1	Please, briefly describe your professional career trajectory. *Probe: age, professional trajectory, main abilities, Position: developer, tester, designer, front-end.*	Background
BKG	2	What were the reasons that made you start working as a Project Manager *Probe: Have you ever worked in another working area out of computer science?*	Background
BKG	3	How long have you been working in this company?	Background
MOT	4	What made you decide to work in this company?	Background
SAT	5	How do you feel about your work in this company? *Probe: How do you fell in comparison to the other companies you have worked for?*	Feeling
CCTX	6	What are the characteristics of this company that stimulate	Opinion

		you working here?	
CCTX	7	What are the characteristics of this company that don't stimulate you working here?	Opinion

Now we will talk about the company.

Organization Characteristics - ORG			
Factor	**ID**	**Questions**	**Type**
ORGSTG	1	What is the importance of innovation to the company you work now? *Probe: Why?*	Feeling
ORGSTG	2	Does your employer encourage the employees to contribute to the development of new products, new working methods or new technology adoption? *Probe YES: Can you tell me more about how the employer encourages you?* *Probe NO: Why you don't feel encouraged to contribute with these kinds of ideas? (facts, fears)*	Feeling
IDEA	3	Can you mention facts in this company that resulted in people giving more ideas of new products, working methods or new technologies? (company-wide) *Probe YES: What do you think that trigged this creative behavior?*	Backgound
IMPL	4	Can you mention facts in this company that resulted in people (including yourself) implementing ideas by their own, promoting ideas, applying extra-effort on the project (company-wide)? *Probe YES: What do you think that trigged this implementation behavior? Is it common?*	Backgound
IDEA	5	Can you mention facts in this company that inhibited people to give ideas (company-wide)? *Probe YES: Why do you think these facts inhibited people to give ideas?*	Backgound
IMPL	6	Can you mention facts in this company that inhibited people implementing ideas by their own, promoting ideas, applying extra-effort on the project (company-wide)? *Probe YES: Why do you think these facts inhibited people to give ideas?*	Backgound

The next questions are about the project you are working nowadays.

Working Group and Leader Facts – WKG-LDRFCT			
Factor	**ID**	**Questions**	**Type**
PROC	1	Which process does your team use for software development? *Probe: Can you explain me the process?*	Background
ROLE	2	What is your role in the tasks performed by your team? *Probe: In your opinion, do you have to be innovative in your work?*	Background/ Opinion
LDRPERSLT	3	Where do you use to invest more effort: in the optimization of work to reduce deviations or in the challenging of status quo towards innovation? *Probe REDUCE: Do you invest some effort to push team members towards innovative behavior?*	Background

		If only REDUCE, jump to 6.	
PRAC	4	Can you tell me what you do to push them to give ideas of new products, new working methods and new technologies? *Probe: What are the practices you think are more effective in this way?*	Opinion
PRAC	5	And to push them to implement new ideas, new working methods and new technologies, what practices do you think are more effective?	Opinion
EXT	6	What happens when your team receives external challenging demands with high levels of uncertainty? *Probe: is it more usual to avoid the risks or to develop new ways to address the demand?*	Background
EXT	7	When these external demands happens the timing to address the solicitation changes? *Probe: How it changes?*	Background

Now we will talk about the team members that will participate in this research.

Team member 1:

Team member 2:

Team member 3:

I will ask you questions about them.

Subordinates – SUBNT			
Factor	**ID**	**Questions**	**Type**
Let's talk about Team Member X.			
INDBHV	1	Can you tell me about his/her behavior at work? *Looking for behaviors that stand.*	
TECSKL	2	How do you evaluate his/her technical skills? *(looking for junior, intermediate, senior, low/high skilled)*	
PROAC	3	What is his/her behavior regarding proactivity?	
IDVIDEA	4	And with regard to idea proposal of new products, new working methods and new technology. What can you tell me about his/her behavior? *Probe: Do you have an example of such behavior?*	
IDVIMPL	5	And in the implementation of new technologies, new working methods and new products. What can you tell me about his/her behavior? *Probe: Do you have an example of such behavior?*	
INVBHV	6	In your opinion, him/her has an innovative behavior? *Probe: Can you explain me why do you consider him/her not innovative OR innovative?*	

Finally we will talk about your individual characteristics and preferences.

Individual Characteristics – INCHR			
Factor	**ID**	**Questions**	**Type**

INDVPRF	1	What do you feel about projects of innovative products, new technologies and new working methods? *Probe: What are the aspects you **do** and **don't** like in these projects?*	Feeling

Do you want to give complementary information in the scope of this research about you, your team or the company?

THANKS

Thank you so much. Your participation was very important to this research.

Interview Guide for Team Members

Innovative Behavior

HASE-InnovativeBehavior-Script-Members

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Website	www.haseresearch.com
Projeto de Pesquisa	Comportamento inovador em engenheiros de software
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Website	www.cin.ufpe.br
Pesquisador Responsável	Professor Fabio Q. B. da Silva
Contato	fabio@cin.ufpe.br
Pesquisadora	Cleviton Monteiro
Contato	cvfm@cin.ufpe.br

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There are no right or wrong anwers for most of the questions in this interview. My goal is to colect your impressions, opinions, and feelings about the various subjects addressed. So, please answer the questions as exponteneous and honestly as possible, knowing that your answers will not be, in any way, disclosed to other individuals inside or outside your company.

May we start?

QUESTIONS

Team Member Background - TMB			
Factor	**ID**	**Questions**	**Type**
BKG	1	Please, briefly describe your professional career trajectory. *Probe: age, professional trajectory, main abilities, Position: developer, tester, designer, front-end.*	Background
BKG	2	What were the reasons that made you start working as a Software Engineering/Tester/Documentation? *Probe: Have you ever worked in another working area out of computer science?*	Background
BKG	3	How long have you been working in this company?	Background
MOT	4	What made you decide to work in this company?	Background
SAT	5	How do you feel about your work in this company?	Feeling

		Probe: How do you fell in comparison to the other companies you have worked for?	
CCTX	6	What are the characteristics of this company that stimulate you working here?	Opinion
CCTX	7	What are the characteristics of this company that don't stimulate you working here?	Opinion

Team Member Innovative Behavior Fact - INBHF			
IDEA	8	Have you ever proposed an idea of new product, new process, new technology or new working method in the company you work now? *Probe-YES: Can you tell me more about one of these ideas?* *Probe-NO: And in companies you worked previously?*	Background
If had idea.			
IDEA	8.1	How did you come up with this idea? *(you were searching something…, somebody asked you to help to solve a problem…, you saw the problem and wanted to solve it…)*	Background
IDEA	8.2	What did help you to come up with this idea? *(looking for facts, support, leader and peers help, prior knowledge)*	Feeling
IMPL	8.3	What happens between the moment you came up with the idea and the moment it was decided to (implement it)/(don't implement it)? *Probe1 Impl.: What was decisive to convince the people to implement the idea?* *Probe2 Impl.: Who or what helped you in this moment?* *Probe1 NOT Impl.: What was decisive in the decision to abandon the idea?* *Probe2 NOT Impl.: What you think was not decisive but contributed to give up the idea?* *IF Not Implemented jump to 8.8.*	Background
IMPL	8.4	Can you tell me more about what was important for this idea became implemented?	Feeling
NOVEL	8.5	Was this idea new to the company? *Probe NO: Was it new to your working group?*	Background
OUTC	8.6	What were the results of the idea for the company? *(looking for competitive advantages, cost reduction, etc.)*	Background
OUTC	8.7	What were the results for you? *(looking for rewards, personal satisfaction, knowledge acquired)*	Opinion
LOOP	8.8	Did you propose another idea that you think is important to analyze? *Probe: can be an idea that was not successful or not implemented* *If there was another idea, ask "Tell me about this another idea." and jump to 8.1*	Opinion
If didn't had idea.			
IDEA	9.1	In your opinion, why have you not given ideas to the companies you work for? *Probe: can you tell me more about it?* *(looking for facts, lack of motivation, lack of knowledge, manager behaviors, company support, peers support)*	Opinion
IDEA	9.2	In your opinion, are your ideas important to the company? *Why?*	Opinion
IMPL	9.3	Do you like to work in the implementation of new products, new working methods or new technologies? *Probe: Why?*	Feeling

		Probe2: Have you ever worked in projects like these? *If YES: You chose to work in these projects or you were assigned to them?* *If No: Why not?*	
IMPL	9.4	In your opinion, is it important for your company that you participate in these innovative projects? *Probe: why?*	Opinion

Now we will talk about what happened in the companies you worked and make some comparisons.

Organization Characteristics - ORG			
Factor	**ID**	**Questions**	**Type**
ORGSUP	1	Bring to your mind a company you worked in your professional career, which you think was **more supportive for innovation (can be the one you are working now)**. Can you tell me about your behavior relative to propose ideas in those companies? *(looking for comparison between extreme cases regarding to company support for innovation and idea proposal: quantity of ideas, motivation, when it more happened)*	Experience
ORGSUP	2	Now, please tell me about your behavior regarding the proposal of ideas in the company you think was the less supportive for innovation. *(looking for comparison between extreme cases regarding to company support for innovation and idea proposal: quantity of ideas, motivation, when it more happened)*	Experience
ORGSUP	3	Can you compare your behavior on those companies?	Experience
ORGSUP	4	Still related to these companies (which you think that were more and less supportive). Can you tell me about your behavior relative to implement ideas of new products, new working methods or new technology in the company that was more supportive to innovation? *(looking for comparison between extreme cases regarding to satisfaction and idea implementation)* *Probe: Were you assigned to the project or you chose to work on it?* *Probe 2: Did you promoted the idea to be implemented?* *Probe 3: What about the effort you applied in these projects?*	Experience
ORGSUP	5	What about your implementation behavior in the company that was less supportive to innovation? *(looking for comparison between extreme cases regarding to satisfaction and idea implementation)* *Probe: Were you assigned to the project or you chose to work on it?* *Probe 2: Did you promoted the idea to be implemented?* *Probe 3: What about the effort you applied in these projects?*	Experience
ORGSUP	6	Can you compare your behavior on those companies?	Experience
SAT	7	Now, bring to your mind the company you were **more satisfied** to work. Is it the same that was **more supportive for innovation**? *Probe yes: Go to the next question.* *Probe No: So, now, bring to your mind the company you were more satisfied in working for. Can you tell me about your behavior relative to propose ideas in this company?* *(looking for comparison between extreme cases regarding to satisfaction and idea proposal)*	Experience

SAT	8	What about the company you were **less satisfied.** Was it the less supportive for innovation? *Probe YES: Go to the next question.* *Probe NO: Please tell me your behavior regarding the proposal of ideas in the company you were less satisfied?* *(looking for comparison between extreme cases regarding to satisfaction and idea proposal)*	Experience
SAT	9	Still related to these companies (which you were more and less satisfied). Can you tell me about your behavior relative to implement ideas of new products, new working methods or new technology? *(looking for comparison between extreme cases regarding to satisfaction and idea implementation)* *Probe: Were you assigned to the project or you chose to work on it?* *Probe 2: Did you promoted the idea to be implemented?* *Probe 3: What about the effort you applied in these projects?*	Experience
ORGSTG	10	What is the importance of innovation to the company you work now? *Probe: Why?*	Feeling
ORGSTG	11	Does your employer encourage the employees to contribute to the development of new products, new working methods or new technology adoption? *Probe YES: Can you tell me more about how the employer encourages you?* *Probe NO: Why you do not feel encouraged to contribute with these kinds of ideas? (facts, fears)*	Feeling
IDEA	12	Can you mention facts in this company that resulted in people giving more ideas of new products, working methods or new technologies? (company-wide) *Probe YES: What do you think that trigged this creative behavior?*	Backgound
IMPL	13	Can you mention facts in this company that resulted in people (including yourself) implementing ideas by their own, promoting ideas, applying extra-effort on the project (company-wide)? *Probe YES: What do you think that trigged this implementation behavior? Is it common?*	Backgound
IDEA	14	Can you mention facts in this company that inhibited people to give ideas (company-wide)? *Probe YES: Why do you think these facts inhibited people to give ideas?*	Backgound
IMPL	15	Can you mention facts in this company that inhibited people implementing ideas by their own, promoting ideas, applying extra-effort on the project (company-wide)? *Probe YES: Why do you think these facts inhibited people to give ideas?*	Backgound

The next questions are about the project you are working nowadays.

Working Group - WRKG			
Factor	**ID**	**Questions**	**Type**
PROC	1	Which process does your team use for software development? *Probe: Can you explain me the process?*	Background
ROLE	2	What is your role in the tasks performed by your team? *Probe: In your opinion, do you have to be innovative in your work?*	Background
CHLG	3	Do you think your tasks are challenging for you?	Feeling

		Probe: Do you like it?	
VAR	4	The tasks are routine or variety? *Probe: Do you like it?*	Opinion
ESP	5	How long have you been working with the technologies that you are using in this project?	Experience
ESP	6	How long have you been working in the specific area you are working now? (health care, communication, logistics) *Probe: How do you evaluate your knowledge in this area?*	Experience
GOAL	7	Who defines your team goals? *Probe: The goals are always clear?*	Background/ Opinion
GOALCOM	8	In your opinion, are the team members always committed to the goals? *Probe NO: In your opinion, why this happens?*	Opinion
DM	9	Do the team members have participation in decision making on group tasks?	Background
IDEADM	10	The way your team makes decision has affected the way you propose new ideas? *Probe: Do you feel more, or less, interested to give ideas?*	Feeling
CONF	11	What is the frequency that conflicts happens in your team?	Background
CONF	12	When they happen how they are managed? *Probe: In your opinion, are the conflicts well managed?*	Background/ Opinion
IDEACONF	13	Do the different points of view in the conflicts produce new ideas? *Probe: Did you record any discussion that a minority could convince the group about its idea?*	Background
TEAMSUP	14	Do you consider your team as innovation supportive or changing avoiding? *Probe: Can you explain me your feeling?*	Feeling
TEAMSUP	15	Have you implemented something when the group didn't support you? *Probe YES: What made you implement the idea without their support? How do you feel in these occasions?* *Probe NO: Why?*	Feeling
SFTY	16	Do you like to propose ideas to your team? *Probe: Why?*	Feeling
AUTIMPL	17	When an idea is approved by the group is it usually implemented? *Probe IMPLE: Which types of idea have more and less probability of be implemented?* *Probe NO IMPLE: Why the ideas are not implemented?*	Background
AUT	18	In your opinion, do you have autonomy to decide the way your work should be done? *Probe: Why?*	Feeling
EXT	19	**Now about external demands** What happens when your team receives external challenging demands with high levels of uncertainty? *Probe: is it more usual to avoid the risks or to develop new ways to address the demand?*	Background
EXT	20	Do you agree with your team decision? (to avoid risk or try new ways?)	Opinion
EXT	21	When these external demands happens the timing to solve the problems changes?	Background

Now we will talk about your relationship with your leader (or leaders).

Leadership - LDR			
Factor	**ID**	**Questions**	**Type**
IDN	1	Who is the team leader in your team? *Probe: Why you consider him your leader?*	Background
LDRROLE	2	What is the role of the leader in the team?	Background
ROLEEXP	3	In your opinion, what your leader expects from you? *Probe: For your leader, should you be innovative?*	Opinion
LDRMNT	4	How the leader monitors the teamwork? *Probe: What is your opinion about it?*	Background
XPT	5	Does your leader(s) have technical expertise in the area of your project? *Probe: How do you feel about it?*	Opinion
LDRCRT	6	Does your leader propose new ideas of new products, new working methods or new technology? *Probe: What do you think about this?* *Probe YES: What is the frequency?*	Background
LDRSUP	7	Do you perceive support from your leader (I mean not only technically) to search for opportunities and propose new ideas? *Probe YES: Can you tell me examples of how he supports you? (encourage, model the way, challenge the process, provides vision)* *Probe NO: How do you feel about it?*	Feeling
LDRSUP	8	And to implement new ideas, new working methods and technologies. Do you receive his support? *Probe YES: Can you tell me examples of how he supports you?* *Probe NO: How do you feel about it?*	Feeling
INTSML	9	Do you remember any moment that you felt intellectually stimulated by your leader? *Probe YES: Tell me more about this. What he did? Did you proposed something new or was able to solve a problem?* *Probe NO: Do you think it happened someday?*	Background
LDRFBK	10	Does your leader give feedback on your ideas? *Probe: What do you think about it?*	Background/ Opinion
LDRFBK	11	And in the implementation of these ideas? *Probe: What do you think about it?*	Background/ Opinion
LDRINH	12	Did your leader made something in this project that made you feel giving ideas worthless? *Probe YES: Can you tell me more about this? What is the frequency it happens?*	Background
LDRINH	13	Did your leader made something in this project that made you feel giving extra-effort to implement ideas worthless? *Probe YES: Can you tell me more about this? What is the frequency it happens?*	Opinion
RSK	14	What happens when ideas from team members does not work? *Probe: What is the leader position?* *Probe2: In your opinion, the team members feel safety to take the risks again?*	Background/ Feeling
LDREXT	15	**What about external contacts**	Background

		In the project, do you contact people outside the company? *Probe YES: Does your leader manage these contacts?* *Probe YES2: Did you have new ideas because of these external contacts?* *Probe NO: Why?*	
REW	16	**What about rewards** Do you receive rewards when new ideas are proposed and implemented? *Probe: What is your opinion about it?*	Background/ Opinion
LDRBHV	17	**Now about previous projects** In previous projects, maybe with other leaders, did your leader incite you to propose ideas of new products, new working methods or new technologies? *Probe YES: What he did?*	Background
LDRBHV	18	What about the implementation of new products, new methods or new technology. Do you remember anything that enabled you to act? *Probe YES: Can you tell me more about it?*	Background

Finally we will talk about your individual characteristics and preferences.

Individual Characteristics - INCHR			
Factor	**ID**	**Questions**	**Type**
INDVPRF	1	What do you feel about projects of innovative products, new technologies and new working methods? *Probe: What are the aspects you **do** and **don't** like in these projects?*	Feeling
INDVANTC	2	In your opinion which are the most important aspects that enacts you to propose new ideas?	Opinion
INDVANTC	3	Which are the factors that you consider most important to you implement a new idea?	Opinion

Do you want to give complementary information in the scope of this research about you, your team or the company?

THANKS

Thank you so much. Your participation was very important to this research.

Observation Form

The following form should be used on each observation.

Date:	
Moment:	<planing meeting, daily meeting, etc.>
Team and present members:	Team X. Members:
Leader is present?	( ) Yes ( ) No
Observation notes:	

Case Study 2

Roteiro da Entrevista

Comportamento inovador

HASE-InnovativeBehavior-Script-Members

Grupo de Pesquisa	Human Aspects in Software Engineering (HASE)
Website	www.haseresearch.com
Projeto de Pesquisa	Comportamento inovador em engenheiros de software
Identificação do Projeto	HASE-Innovative-Behavior
Organização de Pesquisa	Centro de Informática – UFPE
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Pesquisadora	Cleviton Monteiro
Contato	cvfm@cin.ufpe.br

INFORMAÇÃO DO PARTICIPANTE

Nome	
E-mail	
Cargo	
ID	

ROTEIRO (1/2)

- Apresente-se

- Leia a “Descrição da pesquisa” e “Sobre as respostas”

DESCRIÇÃO DA PESQUISA

O objetivo de longo prazo desta pesquisa é construir uma teoria sobre o que influencia o comportamento inovador dos profissionais da engenharia de software. Acreditamos que esta teoria é essencial para dar suporte e promover melhorias nas práticas de líderes e membros do time em busca da inovação.

Todas as suas respostas serão tratadas de maneira confidencial. Sua participação é voluntária e você não será penalizado, de forma alguma, se escolher não participar desta pesquisa. Você tem alguma pergunta sobre esta entrevista?

SOBRE AS RESPOSTAS

Não existem respostas corretas ou erradas para as perguntas desta entrevista. Meu objetivo é captar suas intenções, opiniões e sentimentos sobre os assuntos abordados. Por favor, responda às questões com a maior sinceridade possível. Lembro que as suas respostas não serão divulgadas ou entregues a pessoas da empresa, ou de fora dela, e serão acessíveis apenas pela equipe da pesquisa.

Podemos começar?

ROTEIRO (2/2)

- Agradeça ao participante (obrigado por participar da nossa pesquisa)
- Inicie a gravação do audio e em seguida peça permissão para gravar a entrevista
- Pergunte o nome completo do entrevistado
- Siga para as perguntas

BACKGROUND - TMB			
Fator	**ID**	**Perguntas**	**Tipo**
BKG	1	Você poderia descrever brevemente sua carreira como profissional? *Probe: idade, principais habilidades, cargo: desenvolvedor, eng. de testes, designer, front-end.*	Background
BKG	2	Por que você escolheu trabalhar como desenvolvedor (tester, analista ou designer)? *Probe: Você já trabalhou em outra área?*	Background

Agora vamos falar sobre ideias. Quando eu me referir a ideias, estamos falando de ideias de produtos, serviços, processos ou adoção de tecnologias.

FATOS DE COMPORTAMENTO INOVADOR - INBHF			
IDEA	1	Para o seu trabalho, você acha que é importante propor ideias de novos produtos, processos, tecnologias? *Probe-NÃO: Por que você não acha importante?*	Background
NÃO ACHA IMPORTANTE			

IDEA	2	Com que frequência você costuma propor ideias de novos produtos, novos processos, novas tecnologias ou novos métodos de trabalho aqui na empresa? *Probe MUITA IDEIA: Por que você acha que tem muita ideia mesmo sem achar importante para a empresa?* *Probe POUCA IDEIA: Além de não achar importante dar ideias, na sua opinião, qual seria o motivo de você não dar muitas ideias?*	Background
	3	Você lembra alguma ideia proposta por você? *Probe SIM: Você poderia falar sobre ela? (DEPOIS PULA PARA **TEVE IDEIA**)* *Probe NÃO (não lembro): PULA PARA O **BLOCO ORGANIZAÇÃO***	
ACHA IMPORTANTE			
IDEA	4	Com que frequência você costuma propor ideias de novos produtos, novos processos, novas tecnologias ou novos métodos de trabalho aqui na empresa? *Probe MUITA IDEIA: Na sua opinião, por que você tem muitas ideias?* *Probe POUCA IDEIA: Na sua opinião, qual seria o motivo de você não dar muitas ideias?*	Background
IDEA	5	Você poderia falar sobre uma dessas ideias? *Probe SIM: Você poderia falar sobre ela? (SEGUE PARA **TEVE IDEIA**)* *Probe NÃO (não lembro): PULA PARA O **BLOCO ORGANIZAÇÃO***	Background
TEVE IDEIA.			
IDEA	6	Como você teve essa ideia? *(você estava buscando algo para resolver um problema, alguém te pediu ajuda, você viu o problema e quis resolvê-lo?)*	Background
IDEA	7	Na sua opinião, o que te ajudou a ter essa ideia? *(conhecimento prévio do domínio da aplicação, conhecimento técnico, experiência passada)*	Feeling
IMPL	8	Essa ideia foi implementada? *Probe1 Impl.: O que você fez para convencer as pessoas a implementar a ideia?* *Probe2 Impl.: Alguém ou algo específico te ajudou neste momento?* *Probe1 NOT Impl.: O que foi decisivo para que você abandonasse a ideia?* *Probe2 NOT Impl.: Você pode falar sobre alguma ideia que você deu e foi implementada?* ***SE NÃO, PULAR PARA BLOCO ORGANIZAÇÃO.*** ***SE SIM, Voltar PARA 6***	Background
IMPL	9	Você pode falar mais sobre o que foi importante para que a ideia viesse a ser implementada?	Feeling
NOVEL	10	Essa ideia era algo novo para a empresa? *Probe NÃO: Ela era nova para a sua equipe?*	Background
OUTC	11	Quais foram os resultados da ideia para a empresa/equipe? *(facilitou o dia-a-dia, deu vantagem competitiva, reduziu custos, melhorou a qualidade)*	Background
OUTC	12	Quais foram os resultados para você? *(recebeu recompensa, satisfação pessoal, conhecimento adquirido)*	Opinion
LOOP	13	Você propôs alguma outra ideia que seria interessante analisarmos? ***SE SIM, Voltar PARA 6.*** ***SE NÃO, segue adiante.***	Opinion

Agora vamos falar sobre empresas. Tanto da empresa que você trabalha agora, quanto de outras empresas onde você já trabalhou.

ORGANIZAÇÃO - ORG			
Fator	**ID**	**Perguntas**	**Tipo**
ORG	1	Você trabalhou em alguma outra empresa?	Background
		SE SIM	
ORGSUP	2	Em outras empresas você costumava propor mais ou menos ideias do que aqui? *(Se o entrevistado responder que depende da empresa, peça para ele falar sobre a empresa onde ele dava mais ideias e sobre a empresa que ele dava menos ideias.)*	Experience
ORGSUP	3	Na sua opinião, qual o motivo para você ter comportamentos diferentes (ou iguais) em relação a dar ideias em outras empresas e aqui?	Opinion
		CONTINUAR DAQUI PARA SIM OU NÃO NA PERGUNTA 1	
ORGSTG	4	Qual é a importância da inovação para a empresa que você trabalha agora? *Probe: Por quê?*	Feeling
ORGSTG	5	A empresa incentiva os funcionários a contribuir com o desenvolvimento de novos produtos, novos métodos de trabalho ou novas tecnologias? *Probe SIM: Como ele incentiva?* *Probe NÃO: Por que você não se sente incentivado a contribuir com novas ideias? (algum fato, receio)*	Feeling
IDEA	6	Aconteceu algo na empresa (algum fato) que fez com que as pessoas passassem a dar mais ideias? (na empresa toda ou na equipe) *Probe SIM: Na sua opinião, por que você isso aconteceu?*	Backgound
IMPL	7	Aconteceu algo na empresa (algum fato) que fez com que as pessoas (incluindo você) implementassem uma ideia por conta própria, ou passassem a promover uma ideia? (na empresa toda ou na equipe) *Probe SIM: Na sua opinião, por que você isso aconteceu?*	Backgound
IDEA	8	Aconteceu algo na empresa que inibiram as pessoas a dar novas ideias? (na empresa toda ou na equipe) *Probe SIM: Na sua opinião, por que isso aconteceu?*	Backgound
IMPL	9	E quanto à implementação de ideias, algo aconteceu que inibiu as pessoas de implementarem ideias? (na empresa toda ou na equipe) *Probe SIM: Na sua opinião, por que isso aconteceu?*	Backgound

As próximas perguntas são sobre o projeto que você trabalha hoje.

Equipe - WRKG			
Fator	**ID**	**Perguntas**	**Tipo**
SFTY	1	O que você acha de propor ideias para o seu time? *Probe: Por quê?*	Feeling
DM	2	Os membros do time têm participação nas decisões das tarefas do time?	Background
IDEADM	3	A forma como o seu time decide as coisas afeta a forma como você propõe ideias para o time? *Probe: Você se sente mais ou menos interessado a propor ideias?*	Feeling

TEAMSUP	4	Na sua opinião, seu time é avesso a mudança ou ele costuma ser receptivo a mudanças? *Probe: Por quê?*	Feeling
TEAMSUP	5	Você implementou algo que a equipe não te apoiou? *Probe YES: O que te motivou a implementar a ideia mesmo sem apoio? Como você se sentiu nesta ocasião?* *Probe NO: Por quê?*	Feeling
AUTIMPL	6	Quando uma ideia é aprovada pelo grupo, ela costuma ser implementada? *Probe IMPLE: Quais tipos de ideia têm mais chances de ser implementadas?* *Probe NÃO IMPLE: Por que as ideias costumam não ser implementadas?*	Background
STABREQ	7	O projeto em que você trabalha tem espaço para proposição de ideias ou tudo já está pré-definido?	Feeling

Agora vamos falar sobre sua relação com seus líderes (gerente e líder técnico).

Líder - LDR			
Fator	**ID**	**Perguntas**	**Tipo**
ROLEEXP	1	Na sua opinião, o que o seu líder espera de você? *Probe: Para o seu líder, você deve ser inovador?*	Opinion
LDRCRT	2	O seu líder costuma propor ideias? *Probe: O que você acha sobre isso?*	Background
LDRSUP	3	Você sente que seu líder te apoia a buscar oportunidades de fazer melhor e de propor novas ideias? *Probe YES: Você poderia me dar exemplos de como ele te apoia?* *Probe NO: Qual a sua opinião sobre isso?*	Feeling
LDRSUP	4	E para implementar novas ideias? Você sente apoio? *Probe YES: Você poderia me dar exemplos de como ele te apoia?* *Probe NO: Qual a sua opinião sobre isso?*	Feeling
LDRFBK	5	O seu líder dá feedback nas suas ideias? *Probe: O que você acha sobre isso?*	Background/ Opinion
LDRFBK	6	E na implementação das ideias? *Probe: O que você acha sobre isso?*	Background/ Opinion
LDRINH	7	O seu líder fez algo neste projeto que desanimou a propor ideias? *Probe YES: Você poderia me falar mais sobre isso? Com que frequência isso acontece?*	Background
LDRINH	8	O seu líder fez algo neste projeto que desanimou a implementar ideias? *Probe YES: Você poderia me falar mais sobre isso? Com que frequência isso acontece?*	Opinion
RSK	9	O que acontece quando a ideia de alguma pessoa da equipe não dá certo? *Probe: Qual é o posicionamento do líder?* *Probe2: Na sua opinião, os membros do time se sentem seguros a assumir riscos após uma ideia falhar?*	Background/ Feeling
LDRBHV	10	**Agora sobre líderes que você teve anteriormente** Você teve algum líder que te fazia se comportar de maneira mais inovadora? Ou seja, propondo mais ideias e mais melhorias para o trabalho? *Probe YES: O que ele fazia para que isso acontecesse?*	Background/ Opinion
LDRBHV	11	Você teve algum líder que te deixava sem vontade de propor ideias e melhorias para o trabalho? *Probe YES: O que ele fazia para que isso acontecesse?*	Background/ Opinion

Vamos falar sobre algumas de suas características individuais e preferências.

CARACTERÍSTICAS INDIVIDUAIS - INCHR			
Fator	**ID**	**Perguntas**	**Tipo**
INDVPRF	1	Qual a sua opinião sobre projetos de produtos inovadores, novas tecnologias e novos métodos de trabalho? *Probe: O que você gosta e não gosta neste tipo de projeto?*	Feeling
INDVANTC	2	Na sua opinião, quais são os aspectos mais importantes que te incentivam a propor ideias?	Opinion
INDVANTC	3	Quais são os fatores que te motivam a implementar novas ideias?	Opinion

Você gostaria de dar alguma informação complementar sobre o que discutimos, sobre a empresa, sua equipe ou seu líder?

AGRADEÇA

Muito obrigado. Sua participação foi muito importante para esta pesquisa.

Roteiro da Entrevista

Comportamento inovador

HASE-InnovativeBehavior-Script-Members

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Website	www.haseresearch.com
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Pesquisador Responsável	Professor Fabio Q. B. da Silva
Contato	fabio@cin.ufpe.br
Pesquisadora	Cleviton Monteiro
Contato	cvfm@cin.ufpe.br

INFORMAÇÃO DO PARTICIPANTE

Nome	
E-mail	
Cargo	
ID	

ROTEIRO (1/2)

- Apresente-se
- Leia a “Descrição da pesquisa” e “Sobre as respostas”

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SOBRE AS RESPOSTAS

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Podemos começar?

ROTEIRO (2/2)

- Agradeça ao participante (obrigado por participar da nossa pesquisa)
- Inicie a gravação do audio e em seguida peça permissão para gravar a entrevista
- Pergunte o nome completo do entrevistado
- Siga para as perguntas

Background - LDRBKG			
Factor	**ID**	**Perguntas**	**Type**
BKG	1	Você poderia descrever brevemente sua carreira profissional? *Probe: idade, trajetória profissional, habilidades, posição: desenvolvedor, tester, designer, front-end.*	Background
BKG	3	Quanto tempo você trabalha nesta empresa?	Background
MOT	4	Por que você veio trabalhar nesta empresa?	Background
SAT	5	Qual a sua opinião sobre trabalhar aqui nesta empresa? *Probe: Você poderia comparar essa empresa com outra que você trabalhou?*	Feeling
CCTX	6	Quais são as características que te estimulam a trabalhar aqui?	Opinion
CCTX	7	Quais são as características que não te estimulam a trabalhar aqui?	Opinion

Agora vamos falar sobre a empresa.

Organização - ORG			
Factor	**ID**	**Perguntas**	**Type**
ORGSTG	1	Qual a importância da inovação para a empresa? *Probe: Por quê?*	Feeling
ORGSTG	2	A empresa incentiva os colaboradores a contribuir com o desenvolvimento de novos produtos, novos métodos de trabalho ou na adoção de novas tecnologias? *Probe SIM: Pode me falar um pouco mais sobre como a empresa incentiva?* *Probe NÃO: Por que você não se sente incentivado a contribuir com ideias? (fatos, insegurança)*	Feeling

As próximas perguntas são sobre o projeto <projeto>.

Equipe e Papel do líder – WKG-LDRFCT			
Factor	**ID**	**Perguntas**	**Type**
PROC	1	Qual processo o time usa no desenvolvimento do sistema?	Background
ROLE	2	Qual o seu papel no trabalho realizado pela equipe? *Probe: Na sua opinião, você precisa ser inovador(a) no seu trabalho?*	Background/ Opinion
LDRPERSLT	3	Onde você investe mais esforço: na otimização do trabalho para reduzir desvios ou na busca por inovação? *Probe REDUZIR: Você investe algum esforço para incentivar os membros do time em busca da inovação?* Se apenas REDUZ, pular para o passo 6.	Background
PRAC	4	O que você faz para incentivá-los a propor ideias? *Probe: Quais práticas você acha mais eficaz para incentivá-los?*	Opinion
PRAC	5	E para incentivá-los a implementar novas ideias, quais práticas são mais efetivas?	Opinion

Agora vamos falar sobre os membros selecionados para serem entrevistados.

Membro 1:

Membro 2:

Membro 3:

Membro 4:

Vou fazer perguntas sobre cada um deles.

Subordinados – SUBNT			
Factor	**ID**	**Perguntas**	**Type**
Vamos falar sobre X.			
INDBHV	1	Como você pode descrever o comportamento dele no trabalho? *Em busca de comportamentos que se destacam.*	
TECSKL	2	Como você avalia a capacidade técnica dele?	
PROAC	3	Ele costuma ser proativo?	
IDVIDEA	4	Ele costuma dar ideias de novos produtos, processos, métodos de trabalho ou tecnologias? *Probe: Poderia me dar um exemplo de uma ideia dada por ele?*	
	5	No geral, ele costuma dar ideias de que tipo? (produto, processo, tecnologia, equipe)	
IDVIMPL	6	Como é o comportamento dele com relação ao uso de novas tecnologias e implementação de novos métodos de trabalho? *Probe: Você pode dar exemplos do comportamento dele?*	
INVBHV	7	Na sua opinião, ele se comporta de maneira inovadora? *Probe: Você pode detalhar porque o avalia dessa forma?*	

Por fim, vamos falar sobre suas características individuais e preferências.

Características individuais – INCHR			
Factor	**ID**	**Perguntas**	**Type**
INDVPRF	1	O que você acha de projetos de produtos inovadores, novas tecnologias ou novos métodos de trabalho? *Probe: Quais são os aspectos que você gosta e que você não gosta nestes tipos de projetos?*	Feeling

Você gostaria de dar alguma informação complementar sobre o que conversamos?

AGRADEÇA

Muito obrigado. Sua participação foi muito importante para esta pesquisa.

Appendix B

Systematic Literature Review Protocol

REVISION HISTORY

Date	Version	Description	Author
20/10/2011	0.1	First version	Cleviton Monteiro
27/02/2011	0.2	Update	Igor Ebrahim
01/03/2011	0.3	Update	Igor Ebrahim
02/03/2011	0.4	Update	Cleviton Monteiro
02/03/2011	0.4.1	Revision	Igor Ebrahim

TEAM

Name	Organization	Role
Cleviton Vinícius Fonseca Monteiro	CIn – UFPE	Author
Fabio Queda Bueno da Silva	CIn – UFPE	Co-Author e Internal reviwer
Igor Ebrahim dos Santos	CIn – UFPE	Author

INTRODUCTION

Systematic Literature Reviews studies are used to perform wide literature reviews using an unbiased approach. Its objective is to present a fair evaluation about a research topic thought the use of a rigorous, trustable and auditable methodology. Therefore, its results should have scientific value (Travassos and Biolchini, 2007).

The advantages of this type of study comparing to traditional literature reviews are: unbiased results, more comprehensive, higher quality and with higher scientific rigor. The reasons to perform a SLR are listed below:

- Identify gaps in the current knowledge of certain research area;
- Summarize the current evidences about a phenomena;
- Support the generation of new hypothesis;

- Provide the basis for new research positioning.

Once the SLR methodology has to be well defined it has to begin with the definition of the research's protocol. This document contains the research questions the strategy that should be followed by the researchers. Particularly, the protocol has to define the search strategy to find the primary studies, the inclusion and exclusion criteria of these studies, the procedure to evaluate their quality, the way the data shall be extracted, the process documentation strategy and the way the results will be presented.

Therefore, this document will present the SLR protocol that aims to answer the research questions stated in the following section.

RESEARCH QUESTIONS

The research questions that guide this SLR are the following:

- **QP1. How leaders influence the innovative behavior of individuals?**
  - **QP1.1. Which of leader factors are more studied?**
- **QP2. Which are the other antecedents of individual innovative behavior found in the studies?**

SEARCH STRATEGY

This SLR will use manual and automatic search. The search string for the automatic search was obtained following the steps below:

a) Extract the main terms from the research question;
b) Identify a list of synonyms and abbreviations for each term. To find additional terms search for synonyms on articles from the same research area.
c) Build the search string using the connectors *OR*, between synonyms, and *AND*, to concatenate different terms.
d) Verify the search string performing a pilot search and comparing the result with the already known list of primary studies. Then update the search string until the results already known have been retrieved. Also update the string if it became too broad and cannot be retrieved by the search engine.

Result of step A

(leadership OR "leadership behavior" OR "leadership behaviour") AND ("innovative behavior" OR creativity)

Result of step B

At this step, articles, books and search engines were the main sources of synonyms, abbreviations and alternative spelling for each one of the main terms. For example, using the search engine the following synonyms were found for "*leadership*": directorship, management. On some cases in which the plural form of the word or an alternative spelling can be used, the asterisk (*) character was used as a wildcard character.

Following these steps, the synonyms below could be found:

- **Leadership behavior**
  - Leadership behaviour
  - Leader Personality
  - Leadership style
  - Transactional leadership
  - Transformational leadership
  - Participative leadership
  - Directive leadership
  - Leader-member Exchange
  - LMX
- **Innovative behavior**
  - Innovative behaviour
  - Intrapreneurship
  - Corporate entrepreneurship
  - Corporate venturing
  - Creative thinking
  - Creative effort
  - Creative outcome
  - Creative behavior
  - Creative behaviour
  - Idea promotion
  - Championing

- Idea generation
- Idea implementation

Result of step C

The search string initially found was the following:

(“Leadership behavior” OR “Leader Personality” OR “Leadership style” OR “Transactional leadership” OR “Transformational leadership” OR “Participative leadership” OR “Directive leadership” OR “Leader-member Exchange” OR LMX) AND (“Innovative behavior” OR Intrapreneurship OR “Corporate entrepreneurship” OR “Corporate venturing” OR “Creative thinking” OR “Creative effort” OR “Creative outcome” OR “Creative behavior” OR “Creative behavior” OR “Idea promotion” OR Championing OR “Idea generation” OR “Idea implementation”)

Result of step D

After some tailoring on the search string from step C, the following string was used:

("Leadership behavior" OR "Leadership behaviour" OR "leader behavior" OR "leader behaviour" OR "leader personality" OR "leadership style" OR "transactional leadership" OR "transformational leadership" OR "participative leadership" OR "directive leadership" OR "transactional leader" OR "transformational leader" OR "leader-member exchange") AND ("innovative behavior" OR "Innovative behaviour" OR "innovation behavior" OR "innovation behavior" OR creativity OR innovation OR "new product development")

During the tries to adapt the search string, unexpectedly, the removal of terms from “OR” clauses returned more results than before. Also the inclusion of some terms on “OR” clause returned fewer articles. Logically this is not the expected behavior. However the string had to be tailored considering this constraint and all the strings were stored as a historical register.

SEARCH SOURCES

The search will be performed using both automatic and manual approach. The criterias to choose a source were the following:

- Web search or browsing availability;
- Source relevance for the research area. The list of sources will be built based on specialists' suggestions and on the already known articles' source as well as on their references.

The automatic searches will be done in English because the majority of the articles are available in this language. The following search engines will be used:

- IEEE Explore
- ScienceDirect - Elsevier
- Scopus

The manual search will be done in the following sources:

- IEEE Transactions on Software Engineering (132 issues - IEEE Xplore)
- Journal of Product Innovation Management (69 issues - Wiley)
- Technovation (132 issues - Science Direct)
- Journal of Technology Management & Innovation (20 issues - http://www.jotmi.org/index.php/GT/issue/archive)
- Information and Software Technology (137 issues - Science Direct)
- Radical Innovations of Software and Systems Engineering in the Future (http://academic.research.microsoft.com/Conference/1524.aspx)(1 issue - Springer)
- Standardization and Innovation in Information Technology - SIIT (http://academic.research.microsoft.com/Conference/373.aspx)
- Innovations in Systems and Software Engineering - ISSE (http://academic.research.microsoft.com/Journal/742.aspx) (21 issues - Springer)
- The Leadership Quarterly - http://www.journals.elsevier.com/the-leadership-quarterly/ (68 issues - Science Direct)

The manual search should be performed in issues from 2000 to 2011.

STUDY SELECTION CRITERIA

The wide-ranging search aims to eliminate the bias in the selection of the primary studies for this research. Additionally inclusion criteria should be defined to

guide the selection of primary studies. Therefore the following criteria should be met to accept a study as a relevant source of information for this SLR:

- Studies that provide primary evidences about the influence of leadership behavior on the individual behavior;
- Only complete studies should be included;
- The study has to be written in English;
- If duplicated studies were found and they report results about the same research, only the newer or the most complete should be included. If the different articles have complementary information, all of them shall be included.
- When there is doubt about the inclusion or exclusion of a study, it shall be included.
- The study has to be an accepted article on a peer reviewed event or journal. Master and PhD thesis are acceptable as well.

Moreover, with the aim to reduce the selection bias, if two researchers have divergent opinions about the inclusion of a study, a meeting should be scheduled to discuss the divergences and decide about the inclusion. If an agreement could not be found, the supervisor should be contacted to provide advice.

SELECTION PROCESS

The selection process should be performed following the steps below:

1. A researcher shall perform the search in each one of the sources (search engines and manually on the issues).
2. The researcher shall read the study's title and, if required, abstract to verify if the study is clearly irrelevant to the research. According to Kitchenham (2007) the initial search will return a large amount of studies clearly irrelevant for the research. Therefore these studies shall be excluded from the beginning and no records should be registered about them. The remaining articles should be recorded in a list of potential relevant articles.
3. The potential relevant studies shall be evaluated by the researches according to the inclusion criteria. The verification should be done by reading the abstract and, if required, the introduction and conclusion. Also keywords searches should be done on the study's text. At this point all of the studies shall be registered in

the form A which is presented in the end of this section and that will be implemented using electronic spreadsheet;

4. After that each study shall be entirely read to perform the data extraction. This step should be performed with the support of the NVivo13 tool following the data extraction section guidelines.

If on the steps 2, 3 or 4 the researcher decides to exclude an article, he shall register his decision using the form A.

Following the form A will be presented. It will be used to register the included and excluded studies. The column decision shall be filled with the "included" or "excluded" labels. The search type is about "automatic" or "manual" search. The search source shall contain the search engine or the issue name where the study was found.

FORM A

The form A shall be used to record the included and excluded studies' source information as well as the selection process decisions.

Researcher	Decision	DD	Search type	Search source	title	Year	Comments / Decision remarks

DATA EXTRACTION

The data extraction shall be performed in different ways for qualitative and quantitative data.

For the quantitative data the researchers shall use the NVivo "Node classification sheets[14]" functionality to register for each article the following information:

[13] NVivo is a software that supports qualitative and mixed methods research. It lets you collect, organize and analyze content from interviews, focus group discussion, audio, etc. Webpage: http://www.qsrinternational.com/products_nvivo.aspx (last access on Jul 2nd, 2013).

- Publication year
- Publication type (Journal, Proceedings, Book chapter)
- Publication source
- Research type (survey, experiment, quasi-experiment, case study, qualitative research, multiple)
- Respondents country
- Study type (Qualitative, Quantitative, Both)
- Participants (Professionals, Students, Both)

The qualitative data shall be coded using the NVivo "Node" feature with allows the codification of an article excerpt with a customized code. The codes shall be named according to the code formats presented following:

Type of information	Description	Code format
Constructs	Description of constructs used by the research.	Construct_<name> Ex: Construct_Innovative Behavior
Measures	The measure used by the research for a construct.	Measure_<construct name> Ex: Measure_Innovative Behavior
Relationship between constructs	Relationship between constructs. Such as positive relations, negative relations and no relations found.	NegRelated_<outcome construct>_<antecedent construct>(<mediator>) Ex1: NegRelated_Creativity_Transactional Leadership(Knowledge sharing) Ex2: PosRelated_Creativity_Transformational Leadership

Therefore, all article constructs shall be coded, as well the measures used by the article (when available) and the relationship between constructs found by the study. However, relationships cited by the article which were found by referenced (other) studies do not shall be recorded. Furthermore, see that the relationship format can be

[14] This functionality allows the classification of a node (in this case, primary study) according customized attributes, such as publication year, source, etc.

used to record negative relationships (using the prefix *NegRelated*), positive relationships (using the prefix *PosRelated*) and inexistent relationship (using the prefix *NotRelated*) between constructs. The *NotRelated* prefix means that the research studied the relationship. But did not find support for the relation between two or more constructs.

Using this codification approach it will be possible to have a relationship inventory which can be used to find all the primary studies that found one specific relationship. For example, all the studies that found a positive relationship from transformational relationship on innovative behavior. It also will be possible compare the constructs used by different studies.

SEARCH PROCESS DOCUMENTATION

According to Kitchenham (2007), the execution process has to be transparent and replicable. Therefore, the search steps have to be recorded as it is being performed and each adaptation or deviation should be registered.

Following this recommendation this section will describe the limitations of the search process and about the decision made in the construction of this protocol.

First, the automatic search process had some adaptions for each search engine. For example, for the Science Direct there is no need to use words variations, such as behavior, behaviors and behaviour, in the search string. Furthermore, when some search terms are used in the search engines they return too many irrelevant results or the engine returned an error message, for example, the use of the terms "*OR management OR manager OR managing OR leadership OR leader OR leading*" on the Scopus engine. Therefore, all adaptations made on the search strings were recorded.

Second, the quality assessment proposed by Kitchenham (2007) was not performed in this research and represents a threat to validity. The assessment was not performed because the majority of the studies were published on important journals. Therefore it was judged that the risk of low quality studies is lower than if they were published on minor conferences/sources or if they were technical report not reviewed by third parties.

INCLUDED ARTICLES

ID	References
PS014	AKGÜN, A. E. *et al.* Team stressors, management support, and project and process outcomes in new product development projects. **Technovation**, v. 27, n. 10, p. 628–639, out. 2007.
PS016	ZHANG, A. Y.; TSUI, A. S.; WANG, D. X. Leadership behaviors and group creativity in Chinese organizations: The role of group processes. **The Leadership Quarterly**, v. 22, n. 5, p. 851–862, out. 2011.
PS036	WEST, M. A *et al.* Leadership clarity and team innovation in health care. **The Leadership Quarterly**, v. 14, n. 4-5, p. 393–410, ago. 2003.
PS040	JAUSSI, K. S.; DIONNE, S. D. Leading for creativity: The role of unconventional leader behavior. **The Leadership Quarterly**, v. 14, n. 4-5, p. 475–498, out. 2003.
PS041	KAHAI, S. S.; SOSIK, J. J.; AVOLIO, B. J. Effects of leadership style, anonymity, and rewards on creativity-relevant processes and outcomes in an electronic meeting system context. **The Leadership Quarterly**, v. 14, n. 4-5, p. 499–524, out. 2003.
PS047	AMABILE, T. *et al.* Leader behaviors and the work environment for creativity: Perceived leader support. **The Leadership Quarterly**, v. 15, n. 1, p. 5–32, fev. 2004.
PS050	KRAUSE, D. E. Influence-based leadership as a determinant of the inclination to innovate and of innovation-related behaviors. **The Leadership Quarterly**, v. 15, n. 1, p. 79–102, fev. 2004.
PS070	GUMUSLUOGLU, L.; ILSEV, A. Transformational leadership, creativity, and organizational innovation. **Journal of Business Research**, v. 62, n. 4, p. 461–473, abr. 2009.
PS073	ATWATER, L.; CARMELI, A. Leader–member exchange, feelings of energy, and involvement in creative work. **The Leadership Quarterly**, v. 20, n. 3, p. 264–275, jun. 2009.
PS077	SUN, L.-Y. *et al.* Empowerment and creativity: A cross-level investigation. **The Leadership Quarterly**, v. 23, n. 1, p. 55–65, fev. 2012.
PS078	KRATZER, J.; LEENDERS, R. T. A. J.; ENGELEN, J. M. L. VAN. The social structure of leadership and creativity in engineering design teams: An empirical analysis. **Journal of Engineering and Technology Management**, v. 25, n. 4, p. 269–286, dez. 2008.

PS089	REGO, A. *et al.* Authentic leadership promoting employees' psychological capital and creativity. **Journal of Business Research**, v. 65, n. 3, p. 429–437, mar. 2012.
PS095	SUNG, S. Y.; CHOI, J. N. Effects of team knowledge management on the creativity and financial performance of organizational teams. **Organizational Behavior and Human Decision Processes**, v. 118, n. 1, p. 4–13, maio. 2012.
PS097	WU, C. *et al.* The influence of leader regulatory focus on employee creativity. **Journal of Business Venturing**, v. 23, n. 5, p. 587–602, set. 2008.
PS098	VOLMER, J.; SPURK, D.; NIESSEN, C. Leader–member exchange (LMX), job autonomy, and creative work involvement. **The Leadership Quarterly**, v. 23, n. 3, p. 456–465, nov. 2011.
PS101	CARMELI, A.; SCHAUBROECK, J. The influence of leaders' and other referents' normative expectations on individual involvement in creative work. **The Leadership Quarterly**, v. 18, n. 1, p. 35–48, fev. 2007.
PS102	ANDERSON, L. R.; FIEDLER, F. E. The effect of participatory and supervisory leadership on group creativity. **Journal of Applied Psychology**, v. 48, n. 4, p. 227–236, 1964.
PS106	REDMOND, M. R.; MUMFORD, M. D.; TEACH, R. Putting Creativity to Work: Effects of Leader Behavior on Subordinate Creativity. **Organizational Behavior and Human Decision Processes**, v. 55, n. 1, p. 120–151, jun. 1993.
PS110	BASU, R.; GREEN, S. G. Leader-Member Exchange and Transformational Leadership: An Empirical Examination of Innovative Behaviors in Leader-Member Dyads. **Journal of Applied Social Psychology**, v. 27, n. 6, p. 477–499, mar. 1997.
PS111	SOSIK, J. J. Effects of Transformational Leadership and Anonymity on Idea Generation in Computer-Mediated Groups. **Group & Organization Management**, v. 22, n. 4, p. 460–487, 1 dez. 1997.
PS113	SOSIK, J. J.; AVOLIO, B. J.; KAHAI, S. S. Inspiring Group Creativity: Comparing Anonymous and Identified Electronic Brainstorming. **Small Group Research**, v. 29, n. 1, p. 3–31, 1 fev. 1998.
PS114	SCOTT, S.; BRUCE, R. Following the leader in R&D: The joint effect of subordinate problem-solving style and leader-member relations on innovative behavior. **Engineering Management, IEEE …**, v. 45, n. 1, p. 3–10, 1998.
PS115	SOSIK, J. J.; KAHAI, S. S.; AVOLIO, B. J. Transformational Leadership and Dimensions of Creativity: Motivating Idea Generation in Computer-Mediated Groups. **Creativity Research Journal**, v. 11, n. 2, p. 111–121, abr. 1998.

PS117	TIERNEY, P.; FARMER, S. M.; GRAEN, G. B. AN EXAMINATION OF LEADERSHIP AND EMPLOYEE CREATIVITY: THE RELEVANCE OF TRAITS AND RELATIONSHIPS. **Personnel Psychology**, v. 52, n. 3, p. 591–620, set. 1999.
PS118	JUNG, D. I. Transformational and Transactional Leadership and Their Effects on Creativity in Groups. **Creativity Research Journal**, v. 13, n. 2, p. 185–195, abr. 2001.
PS123	LIU, Y.; PHILLIPS, J. S. Examining the antecedents of knowledge sharing in facilitating team innovativeness from a multilevel perspective. **International Journal of Information Management**, v. 31, n. 1, p. 44–52, fev. 2011.
PS137	TIERNEY, P. The Pygmalion Process and Employee Creativity. **Journal of Management**, v. 30, n. 3, p. 413–432, jun. 2004.
PS145	VINARSKI-PERETZ, H.; BINYAMIN, G.; CARMELI, A. Subjective relational experiences and employee innovative behaviors in the workplace. **Journal of Vocational Behavior**, v. 78, n. 2, p. 290–304, abr. 2011.
PS153	WILSON-EVERED, E.; HÄRTEL, C. E. J.; NEALE, M. A longitudinal study of work group innovation: The importance of transformational leadership and morale. *In*: **Advances in Health Care Management**. [s.l.] Emerald Group Publishing Limited, 2001. p. 315–340.
PS155	RAMUS, C. A. Encouraging innovative environmental actions: what companies and managers must do. **Journal of World Business**, v. 37, n. 2, p. 151–164, jun. 2002.
PS161	SARIN, S.; MCDERMOTT, C. The Effect of Team Leader Characteristics on Learning, Knowledge Application, and Performance of Cross-Functional New Product Development Teams. **Decision Sciences**, v. 34, n. 4, p. 707–739, nov. 2003.
PS169	SHIN, S.; ZHOU, J. Transformational leadership, conservation, and creativity: Evidence from Korea. **Academy of Management Journal**, v. 46, n. 6, p. 703–714, 1 dez. 2003.
PS177	KAHAI, S. S.; SOSIK, J. J.; AVOLIO, B. J. Effects of Participative and Directive Leadership in Electronic Groups. **Group & Organization Management**, v. 29, n. 1, p. 67–105, 1 fev. 2004.
PS247	FODOR, E. M.; ROFFE-STEINROTTER, D. Rogerian Leadership Style and Creativity. **Journal of Research in Personality**, v. 32, n. 2, p. 236–242, jun. 1998.

PS263	POLITIS, J. D. Dispersed leadership predictor of the work environment for creativity and productivity. **European Journal of Innovation Management**, v. 8, n. 2, p. 182–204, 2005.
PS267	JANSSEN, O. The joint impact of perceived influence and supervisor supportiveness on employee innovative behaviour. **Journal of Occupational and Organizational Psychology**, v. 78, n. 4, p. 573–579, 10 dez. 2005.
PS270	SOMECH, A. The Effects of Leadership Style and Team Process on Performance and Innovation in Functionally Heterogeneous Teams. **Journal of Management**, v. 32, n. 1, p. 132–157, 1 fev. 2006.
PS273	JASKYTE, K.; KISIELIENE, A. Determinants of Employee Creativity: A Survey of Lithuanian Nonprofit Organizations. **VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations**, v. 17, n. 2, p. 128–136, 25 jul. 2006.
PS300	AMO, B. W. Employee innovation behaviour in health care: the influence from management and colleagues. **International nursing review**, v. 53, n. 3, p. 231–7, set. 2006.
PS304	JONG, J. P. J. DE; HARTOG, D. N. DEN. How leaders influence employees' innovative behaviour. **European Journal of Innovation Management**, v. 10, n. 1, p. 41–64, 2007.
PS307	MOSS, S. A.; RITOSSA, D. A. The Impact of Goal Orientation on the Association between Leadership Style and Follower Performance, Creativity and Work Attitudes. **Leadership**, v. 3, n. 4, p. 433–456, 1 nov. 2007.
PS308	SUBRAMANIAM, I. Determinant of Innovative Behavior in the Workplace: A Case Study of a Malaysian Public Sector Organisation. **American Journal of Social Issues and Humanities**, v. 5, n. 3, p. 96–108, 2012.
PS311	LEE, J. Effects of leadership and leader-member exchange on innovativeness. **Journal of Managerial Psychology**, v. 23, n. 6, p. 670–687, 2008.
PS315	EISENBEISS, S. A; KNIPPENBERG, D. VAN; BOERNER, S. Transformational leadership and team innovation: integrating team climate principles. **The Journal of applied psychology**, v. 93, n. 6, p. 1438–46, nov. 2008.
PS333	GONG, Y.; HUANG, J.-C.; FARH, J.-L. Employee Learning Orientation, Transformational Leadership, and Employee Creativity: The Mediating Role of Employee Creative Self-Efficacy. **Academy of Management Journal**, v. 52, n. 4, p. 765–778, 1 ago. 2009.

PS337	PAULSEN, N. *et al.* Charismatic leadership, change and innovation in an R&D organization. **Journal of Organizational Change Management**, v. 22, n. 5, p. 511–523, 2009.
PS338	RANK, J. *et al.* Leadership predictors of innovation and task performance: Subordinates' self-esteem and self-presentation as moderators. **Journal of Occupational and Organizational Psychology**, v. 82, n. 3, p. 465–489, 24 set. 2009.
PS339	HIRST, G.; DICK, R. VAN; KNIPPENBERG, D. VAN. A social identity perspective on leadership and employee creativity. **Journal of Organizational Behavior**, v. 30, n. 7, p. 963–982, out. 2009.
PS343	WANG, A.; CHENG, B. When does benevolent leadership lead to creativity? The moderating role of creative role identity and job autonomy. **Journal of Organizational Behavior**, v. 31, n. 1, p. 106–121, 9 set. 2009.
PS345	KIM, T.-Y.; HON, A. H. Y.; LEE, D.-R. Proactive Personality and Employee Creativity: The Effects of Job Creativity Requirement and Supervisor Support for Creativity. **Creativity Research Journal**, v. 22, n. 1, p. 37–45, 10 fev. 2010.
PS346	MICHAELIS, B.; STEGMAIER, R.; SONNTAG, K. Shedding light on followers' innovation implementation behavior: The role of transformational leadership, commitment to change, and climate for initiative. **Journal of Managerial Psychology**, v. 25, n. 4, p. 408–429, 2010.
PS349	PIETERSE, A. N. *et al.* Transformational and transactional leadership and innovative behavior: The moderating role of psychological empowerment. **Journal of Organizational Behavior**, v. 31, n. 4, p. 609–623, 20 ago. 2009.
PS355	ZHANG, X.; BARTOL, K. M. Linking Empowering Leadership And Employee Creativity: The Influence Of Psychological Empowerment, Intrinsic Motivation, And Creative Process Engagement. **Academy of Management Journal**, v. 53, n. 1, p. 107–128, 1 fev. 2010.
PS357	WANG, P.; RODE, J. C. Transformational leadership and follower creativity: The moderating effects of identification with leader and organizational climate. **Human Relations**, v. 63, n. 8, p. 1105–1128, 6 maio. 2010.
PS358	HAQ, I. U. *et al.* Mediation role of employee engagement in creative work process on the relationship of transformational leadership and employee creativity. **European Journal of Economics, Finance and Administrative Sciences**, n. 25, p. 94–101, 2010.

PS359	YANG, Y.; WANG, C. Creativity among R&D professional: Supervisory support and personality traits. **Asian Journal of Technology Innovation**, v. 18, n. 1, p. 229–248, jan. 2010.
PS360	WANG, D.; HONG, Y. **Work support and team creativity: The mediating effect of team psychological safety**2010 IEEE 17Th International Conference on Industrial Engineering and Engineering Management. **Anais**...IEEE, out. 2010
PS398	BRUNDIN, E.; PATZELT, H.; SHEPHERD, D. A. Managers' emotional displays and employees' willingness to act entrepreneurially. **Journal of Business Venturing**, v. 23, n. 2, p. 221–243, mar. 2008.
PS415	FLAHERTY, K. E.; PAPPAS, J. M. Control mechanisms, idea transfer, and performance in sales organizations. **Industrial Marketing Management**, v. 41, n. 5, p. 841–848, jul. 2012.
PS428	KHAZANCHI, S.; MASTERSON, S. S. Who and what is fair matters: A multi-foci social exchange model of creativity. **Journal of Organizational Behavior**, v. 32, n. 1, p. 86–106, 22 jan. 2011.
PS431	WANG, P.; ZHU, W. Mediating Role of Creative Identity in the Influence of Transformational Leadership on Creativity: Is There a Multilevel Effect? **Journal of Leadership & Organizational Studies**, v. 18, n. 1, p. 25–39, 18 maio. 2010.
PS440	EISENBEIS, S. A.; BOERNER, S. A Double-edged Sword: Transformational Leadership and Individual Creativity. **British Journal of Management**, p. n/a–n/a, 14 dez. 2011.
PS450	CHEUNG, M. F. Y.; WONG, C.-S. Transformational leadership, leader support, and employee creativity. **Leadership & Organization Development Journal**, v. 32, n. 7, p. 656–672, 2011.
PS451	ISAKSEN, S. G.; AKKERMANS, H. J. Creative Climate: A Leadership Lever for Innovation. **The Journal of Creative Behavior**, v. 45, n. 3, p. 161–187, 22 set. 2011.
PS452	PALANSKI, M. E.; VOGELGESANG, G. R. Virtuous Creativity: The Effects of Leader Behavioural Integrity on Follower Creative Thinking and Risk Taking. **Canadian Journal of Administrative Sciences / Revue Canadienne des Sciences de l'Administration**, v. 28, n. 3, p. 259–269, 19 set. 2011.

PS467	LEE, K. C.; LEE, D. S.; SEO, Y. W. **Effects of shared leadership on team creativity through knowledge-sharing in an e-learning environment**Proceedings of the 5th International Confernece on Ubiquitous Information Management and Communication - ICUIMC '11. **Anais**...New York, New York, USA: ACM Press, 2011
PS468	ALZAWAHREH, A. Transformational Leadership of Superiors and Creativity Level among Faculty Members in Jordanian Universities. **Journal of Institutional Research South East Asia**, v. 9, n. 1, p. 125–132, 2011.
PS469	LIU, J.; LIU, X.; ZENG, X. Does transactional leadership count for team innovativeness?: The moderating role of emotional labor and the mediating role of team efficacy. **Journal of Organizational Change Management**, v. 24, n. 3, p. 282–298, 2011.
PS476	STRICKLAND, S.; TOWLER, A. Correlates of creative behaviour: the role of leadership and personal factors. **Canadian Journal of Administrative Sciences / Revue Canadienne des Sciences de l'Administration**, v. 28, n. 1, p. 41–51, 3 mar. 2011.
PS489	SI, S.; WEI, F. Transformational and transactional leaderships, empowerment climate, and innovation performance: A multilevel analysis in the Chinese context. **European Journal of Work and Organizational Psychology**, v. 21, n. 2, p. 299–320, abr. 2012.
PS504	SCOTT, S. G.; BRUCE, R. A. **Creating innovative behavior among R&D professionals: the moderating effect of leadership on the relationship between problem-solving style and innovation.** Proceedings of 1994 IEEE International Engineering Management Conference - IEMC '94. **Anais**...IEEE, 1994
PS513	HSU, L. A.; HUNG, H. F.; LU, T. C. **Using DEMATEL to explore the interaction effect of team innovation factors**2008 IEEE International Conference on Industrial Engineering and Engineering Management. **Anais**...IEEE, dez. 2008
PS517	SUN, R.; CHEN, G. **Empirical Research on Expectation of Leader, Horizontal Member Exchange, Intrinsic Motivation and Employee Innovation in China**2008 International Seminar on Business and Information Management. **Anais**...IEEE, dez. 2008
PS518	XUAN, W.; JINZHONG, L. **ABC Model of Team Innovation Behavior**2008 International Conference on Information Management, Innovation Management and Industrial Engineering. **Anais**...IEEE, dez. 2008
PS523	HSU, L. A. *et al.* **Prioritizing critical factors of team innovation - the application of grey relational analysis**2009 IEEE International Conference on Industrial Engineering and Engineering Management. **Anais**...IEEE, dez. 2009

PS525	WANG, D.; XUE, H.; XU, J. **The Mechanism of Leadership Styles Affecting Team Innovation in the PRC**2009 International Conference on Management and Service Science. **Anais**...IEEE, set. 2009
PS526	LIN, L. L.-C. **Team psychological empowerment as a mediator of the relationship between transformational leadership, team effectiveness and innovation: Moderating effect of team task interdependence**PICMET '09 - 2009 Portland International Conference on Management of Engineering & Technology. **Anais**...IEEE, ago. 2009
PS527	ZHITAO, X.; JINLONG, Z.; XINMIN, T. **Effect of Justice Climate on Team Member Creativity: The Mediating Role of Leader-Member Exchange**2009 International Conference on Information Management, Innovation Management and Industrial Engineering. **Anais**...IEEE, 2009
PS528	JUN, L. **Two-side charismatic leadership, organizational politics perception, and employee innovation: A mediation model**2010 IEEE International Conference on Advanced Management Science(ICAMS 2010). **Anais**...IEEE, jul. 2010
PS540	SCOTT, S. G.; BRUCE, R. A. DETERMINANTS OF INNOVATIVE BEHAVIOR: A PATH MODEL OF INDIVIDUAL INNOVATION IN THE WORKPLACE. **Academy of Management Journal**, v. 37, n. 3, p. 580–607, 1 jun. 1994.

LIMITATIONS

The limitations of systematic literature reviews are possible bias introduced in the selection process, the quality of primary studies, and inaccuracies on data extraction. To overcome these problems, the selection process was carried by two researches and each step and decisions were recorded in order to promote traceability, as recommended by Kitchenham and Charters (2007). When discordance about a decision happened, the supervisor was contacted to provide advice.

REFERENCES

KITCHENHAM, B. (2007). Guidelines for performing Systematic Literature Reviews in Software Engineering, V 2.3. **EBSE Technical Report**, 2007.

TRAVASSOS, G., BIOLCHINI J. Revisões Sistemáticas Aplicadas a Engenharia de Software. In: XXI SBES - BRAZILIAN SYMPOSIUM ON SOFTWARE ENGINEERING; 2007, João Pessoa. **Anais...** João Pessoa:[s.n], 2007

Appendix C

Analysis process data

This appendix details the constructs that compose the model. For each construct, it was provided a definition and examples of text excerpts that originated it.

Solve problems
Definition The individual desire to solve the problems faced by himself, the client, and the general people.
Text excerpts "*Eu gosto de ver aquilo que eu pensei, que eu sugeri dando certo, resolvendo o problema. Me satisfaz isso. Eu nem penso o lado promocional, isso pra mim é consequência. Promocional, financeiro, isso pra mim é consequência. Me dá prazer em ajudar as pessoas a resolverem o problema delas...*". (C2PATM2) "*...se é um problema que eu vejo e que eu sofro também daquele problema, eu vou correr mais atrás...*" (C2PFTM1)

Acquire new knowledge
Definition The individual favorable, or unfavorable, appraisal about the possibility to acquire useful knowledge.
Text excerpts "*...é sempre bom conhecer coisas novas, aplicar e ver o resultado que aquilo pode proporciona...*" (C2PDTM2) "*Então eu acho esses projetos inovadores, com coisas novas que você não tem muito conhecimento, que você vai ter que correr atrás para aprender e tal, eu acho muito desafiador...*" (C2PFTM1)

Work on the project domain
Definition The extent that the individual like, or dislike, to work with the project technology and/or on the market to which the software is targeted for.

Text excerpts

"*Como era um projeto que era aplicações, eu acho que era uma coisa que eu me identificava mais, eu acho que era mais fácil pra mim surgir ideias e dar um... surgir alguma coisa que melhorasse a atividade, que melhorasse a aplicação. Quando é um projeto que talvez eu não me identifique tanto, talvez seja mais difícil eu ta propondo essas ideias*" (C2PATM3)

"*Pra mim a tecnologia que você está trabalhando também determinada área eu gosto muito da parte de mobile, eu me incentivo muito trabalhando também é uma área que está muito em alta hoje em dia, mas se você me colocar talvez em um projeto tipo Cloud Computing, eu não sei se eu conseguiria ter tantas ideias*" (C2PFTM2)

Group acceptance of innovative behavior

Definition

The individual perception about the group regular agreement to perform, or not to perform, innovative behavior.

Text excerpts

"*Se eu não sentir que tem abertura, eu nunca vou falar*" (C2PBTM2)

"*Às vezes você trabalha com pessoas que são completamente, assim, são muito de não aceitar muito a opinião dos outros. Tem pessoas que têm esse tipo de comportamento, que acham que o seu pensamento é o pensamento mais certo, então e às vezes você tem que saber lidar com esse tipo de pensamento, com pensamento mais fechado. Como é que você vai propor ideia pra um tipo de pessoa que não aceita ideias? É nesse sentido. Ela não tem um cargo de gerência, não é ela que decide, mas é uma pessoa que não aceita as ideias das outras, então você tem que saber lidar com essas situações. Então, você não pode ta propondo muita coisa nova, talvez, com esse tipo de membro na equipe*" (C2PCTM2)

Organization norms about innovative behavior

Definition

The individual perception about the organization expectation to perform, or not to perform, innovative behavior.

Text excerpts

"*ela se vê como uma empresa inovadora, ela propõe, tenta passar isso nos projetos. ... então a importância pra eles de que os funcionários, colaboradores, dêem ideias inovadoras é realmente agregar valor ... porque traz um diferencial pra o cliente... pra eu me sentir à vontade pra propor ideias, acho que o primeiro requisito básico seria um ambiente propício, um ambiente que incentive isso, que esse tipo de ideia, de postura seja incentivado ou que a empresa apoie, que eu acredito que eu tenho aqui, ninguém vai me criticar porque eu fui inovador*" (C2PATM1)

"*eu acho que a [Company B] ela incentiva muito a pratica de se pensar em inovação, de estimular que as pessoas tentem fazer diferente, mesmo que sejam essas coisas pequenas do dia a dia, do seu contexto, da sua atividade, desde a forma que você codifica, a forma que se relaciona na equipe, que você realiza o projeto, quando você pensa em inovação e, sei lá, produto... eu acho que é algo que a [Company B] quer muito*" (C2PGTM3)

Innovative behavior of co-workers
Definition The individual perception about the co-workers innovative behavior.
Text excerpts "*...quando eu voltei eu dei algumas ideias e eu acho que quando as pessoas começam a dar ideias, os outros vão convivendo e ficam mais à vontade pra dar ideias novas também...*" (C2PCTM1) "*...o que mais assim me dá liberdade para ter ideia é ter gente que tenha ideia também...*" (C2PGTM1)

Intra-group conflict
Definition The individual perception about the existence of group conflicts that are detrimental.
Text excerpt "Na minha equipe, quando eu cheguei, existia uma guerra na realidade. Existia uma segregação de dois grupos na equipe, tanto que não se batiam. ... a gente não conseguia propor nada, a gente não conseguia ir para cima, porque sempre 'ah, se fizer isso, vão barrar logo assim. Ah, já tentei fazer isso e nunca deixaram'. E muito que o cara está traumatizado. Então o cara não quer mais apanhar..."

Leader idea acceptance
Definition The individual perception about the leader openness to the individuals' ideas.
Text excerpts "*No dia a dia de trabalho, quando vinha uma ideia ele já ... dava sinal positivo pra continuar*" (C2PDTM5) "*Isso é extremamente desestimulante. Eu já pedi pra sair de um projeto porque o caminho era*

esse. O líder técnico tinha muito espaço, vetava completamente qualquer ação de inovação" (C2PCTM3)

Leader proximity
Definition The leader participation in the individual's routine.
Text excerpts "*eu acho que ele acompanhar bem de perto que você ta fazendo, tentar entender o que você ta fazendo, quando você faz uma proposta, ele tenta entender nos mínimos detalhes, quando ele não sabe, ele mostra que não sabe e que ele ta aberto a ouvir a sua sugestão e no final dizer se isso realmente vale a pena ou não. Eu acho que isso aí incentiva você a ter novas ideias*" (C2PCTM1) "*Eu acho que com [technical leader 1] eu tinha menos abertura do que eu teria com [technical leader 2]. [Porque] com [technical leader 1] eu só tenho contato de trabalho com [technical leader 2] eu tenho mais contato pessoal*".

Creativity encouragement by the organization
Definition The individual's perception about the company encouragement and acceptance of ideas.
Text excerpts *"É uma coisa implícita. Na parte de desenvolvimento, sempre há a discussão: qual a melhor tecnologia? E se a gente utilizar uma nova tecnologia, vamos estudar a melhor alternativa pra isso aqui. Quando se percebe que a melhor tecnologia pra resolver um determinado problema, não é uma coisa trivial, sempre há um espaço pra os colaboradores estudarem, pesquisarem, proporem, às vezes se contrata um consultor de determinada área específica, então o espírito de inovação, de gerar ideias, de propor coisas novas, de aprender coisas novas"* (C2PCTM3) *"...nessas outras empresas não existia isso de o próprio funcionário chegar [e propor idea]... quando eu entrei percebi que ela era bem grande, mas existia aquela acomodação por parte da empresa... então não tava muito preocupada com inovação. Aqui foi mais na [Organization X] e aqui na [Company B], foi bem mais forte isso de chegar e propor alguma coisa*" (C2PDTM5) "*Nas várias vezes que eu tentei fazer isso [em uma empresa anterior], apesar do meu gerente concordar com algumas coisas, parece que a empresa não tava preparada pra ter esse tipo de trabalho mais criativo lá dentro. Quando fugia um pouco do processo, o pessoal parece que já não achava aquilo legal*" (C2PCTM1)

Project phase
Definition A moment in which the project tasks are focused on conception, development or maintenance.
Text excerpts "*as ideias surgem mais na fase de concepção*" (C2PATM1) "*a gente tem uma cultura de ter esse tipo de proposta muito mais no começo do projeto. Que o impacto de mudança pode ser muito grande se você fizesse na metade ou no final*" (C2PHTM2) "*no projeto que eu to, é meio complicado você propor essas ideias, porque é um projeto muito antigo, que já ta rodando vai fazer 4 anos quase e querendo ou não a curva dele fica estável, a curva de coisas novas que a gente tem que fazer fica estável. Hoje em dia, basicamente, a gente ta mais dando manutenção... Acho que a frequência não ta tal alta, não, hoje em dia. Já foi mais*" (C2PDTM4)

Risk Tolerance
Definition The extent to which the project allows experimentation of new approaches that have uncertain returns.
Text excerpts "*com relação a botar a mão na massa, é só se o projeto, de repente, tiver com algum problema e disserem: ["_pessoal, vamos trabalhar numa coisa mais certa aqui, vamos parar de pensar diferente e pensar de maneira conservadora pra fazer o que tem que ser feito"]. Se acontecer isso com o projeto, aí acaba inibindo*" (C2PATM1) "*Também era interessante, porque as pessoas, nesses dois casos, davam mais autonomia, para a proposta de soluções de ideia. E eu acredito que, talvez, era baixo o risco para eles também, porque não era recurso muito caro... Hoje, as empresas estão cada vez mais avessas a gastar dinheiro e tempo com experimentação. Eles querem, primeiro ter certeza, que aquilo vai ter um retorno*" (C2PETM3)

Client openness to ideas
Definition The extent to which the client considers the acceptance of the individual's ideas and does not impose constraints on the individuals' work and solutions.
Text excerpts

"*quem decidia, dava a palavra final era o cliente com relação ao destino do sistema, então a gente tentava, por mais que a gente quisesse fazer de uma forma diferente, o cliente dizia que não, não quer.*" (C2PATM1) "*A gente conseguiu listar uma série de funcionalidades, uma série de coisas que a gente gostaria de ter. A gente levou isso para o cliente, a gente tava levando isso como uma proposta para o cliente. E dentro dessas propostas o cliente foi lá, foi podando, foi dizendo assim "olha a gente quer mais isso.", "dê mais ênfase para aquilo"... Então, tinha espaço para novas oportunidades, o cliente aceitava.*" (C2PHTM3)

Perception of freedom to create
Definition The individual perception about the ease or difficulty of propose and/or implement new ideas.
Text excerpts "*as ideias saíam da gente mesmo, e a gente tinha bem mais reuniões, a equipe era maior, a gente tinha mais abertura pra propor ideia*" (C2PDTM3) "*depende muito do cliente que você tenha essa abertura de chegar e propor ao cliente*" (C2PDTM5)

Individual self-efficacy
Definition The strength of people's convictions in their own effectiveness. (BANDURA, 1977, p. 193)
Text excerpts "*Se você realmente tiver coragem, inclusive esporte fala isso, você tem que ter coragem ... e dizer posso fazer isso, e faz...*" (C2PGTM1) "*...porque eu não tenho mesmo essa mente brilhante de ta propondo coisas, propondo novos produtos...*" (C2PBTM2)

Job experience
Definition The applied knowledge and skills that you learn in doing a particular job.
Text excerpts "*Eu tava pesquisando sobre isso. Ai dentro da própria pesquisa, dentro do material que eu*

tinha disponível da ferramenta ele já falava que a parte de fazer a extração de características era uma parte muito pesada e por isso ela era feito antes e colocada dentro da aplicação... então surgiu a ideia por conta disso. Mas <u>também pela vivencia na área você vê muita coisa semelhante</u>" (C2PHTM1)

"*Realmente antes eu tinha bem menos ideias ... a questão da <u>experiência</u> mesmo, realmente contribuo bem mais hoje do que nas outras empresas. ... acho que é o motivo maior, que normalmente as primeiras empresas <u>eu mais aprendia</u> do que dava sugestão. Mas nesse ponto chegou a um certo <u>nível de conhecimento</u>, hoje eu comecei a participar mais, dar sugestões, dar ideias*" (C2PETM1)

Technical knowledge
Definition The knowledge an individual have about technical aspects in a field of work.
Text excerpts "*quanto mais experiência você tem você tem uma visão maior do mercado, dos produtos, da parte de <u>desenvolvimento</u>. Eu acho que quando você tá começando, a sua visão é um pouco mais restrita na <u>parte técnica</u>, do que você tá vivenciando. Então, quanto mais experiência você tenha, eu imagino que você consiga ver mais coisas*" (C2PCTM1) "*Primeiro descobrir <u>como comunicação</u> corre, como é que isso funciona de fato, como é que eu poderia implementar esse cenário real, e aí eu fui atrás. 'Ah, tu tem que <u>abrir um socket, tu tem que se comunicar com protocolo</u>'... Talvez se eu soubesse só <u>como se comunicar com o servidor</u> não era suficiente. Então eu tive que aprender <u>como se comunica, como funciona a localização</u>, <u>fui aprendendo</u> as coisas e quando eu aprendi aí a ideia veio fácil*" (C2PATM2)

Group members support
Definition The colleagues' approval of the individual's ideas and the assistance provided to improve and implement the ideas.
Text excerpts "*se o colega que for <u>botar a mão na massa comigo</u> também esteja <u>imbuído na causa</u> e houver reconhecimento disso, que é muito bom quando você ta fazendo um trabalho ser reconhecido por isso, né, nem que seja alguém dizendo assim: ["_pô, fulano, você realmente teve aquela postura que eu esperava, você surpreendeu..."], então eu acho que é <u>apoio</u> e oportunidade também, seja dos colaboradores, seja do ambiente*" (C2PATM1) "*com <u>apoio das pessoas certas</u>, procurando também as alianças certas, você não vai se aliar com um cara que não quer nada da vida. Geralmente esse cara ou cresce, ou é escantiado. Então quando você se alia com caras bons, os caras puxam você, estão de acordo com a sua linha de pensamento, fica bem mais fácil*" (C2PGTM1)

Leadership support
Definition The leader assistance provided to improve and implement the ideas. Examples of such support are the help provided to solve a problem, or the support provided to obtain resources to implement an idea.
Text excerpts "*apoio na liderança, saber que a equipe e a liderança tão disposto a ouvir suas ideias e se teria, assim, algum plano pra implementar essas ideias*" (C2PATM3) "*ele era o tipo da pessoa que sentava junto e ia explicar, ia ensinar, ia mostrar como era, então isso dá um estímulo muito grande pra eu estudar cada vez mais, a buscar conhecimento, trazer ideias também*" (C2PDTM5)

Resource Supply
Definition The resources provided by the organization to support the individual's ideas. For example, time to search or to implement an idea, a specific hardware, software.
Text excerpts "*é questão de orçamento, né, ou prazos. Às vezes o pessoal tem a ideia, mas não implementa porque tem um prazo pra cumprir, então ele vai fazer lá o que tá combinado, porque ele tem medo, que se for fazer aquela ideia lá, que pode melhorar,...que isso possa atrasar alguma coisa*" (C2PATM2) "*acho que o CESAR deveria me dar parte do horário que trabalho aqui, ou deveria me auxiliar contratando, alocando pessoas e não simplesmente ficar esperando que eu fizesse nas minhas horas vagas, tem essas coisas também que às vezes não estimulam tanto as pessoas*" (C2PGTM3) "*O que eles propõem aqui digamos assim é pra o cara trabalhar meio que de graça, então o cara vai ter as regalias, que vai conseguir fazer o projeto andar pra frente, pra ter o auxílio de algumas pessoas dentro do [Company B] que a gente sabe que pode ajudar a gente durante o desenvolvimento da ideia, mas no final das contas existe um certo preciosismo até pelo lado da gente que tem a ideia, e a gente no final das contas vai ter a parceria do [Company B], que o [Company B] que vai ter mais de 50% do seu produto final então, existem outras formas mais vantajosas de fazer isso sem a própria empresa. Então a empresa por esse lado a gente acha que ela peca bastante*". (C2PGTM2)

Bureaucracy to perform change
Definition Is the existence of complex, inefficient, or inflexible rules that are imposed by the organization to accept and implement changes.
Text excerpts "*a própria burocracia governamental, impedia a gente de por exemplo, 'ah, tem uma tecnologia nova, vamos colocar? Não. Por que? Porque o governo já pagou não sei quantos milhões com essa tecnologia que está lá faz 5 anos, e ele não quer investir nova. Não pode ser, porque nós investimos nisso aqui, não pode largar isso'. Então você tinha que ter ideias limitadas aquele contexto que você trabalhava*" (C2PGTM1) "*Quando eu trabalhei no projeto [project from other company] eu tive muitas ideias lá e coloquei praticamente todas as ideias que eu tive em prática. Porque lá eu não precisava, para colocar as ideias em prática, e para colocar uma quantidade grande de gente para usar, eu não precisava ter uma burocracia por trás de mim. Eu simplesmente sabia das necessidades da galera, gerava uma solução, distribuía pro povo. E o povo usava. Então era mais fácil*" (C2PHTM3) "*era uma empresa privada, muito com a mentalidade de empresa pública. Resistência muito grande à inovação. Os caras partiam do pressuposto de 'ah, nós temos um processo consolidado, a gente não precisa mexer muito nisso'. Para mexer no processo virava uma escala gigantesca, burocrática, de alguém conseguir adotar um novo modelo de algo, entendeu? Então era muito complicado. Então quando percebi que a coisa era muito burocrática, havia uma resistência muito grande, então eu decidi 'não, eu não vou dividir meu esforço, energia agora nisso não. Eu preciso convencer nessa escala de que era preciso mudar para depois elaborar soluções para os problemas.*"" (C2PHTM3)