

**UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL
ESCOLA DE ENGENHARIA
PROGRAMA DE PÓS-GRADUAÇÃO EM ENGENHARIA DE PRODUÇÃO**

MASTER'S DISSERTATION

**A STUDY OF INNOVATION BARRIERS AND THE
RESULTING STRATEGIC OPTIONS IN THE
BRAZILIAN INDUSTRY**

Mateus José do Rêgo Ferreira Lima

Porto Alegre, 2018

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Mateus José do Rêgo Ferreira Lima

Advisor: Prof. Alejandro Germán Frank, PhD.

Examination board:

Prof. Daniel de Abreu Pereira Uhr, PhD.

Department of Economics / UFPEL

Prof. Marcelo Nogueira Cortimiglia, PhD.

Department of Production Engineering / UFRGS

Prof. Néstor Fabián Ayala, PhD.

Department of Production Engineering / Grenoble Institute of Technology (France)

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Prof. Alejandro Germán Frank, Ph.D.

PPGEP / UFRGS

Advisor

Prof. Flávio Sanson Fogliatto, Ph.D.

Coordinator PPGEP / UFRGS

Examination Board:

Prof. Daniel de Abreu Pereira Uhr, Ph.D.

Department of Economics / UFPEL

Prof. Marcelo Nogueira Cortimiglia, Ph.D.

Department of Production Engineering / UFRGS

Prof. Néstor Fabián Ayala, Ph.D.

Department of Production Engineering / Grenoble Institute of Technology (France)

*“Shoot for the moon, even if you miss, you’ll
land among the stars.” (Les Brown)*

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ABSTRACT

Innovation has been acknowledged as a main driver for competitiveness whether it is for a firm, industry, region or country. Solutions for improvements in products and processes have emerged from the multitude of innovation tools and its techno-scientific features. However, the path traced by firms to innovate is rarely clear and not always successful. In this regard, a variety of uncertainties have been shaped into the obstacles that hinder firm's innovation activities and prevent them to innovate. To the best of our knowledge, there is no literature that directly addresses the obstacles for innovation in Brazil in a broader sense. Also, the articles focused on the strategies of innovation did not investigated its antecedents, characterizing a clear avenue for research. The objective of this study is to understand which innovation barriers affect the Brazilian industry and how they influence the adoption of innovation strategies. In this way, one of the main strategies that stand out in literature is industrial cooperation. Secondly, a discussion that stands out in literature regards the existence of two juxtaposed strategies, known as *Market-orientation* and *Technology-acquisition*. This work combined with an exploration of the current state of industrial innovation studies in Brazil through a systematic review. Also, we combined multiple methods to quantitatively analyze the relationship among variables of the Brazilian innovation survey (PINTEC). The main results of this dissertation are: (i) the systematization of the industrial innovation literature in Brazil and the proposition of a research agenda; (ii) the assessment of which innovation barriers trigger or which affect industrial cooperation for R&D; (iii) the exploration of the innovation barriers' role on the choice of firms to adopt either *Market-orientation* or *Technology-acquisition* as innovation strategies. From an academic perspective, this study contributes to clarify future avenues of research on industrial innovation in Brazil and to provide insights about the role of innovation barriers in the Brazilian industry. From a practical point of view, this manuscript presents a map of findings so as industries can use in a strategic way. Also, we bring insights on how innovation strategies should be adopted in relation to innovation barriers.

Keywords: Industrial innovation, innovation barriers, innovation strategies, emerging countries.

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1 INTRODUCTION

Innovation is a topic of discussion largely recognized as a key driver of welfare and competitiveness for countries (Tourigny and Le, 2004; Hölzl and Janger, 2014; Santos et al, 2014; Watkins et al., 2015). Several areas have focused on the development of research on this topic. For instance, we may cite business management, engineering, political and social sciences and public administration (Godói-de-Sousa I and Valadão Junior, 2010; Cavalcante e Camões, 2016; Alves et al., 2017). For the industry, the tools and techno-scientific features of innovation have supported the development of new products as well and enhancements in both products and processes.

In Brazil, both industrial and academic community have contributed with case studies, theoretical works and empirical evidences. Nevertheless, there is a need to congregate these research and understand how they pinpoint weaknesses and strategies for the development of industrial innovation in Brazil.

Although innovation has been treated as a motor for competitiveness, the path traced by industry to innovate is susceptible to uncertainties. These uncertainties assume the form of obstacles when they affect industries and hinder their innovation activities (Ferriani et al., 2008; Madrid-Guijarro et al., 2009; D'este et al., 2012; Leoncini, 2016). Whether these obstacles inhibit firms to fully exploit their innovative potential depend upon how the industry and public policies solve them.

In this sense, one of the alternatives that emerged as a response for a constrained innovation scenario is the strategy of cooperation (Luzzini et al., 2015; Robin and Schubert, 2013; Lewandowska et al., 2016). Such orientation may be adapted to the objectives of each situation. For instance, alliances may be formed to share financial risks and R&D costs (Kale and Singh, 2007; Sheth and Parvatiyar, 1992; Stanek, 2004) or to increment internal knowledge (Gudergan et al., 2012, Tsou et al., 2016). However, due to the multitude of characteristics inherent to each innovation barrier (Blanchard, 2013), it is unclear which tend to trigger firms towards cooperation.

Furthermore, we investigate the relationship between the innovation barriers and the innovation path traced by firms. We approach the two most prominent innovation strategies for the Brazilian industry, known as *Market-orientation* and *Technology-acquisition* (Goedhuys and Veugelers, 2012; Frank et al., 2016). In short, *Market-orientation* stands for the firm's own capacity to innovate, by focusing on internal R&D

and product launching efforts (Tsai et al., 2008; Frank et al., 2016). On the other hand, the *Technology-acquisition* option means the obtaining of technological capabilities by external means (Zuniga and Crespi, 2013; Frank et al., 2016; Ahuja and Katila, 2001; Tsai et al., 2008; Tsai et al., 2011; Jones et al., 2001).

We highlight in our work that there is a fertile field for studies about innovation obstacles. Although there are articles discussing innovation strategies and their influence to innovation outcomes, there is no study approaching their influence for adoption of innovation strategies. This study proposes to offer a broader understanding about innovation barriers and its on innovation strategies adoption. In this regard, we aim to answer the following research question: *What is the role of innovation barriers as triggers to industrial innovation strategies adoption?*

1.1 THEME AND OBJECTIVES

This dissertation comprehends a study about the industrial innovation in Brazil. The general objective of this study is to explore the role of innovation obstacles to the adoption of innovation strategies. The study offers a map of findings for future research regarding industrial innovation in Brazil. Also, the research presents result of a quantitative analysis based on secondary data from the Brazilian innovation survey (PINTEC-2014).

In order to achieve the general objective, the following specific objectives are proposed:

- a) Synthesize and present empirical findings about industrial innovation in Brazil covering the period from 2008 to 2018;
- b) Examine which innovation barriers trigger or which affect industrial cooperation for R&D;
- c) Explore the role of innovation barriers on the choice of firms to adopt either ‘Market-orientation’ or ‘Technology-acquisition’ as innovation strategies.

1.2 JUSTIFICATION OF THE THEME AND OBJECTIVES

The strategic orientation that a firm is one of the most important aspects of its innovation system (Keith Pavitt, 1984; Dosi, 1989). Its understanding allows the

identification of the context in which the industry is inserted, the weaknesses of its innovation system and how these downsides could be undermined in order to generate more stable scenarios. Therefore, it is essential to comprehend what lead firms to construct its process.

Among the many elements that contribute to the strategic formation of firms towards innovation, an important one is related to its barriers. According to Hadjmanolis (1999) and D'este et al. (2012) these obstacles may either fully inhibit firms to innovate, a phenomenon called failure without learning, or appear during the innovation process. While the former type does not allow firms to innovate, the latter presents itself constantly during the innovation process.

Although these obstacles are constantly present in the innovation path of industries, few works have addressed them. This feature fundament the necessity of a study such as the one presented here. This dissertation enriches the understanding of innovation barriers in two different ways. Firstly, it provides a review of the the most cited papers regarding this theme which, notably, are few. Secondly, it brings empirical evidence from the Brazilian context, using aggregated data that covers approximately 40.000 industrial businesses in the country.

We approach the influence of innovation barriers for the adoption of innovation strategies in two different ways. In the first one, we examined which barriers trigger the adoption of cooperation as an industrial strategy. We bieleve this analysis is important, since cooperation has been classified as a relevante strategy for innovation in industries. Secondly, we addressed which barriers motivated the adoption of the two most prominent Brazilian strategies to innovation (Goedhuys and Veugeler, 2012; Frank et al., 2016). Both approaches cover crucial aspects of strategic innovation in Brazil. Furthermore, this dissertation presents a research agenda for future research in industrial innovation in Brazil. There is a lack of research providing an integration of the studies about innovation in Brazil, which justifies the need for this work.

This dissertation aims to shed light on aspects not previously approached by previous studies. The contributions of this work intend to serve both industrial and academic communities to a better understanding of both strategies and needs of industrial innovation in Brazil.

1.3 RESEARCH DESIGN

In this topic we bring details about the research methods applied. These methods aimed to achieve the general and specific objectives described in the subsection 1.1.

1.3.1 Research method

The nature of research method applied falls into the category of applied research, since it seeks to offer a solution for a specific issue. The issue analyzed here is related to the innovation barriers. Therefore, this research aims to shed light on how innovation barriers influence the adoption of innovation strategies. Also, it may be useful for a comprehension regarding what strategic actions are taken so as innovation barriers can be surmounted. This knowledge may be applied in future research on the topic. Furthermore, the research approach is both qualitative and quantitative. In the qualitative part it was used previous research to build a literature review about the Brazilian industrial innovation. Secondly, the quantitative approach used data from the Brazilian innovation survey (PINTEC) to examine the relationships among innovation barriers and innovation strategies.

In accordance to Gil (2007), the objectives of a research can be classified in three different ways: exploratory, descriptive and explanatory:

- The exploratory research promotes greater familiarity with the problem under analysis. The main objective of the explanatory research is to make the problem more explicit for the construction of hypotheses (Gil, 2007).
- The descriptive type of research intends to describe facts and phenomena associated to a certain reality (Triviños, 1987).
- The explanatory analysis is concerned to identifying the factors that determine or contribute to the occurrence of the phenomena (Gil, 2007).

Hence, the general objective of this research is classified as explanatory, since it aims to understand real aspects of an innovation system. However, this research is complementarily composed by an exploratory research, since it uses a systematic review of the literature to generate a deeper understanding on the topic (Gil, 2007). In synthesis, this research uses both bibliographic and experimental research to contemplate the objectives proposed in 1.1.

1.3.2 Work method

The development of this dissertation was divided in three different stages. Each stage comprehends an article whose main objective is associated to one of the objectives of this research. The structure of the dissertation is presented in Figure 1.

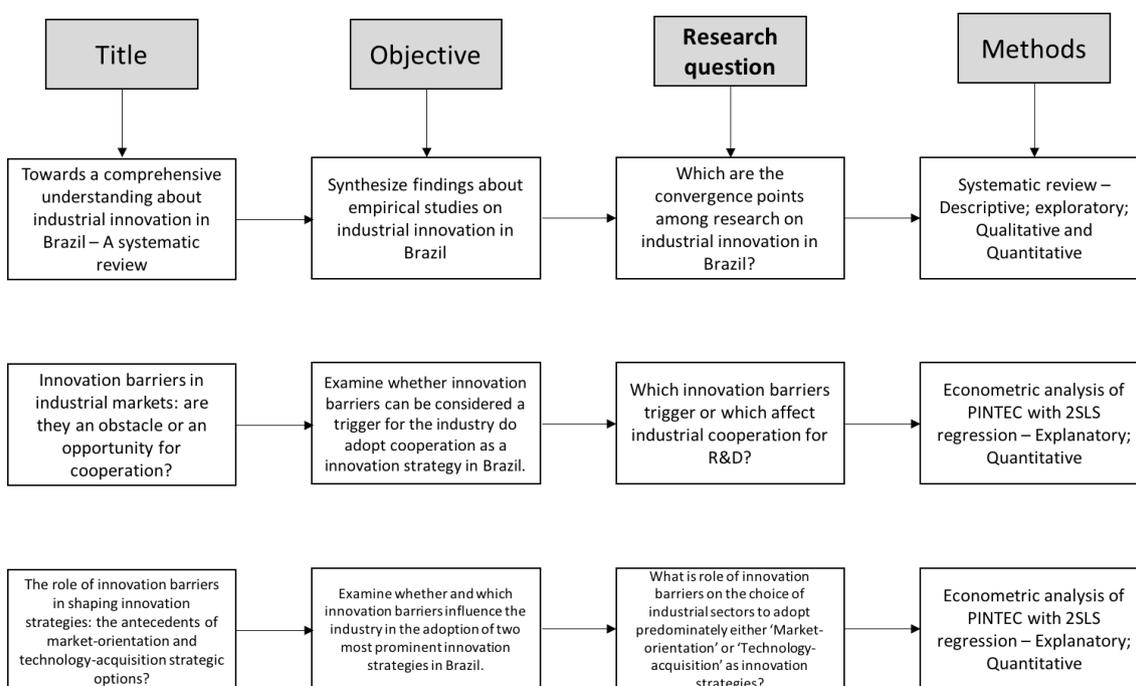


Figure 1 – Stages of the dissertation

The first article – “Towards a comprehensive understanding about industrial innovation in Brazil – A systematic review” aims to reach a general understanding regarding the studies in industrial innovation in Brazil. The results of this study was used to promote insights for the following stages of the dissertation.

The second article – “Innovation barriers in industrial markets: are they an obstacle or an opportunity for cooperation?” investigated the role of innovation barriers as triggers for the adoption of cooperation strategy. The objective of this articles is to asses whether and which innovation barriers can be considered antecedents for industrial cooperation in Brazil.

The third article – “The role of innovation barriers in shaping innovation strategies: The antecedents of market-orientation and technology-acquisition options” analyzed the formation of the two most adopted innovation strategies in Brazil from the perspective of the innovation barriers. Therefore, the objective of this article is to explore whether and which innovation barriers can be considered antecedents to the formation of innovation strategies in Brazil.

Both second and third articles used empirical evidenced from the most recent report of the Brazilian innovation survey (PINTEC – 2014). Econometric analysis was conducted in both studies. In the second article, an econometric model based on the use of two stage least square regression (2SLS) was applied. In the third article, it was used the Generalized Method of Moments (GMM) with the Continuously Updated Estimator (CUE).

1.4 STUDY BOUNDARIES

Innovation can be studied from different perspectives. For the purpose of this research, however, this dissertation aims to approach innovation from an industrial perspective.

The purpose of the first article is to provide an overview of the studies about industrial innovation in Brazil. The second and third articles, in turn, aim to conduct quantitative analysis regarding the innovation barriers and its influence to the innovation activities in Brazil.

This extension of this dissertation faces certain limitations. Some of them that are worth to point out:

We focus on articles published by journals and empirical evidences to conduct our literature review. Therefore, we excluded any type of publication that felt in the categories of expert´s opinion and consultancy reports.

Our econometric analysis used cross-sectional data from the latest report of the Brazilian innovation survey (PINTEC-2014). Other ways to asses the same variables that were used here is to conduct longitudinal analysis. Perhaps, this type of approach may bring more comprehensive results.

Particular nuances among variables could have been studied. For instance, cooperation could have been addressed in terms of its particular actors: govern, universities, other firms, to mention a few.

These boundaries mentioned can be used as a starting point for future research.

1.5 DISSERTATION STRUCTURE

This dissertation is organized in five chapters, including the one presented here. The first chapter discussed the research problem, the objectives and their respective justifications. Furthermore, it was also presented the research methods, the research

boundaries and the structure of the dissertation. Chapters 2, 3 and 4 present the first, second and third articles, respectively. Finally, the fifth and last chapter is dedicated to discussions and conclusions, focusing on the summary of the general objectives and future research propositions.

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As páginas 17 até 116 são correspondentes aos Artigos 1, 2 e 3 da dissertação, que não podem ser publicados na biblioteca por estarem em processo de avaliação em periódicos que requerem artigos inéditos.

2 CONCLUDING REMARKS

The objective of this section is to discuss the proposal of the dissertation, synthesize the contributions in both industrial and academic fields and present avenues for future research.

2.1 FINAL DISCUSSION ON THE DISSERTATION PROPOSAL

Innovation has been calling attention of many scholars in the last decades. As seen throughout this dissertation, its role has been acknowledged to be fundamental for industry growth. However, in emerging economies, the studies around the topic are still maturing. In this dissertation we found several gaps in research are still opened, urging for contributions from both academia and industry. In this regard, we focused on one of the research avenues we identified from literature: innovation barriers.

This study presents a comprehensive insight about the different obstacles that inhibit industrial sectors from innovating in Brazil. Furthermore, this study also contributes for the analysis of these obstacles as antecedents for the adoption of innovation strategies. Therefore, we firstly focused our investigation around industrial cooperation, since this strategy has been extensively pointed out as important for innovation (Luzzini et al., 2015; Robin and Schubert, 2013; Lewandowska et al., 2016). Secondly, we analyzed the two most common Brazilian innovation activities: Market-orientation and Technology-acquisition (Goedhuys and Veugelers, 2012; Frank et al., 2016).

The first article contributed with a systematic literature review. Through this work, it was possible to identify the weaknesses of the Brazilian industrial innovation system, which served as basis for the conduction of the two following studies. The second article addressed the role of innovation barriers as triggers for the adoption of industrial cooperation in Brazil. Finally, the third article focused on the study of innovation barriers as antecedents of innovation strategies in Brazil.

2.2 ACADEMIC CONTRIBUTIONS

The three manuscripts present individual contributions which are, in turn, integrated in the general scope of this dissertation. The first article contributes with a research agenda. This was drawn based on the weaknesses and needs of the Brazilian industrial

innovation system identified on the systematic review. These results allow future academics to explore key areas of industrial innovation in the country. Moreover, it contributes to the understanding about the state of the art of industrial innovation studies in Brazil.

The second article promoted insights in line with previous research, since it identified significant relations between certain innovation barriers and cooperation. It was found that some barriers lead industrial sectors to cooperate. The results may shed light on the role of cooperation as an alternative to circumvent obstacles. These findings corroborate cooperation as substantial for innovation in industries. This may allow academics to explore the role and contribution of specific partners for the innovation process. Opositelly, it also shed light on the conservative behavior of the Brazilian industry, where certain obstacles, acutally, discourage cooperation.

Finally, based on previous findings of Goedhuys and Veugelers (2012) and Frank et al. (2016) the third article assess whether or not innovation barriers can be considered antecedents of these juxtaposed options. Again, the econometric analysis proved that innovation barriers exert a contribution for the strategic choice of the industry. These strategies, however, are not implemented in a combined way. Instead, they are chosen juxtaposedly. Therefore, these insights should encourage future research to understand and explore better alternatives to circumvent obstacles. Perhaps, by exploring these strategies in combination (Tsai and Wang, 2007; Tsai et al., 2008; Tsai et al., 2011).

2.3 PRACTICAL CONTRIBUTIONS

In light of the results found, the present dissertation brings different contributions for practitioners. The first article presents more theoretical aspects of innovation. Even though, it is useful for practitioners as a map of findings. Hence, based on the identification of their own needs, practitioners can use these findings to promote better practices. Furthermore, the 2º and 3º articles highlight strategic aspects that industries must be aware of for a better implementation of their innovation activities.

More specifically, the 2º article may encourage practitioners to investigate how cooperation can be implemented more effectively. Since this article identified that certain barriers are triggers for cooperation, industries should be encouraged to foment cooperation. The 3º article, in turn, may support practitioners in what regards the development of innovation activities. In this sense, this study may delineate insights

about ‘Why’ certain industrial innovation strategies are adopted and ‘How’ they should be.

2.4 FUTURE RESEARCH AVENUES

Based on the results here presented, it is worth to point out that different opportunities for future research. Article 1 brings several opportunities, which are synthesized on a table in the conclusions section. Also, articles 2 and 3 present important insights for future research, although more specific.

In what regards article 1 suggestions, I recommend to revisit the conclusions section for a more detailed orientation. However, it is worth to discuss here about future research that emerged from the conclusions in the 2° and 3° articles. In this sense, article 2 analyzed cooperation in its general comprehension, not differentiation, therefore, the strategy among specific partners. Hence, future research could explore in more details the contributions of each partner for industrial innovation. The 3° article approached the two most common innovation strategies in Brazil, corroborating the juxtaposition of its adoption. However, we did not considered similarities among industrial sectors. This can be done in future research using, for instance, cluster analysis.

Secondly, in what tangles the methodology we used, it is worth to highlight its limitations. Firstly, the econometric approach was conducted through cross section analysis. Further research, in turn, could use longitudinal analysis to draw more accurate conclusions. Since innovation is a dynamic phenomenon, an analysis over a longer period would benefit the understanding of these research (Pavitt, 1984; Castellacci, 2008). Secondly, our data was aggregated, which blocks a firm-level understanding. Therefore, researchers could investigate this level of analysis with the same conceptual variable set.

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