LISBON
SCHOOL OF
ECONOMICS &
MANAGEMENT
UNIVERSIDADE DE LISBOA

MASTER OF SCIENCE IN
MANAGEMENT AND INDUSTRIAL STRATEGY

MASTERS FINAL WORK

DISSERTATION

HOW COLLABORATION CAN LEAD TO INNOVATION:
AN EXPLORATORY STUDY OF PORTUGUESE STARTUPS

ROBERTA CARINA VENTURA COSTA VITTIGLIO

OCTOBER - 2017

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SUPERVISOR:

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ABSTRACT

The literature recognizes that innovation comes, in part, from the collaboration between different entities in the markets. Likewise, it has been strongly studied that startups have obstacles limiting their growth and that can lead to their lack of success. Further, technological startups have increased limitations since they must keep developing their technological know-how. In this sense, to grow the likelihood of success and increase the innovation in the long run, the literature suggests that startups should increase collaboration with other entities. However, in the Portuguese literature, the relationship between the startups' collaboration with other entities and the innovation that may result has not been well established.

First, the present study intends to analyze the different entities that collaborate with Portuguese Technological Startups and identify the resulting Innovation. Second, is intended to understand the difference between the cooperation links startups - big companies and the links with universities, SMEs (Small and Medium Enterprises), research centers, specialized suppliers, and distributors. Further, it is intended to identify their main barriers to innovation. To analyze and explore the possible interactions between the concepts, 66 responses given by startups were used, collected through an online questionnaire, sent by email. The results show that there may be an association between *Product Innovation - SMEs*, *Organizational Innovation - Big Companies*, *Marketing Innovation – Universities* and *SMEs*. There is a future tendency for respondents to increase collaboration with the different entities and especially with *Big Companies*, as suggested by the literature. Likewise, it can be concluded that respondents have strong financial constrains limiting their innovation.

Keywords: Collaboration, Innovation, Portuguese Startups, Technology.

RESUMO

A literatura reconhece que a inovação resulta, em parte, da colaboração entre diferentes entidades presentes nos mercados. Igualmente, têm sido estudados os obstáculos que limitam o crescimento e que podem levar ao insucesso das startups. No caso particular das startups tecnológicas, é necessário aumentar continuamente a sua base de *know-how*. Nesse sentido, para aumentar a probabilidade de sucesso e aumentar a inovação no longo prazo, a literatura sugere que as startups procurem colaborar com outras entidades. No entanto, na literatura portuguesa, ainda não foi estabelecida de forma clara a relação entre a colaboração das startups e a inovação que desta pode resultar.

Primeiramente, a presente investigação pretende explorar as diferentes entidades que colaboram com as Startups Tecnológicas Portuguesas e identificar a inovação resultante. Posteriormente, procura-se perceber a diferença entre a ligação de cooperação startups - grandes empresas e as ligações com universidades, PMEs (Pequenas e Médias Empresas), centros de investigação, fornecedores especializados e distribuidores. Adicionalmente, pretende-se identificar as principais barreiras à inovação para as startups. Por forma a explorar as possíveis interações entre os conceitos, foram utilizadas 66 respostas fornecidas por startups, recolhidas através de um questionário *online*, enviado por *email*. Os resultados demonstraram que poderá existir uma associação entre *Inovação de Produto - PMEs*, *Inovação Organizacional - Grandes Empresas*, *Inovação de Marketing - Universidades* e *PMEs*. Observou-se uma tendência futura por parte dos respondentes em aumentar a colaboração com diferentes entidades e, em particular, com as *Grandes Empresas*, conforme sugerido pela literatura. Por fim, conclui-se que a principal limitação à inovação passa por restrições financeiras.

Palavras-Chave: Colaboração, Inovação, Startups Portuguesas, Tecnologia.

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LIST OF ACRONYMS AND ABBREVIATIONS

HR – Human Resources

ICT – Information and Communication Technologies

IT – Information Technologies

R&D – Research and Development

SMEs – Small and Medium Enterprises

SPSS – *Statistical Package for Social Science*

1. INTRODUCTION

Freeman and Soete (1997) argue that more than 60% of world economic growth is due to technological advances. These were in part possible through the activity of the startups founded so far. SMEs had relevant contributions in the innovation processes and technological disruption of markets. The authors state that different studies in the field of innovation have sought to identify the key factors that contribute to the success and sustainability of organizations. There can be concluded two common factors in all the studies performed. On the one hand, the motivation and commitment of key individuals in organizations towards innovation. On the other hand, the attention of these individuals to key activities, such as market orientation, good internal communication and an innovative strategy. Further, Beaver and Prince (2002, in Rothwell, 1988) report that radical innovation has been found mainly in big companies and research centers. Nevertheless, the authors consider also SMEs as the main agents responsible for the near-market developments and their initial diffusion.

According to Schumpeter (1934), innovation can be described by five different situations: creation of new products, methods of production, finding new sources of supply, exploration of new markets and creating new forms of business organization. In the other hand, Walker et al (2015), innovation is defined as the introduction of a new product, service or process in the external market or system, program or practice in an internal unit. Organizations can generate innovation and simultaneously adopt it from the outside environment. Accordingly, the generation of innovation is an internal process that results in a new product, service, technology or practice that is used by the company itself or supplied to the market. In contrast, the adoption of innovation from abroad encompasses all processes of acquisition and use of technologies, products, policies or practices that differ from those inside the company. The innovation is observed by the

adoption of a new program throughout the activities or operations and results from the contribute of different actors.

Cui et al (2009) mention that there is a growing tendency to externalize part of the innovation activities of the products/services. Factors such as the increasing complexity of technologies and risks associated with their use, the increasingly rapid emergence of radical technologies and global markets have influenced the outsourcing of value chain activities of organizations. According to the authors, in the last ten years, studies have shown an increase in R&D costs and it has been observed that about 45% of innovation efforts (e.g. accessing new knowledge/technologies) were external to the organizations.

Kilubi (2015) states that creating network relationships in organizations' innovation processes is critical to their long-term success. The collaboration mitigates the uncertainty and risk arising from, for example, the globalization of business, acceleration of product launches and changes in customer expectations. Collaboration between organizations facing rapid technological change as technological startups is increasingly relevant in order to improve their position in the markets. Thus, the author refers that partnerships are critical to business innovation in situations where they do not have sufficient internal R&D resources.

Regarding the survival and success of startups, Informa D&B (2016) states that the early years of development are especially relevant. The data collected on entrepreneurship showed that 67% of startups survive the 1st year of activity, 52% survive by the end of the 3rd year, but only 41% survive after the 5th year of activity. Blank (2013) states that globally 75% of startups are not successful, regardless of industry. According to the author, it is fundamental to adopt an open strategy that, among other things, encourages the use of a cooperative approach with other organizations. Thus, it becomes crucial to

understand which strategies lead to the increased probability of success of startups in their early years of activity.

The present theme is part of Innovation, Technology and Strategic Management and aims to analyze which are the different cooperation links used by Portuguese startups with focus on the weight of the collaboration with large companies. In addition, this investigation emphasizes the main barriers of innovation for Portuguese startups. Neither the Portuguese or international studies about startups cooperation are focused in identifying the weight of each collaborative link or how they can enhance innovation. Therefore, the present work adds information about the existence of different cooperation links between startups and other entities and if those are related to the startups innovation. Additionally, increases knowledge regarding the collaborative behavior of Portuguese startups and their innovation barriers. The main results reached in this investigation led to the conclusion that Universities, SMEs and Big Companies are the most chosen collaborative partners, and that there is a future focus in increasing the collaboration between all collaboration links studied. Additionally, there were statistical evidences of an association between *Product Innovation - SMEs*, *Organizational Innovation - Big Companies*, *Marketing Innovation – Universities* and *SMEs*. At last, it was possible to conclude.

This dissertation is divided in five chapters. This first part introduced the theme and identified the objectives of the study. The next chapter presents the literature review, conceptual model used and identifies the research questions. Then, the methodology is identified along with a description of sample selection, elaboration of the survey, follow-up process and the definition of concepts. The analysis and discussion of results are carried out in the 4th chapter. Finally, the last chapter presents the conclusions and limitations of the study and brings suggestions for further research on this matter.

2. LITERATURE REVIEW

1. The Innovation concept

The innovation concept has been widely studied in the literature. In addition to Schumpeter's previous definition, Drucker (1985) affirms that innovation is a set of processes that aim to improve new capacities or to increase the utilization of existing capabilities in an organization. According to Woschke and Haase (2016), the creation of new alliances, cooperation agreements, new forms of customer relationships or integration of suppliers are considered as examples of external innovation of companies. Due to the exploratory nature of this study, it is important to use a widely-studied definition of the innovation concept and innovation results. Thus, this study is based on OECD (2005) and the authors defend the concept of innovation as the creation of new possibilities through the recombining of knowledge, with results in products, processes, in marketing strategies and new routines at the organizational level.

Regarding the first category, product innovation is considered when there is introduction of a new or significantly improved good/service over its previous features/usability. Changes include improvements in technical specifications, components and materials used, usability and functional features. Product innovations can be driven mainly by technological advances, but also by changes in the customer needs, shortening the product lifecycle, and increased competition. The second category, process innovation, is considered when there is a new method of production, transportation or significant improvements of the method initially used. This includes technical changes, new equipment and/or software. This type of innovation can help minimize production/transportation unit costs, increase quality and produce new or improved products (OECD, 2005).

OECD (2005) argues that marketing innovation involves significant changes in product design or packaging, product exposure, promotion, or price. Marketing innovations can be used to better satisfy customers' needs, create new markets or position products better in the same market to increase their sales. Thus, this kind of innovation relates to pricing strategies, packaging design and promotion activities along the four marketing P's (Product, Place, Price and Promotion). Finally, organizational innovation can be defined as the implementation of a new organizational method in the work practices of the company, organization of the workplace or finding new techniques to build external relationships. This kind of innovation can lead to an increase in business performance due to the reduction of administrative costs and enables the improvement of productivity, access intangible know-how or decrease supply costs. When thinking of innovation as the process of transforming know-how and capabilities into commercial value, innovation becomes crucial for organizations. In this sense, launching innovations into the markets can lead to increases of the efficiency and profitability of companies.

2. Big Companies vs Startups: Main similarities and differences

Serra et al (2008) refer that, in the initial perspective of Schumpeter, SMEs were considered the common vehicles for the technological advances and, thus, economic development of the countries. It later stated that large companies, although few, had sufficient financial, physical and human resources (HR) to dedicate a greater part of their efforts to R&D activities. As large companies had the advantage of scale, Schumpeter came to consider that large companies were more likely to bring about innovations. Nevertheless, the opinion on this matter is constantly changing and there's no certainty of what kind of company has the capability of bringing more innovation to the markets.

According to Schilling (2013), big companies have access to high quantity of resources and so invest heavily in R&D. Because of this, established companies can have

multiple advantages as, for example, their size. Comparing them to SMEs, they can reach economies of scale and learning curves in less time. Furthermore, they can become better and more efficient in the long-term. By investing in R&D, big companies develop skills by new product development processes and thereby improve their own processes. Additionally, it is possible for them to acquire new equipment, recruit new qualified employees and, due to long-term learning, more easily select projects that relate to the company's capabilities and are more likely to succeed. Nevertheless, as companies grow, their R&D efficiency can decrease due to loss or limited organizational control. Thus, the bigger the company, the more difficult can the monitoring, motivating, encouragement and individual innovation processes be carried out. Additionally, companies may be less innovative because their size reduces their agility and increases their sensitivity to market changes.

Unlike the former, Schilling (2013) considers SMEs as more flexible and entrepreneurial. These are not compromised by bureaucratic aspects, large fixed assets bases or strategic commitments with a large number of employees, customers and suppliers. The monitoring, motivating, encouragement and individual innovation processes themselves are facilitated. However, accordingly to Beaver and Prince (2002), it’s initial presence on the market is reduced which requires more flexibility and adaptation to keep up with the changes. Additionally, due to resource constraints, SMEs must carefully select new projects and, since they can’t accept all projects, they may relinquish possible success opportunities. On the other hand, Schilling (2013) the extreme attention when selecting new projects in accordance with these organizations’ dynamic capabilities can lead to higher success rates compared to larger companies.

In both cases, organizations have limitations attached to the resources and skills they have for their long-term growth. Fabrício et al (2015) state that no organization or

institution can achieve competitive advantage in developing technologies through the accumulation of isolated experience. Innovation is achieved through a collaborative environment where there is rapid dissemination and transmission of knowledge. Thus, in order to innovate continuously, it is essential for companies to focus on sharing and recombining knowledge and resources.

Beaver and Prince (2002) conclude that cooperation between established firms and startups can be seen as a win-win outcome in the *game theory*. The benefits created for both parties lead to an increasing investment by companies in cooperation strategies. Both parties benefit from the relationship because, on the one hand, startups tend to disrupt innovation, have a less hierarchical organizational structure and a direction for business growth. They provide companies with means of learning, business agility, new talent and technological capabilities. On the other hand, big companies provide infrastructures, brand, market positioning, consolidated relationships and quality in internal processes, which are an asset to enter the markets. The authors conclude that the successful promotion of innovations depends on the availability of complementary assets, which in turn depends on the ability of startups to collaborate with other entities and to assimilate their know-how.

3. Startups Collaboration Links

From the perspective of Cui et al (2009), there are five key entities in business networks, which can be external sources of innovation in a cooperative environment, when studying startups growth. Table 1 lists the different entities, the areas where the know-how to collaborate is more relevant for startups, the stages where each entity has the resources and skills to innovate, the main motivations for cooperation and their respective strengths and weaknesses. However, for this study, the Customers entity referred by the authors in the original table was excluded.

Table 1 - Strengths and Weaknesses of Innovation Providers by Type. Source: Adaptation of Cui et al (2009).

Type	Key Areas of Usefulness	Innovation Stage	Main Outsourcing Motivation	Strengths	Weaknesses
Universities	General theory framework, prototyping.	Raw ideas, early product development.	Tech knowledge, cost.	Access to novel ideas and features, low cost.	Often little market knowledge.
Suppliers	Components, process innovation.	Usually mature technologies or novel components.	Production or tech knowledge, cost.	Familiarity with Firms' systems, expertise in related problems, efficiency.	Lack of novel ideas, might create dependence.
Competitors	Product benchmarking.	Both precompetitive and mature technologies.	Strategic, market access, cost.	Knowledge of current market and technologies.	Competitive threat, ownership conflicts.
Startups	New product concepts, patented technologies.	Emphasis on embryonic technologies.	Tech knowledge, organizational learning, cost.	Source of creativity and disruptive innovations.	High market risk, commercialization gap, potential competitor.

Accordantly to Segarra-Blasco and Arauzo-Carod (2008) the case of cooperation with universities is important because of their research potential and study group diversity. Within the university community, there are formal and informal relations between the university and other scientific institutions, companies and individual researchers. Thus, scientific knowledge is shared, completed and applied in different contexts and situation, and can be used by all parties. In the context of technological industries, innovative firms are those that seek sources of external technological innovation by cooperating with other organizations. Cooperation with universities can be valuable for companies as they are sources of scientific knowledge and allow companies access to state-of-the-art or sophisticated technologies that, in a market acquisition situation, would require high financial investments.

According to Walter (2013) suppliers can contribute to innovation and technological development of companies. For example, joint product development projects are conducted and provide innovative components or new technologies.

Suppliers have detailed knowledge about customers' products/services and processes, especially in long-term relationships, that allow companies to access complementary know-how. In addition, the fact that suppliers have specific knowledge of the processes and products/services makes them easier to solve operational emergencies, accelerate processes and lower operation costs. Thus, the involvement of suppliers leads to an improvement in the performance of new product development processes. However, accordingly to the authors, the creation of this type of relationships is limited by two factors. On one hand, suppliers must have the necessary capabilities to carry out the joint projects, which in turn are acquired through the experience of cooperating (Luzzini et al, 2015). In the other hand, Christiansen and Maltz (2002) point out that suppliers have been decreasing their flexibility in adapting orders placed by customers and increasing their bargaining and buying power. This is due to the increased relocation of operations, concentration of markets and interest of companies seeking to cooperate with shared suppliers, creating a demand pressure.

According to Gnyawali and Park (2011) more than 50% of cooperative relations between companies refer to competitors in the same coopetitive industry. Thus, the cooperation-competition paradox between competing organizations has been targeted largely for analysis. This phenomenon is defined as coopetition. Bengtsson and Kock (2014) argue that this change was mainly due to the shift from a logic of internal resources to a logic based on the ability to integrate external resources through business networks. The authors point out that the cooperation between companies and startups affects the innovation performance of products/services of companies. The study concludes that these relationships promote innovation and the transfer of technological capabilities between parties.

Gnyawali and Park (2011) refer to the emergence of factors that have encouraged cooperation between competing technological companies. One example of this phenomenon is the shortening of the product life cycle, i.e. the need to launch new products/innovate quickly. On the other hand, there is an increase in the need for investment in R&D, which is necessary to maintain the advantageous position. In addition, there is a convergence/dependence on multiple technologies, that is, the tendency to use a single technological infrastructure and change in the standard technologies of the industry that require companies to update resources on a recurring basis. As competing firms hold relevant resources and are constrained by the same market factors, cooperation between competitors allows them to acquire and create new technological know-how and further innovate.

According to Bouncken and Kraus (2013) to achieve technological progress, SMEs cooperate with each other by leveraging economies of scale and scope in the R&D stages and developing technologies together. In this way, technological advancement and innovation result from complex processes with the contribution of different individuals. SMEs operate in value networks that involve suppliers, customers, competitors and business partners. Through these networks, organizations have access to additional resources and knowledge, and benefit from the diffusion of technologies, favoring their competitive advantages.

In agreement with the above, Antolun-Lopez et al (2015) argue that the partners most apt to originate innovation in SME products are other SMEs, universities, research centers and financial institutions. Cooperation with universities and research centers creates a less expensive, less risky and a faster environment for access to specialized knowledge compared to internal development. Through these cooperative links, SMEs have access to technical support and technological infrastructures (e.g. laboratories,

equipment and other technologies). These relationships are particularly interesting for new technological startups because they have reduced resources, low influence on markets, need to minimize costs and neutralize the risks associated with innovation. Cooperative links between new firms and financial institutions have been extensively studied. The fact that startups do not have access to sufficient financial resources to ensure sustained growth or innovation forces them to seek financial partners. In addition, the financing allows startups access to new partners through the multiple relationships of institutions in the industry. Furthermore, the above stated leads to a decrease the development and innovation times of the products/services by reducing the costs and time that would be allocated in the startups search for investors.

4. Startups Advantages and Disadvantages of Collaboration

So far, it has been observed that collaboration between organizations allows the access of essential complementary assets to the creation of competitive advantages in technology-based companies. In agreement with the above, Rothaermel (2001) demonstrated the relationship between the established companies on the development of complementary assets and the success of new *biotech* companies. According to the author, there is a growing symbiosis between competing firms driving technological changes in the markets. Cooperation downstream of the value chain allows new companies to access marketing assets, which can lead to the success of new products/services promotion. Upstream, in *biotech*, it is common for startups to seek financing from established companies to support their R&D activities. The authors conclude that business-to-business cooperation is a mechanism that leads to the adaptation to technological change and innovation, i.e. the alignment with emerging technology trends.

It is possible to affirm that critical resources of the companies go beyond the internal limitations and interconnect with resources and knowledge of other entities. Tomlinson and Fai (2013) state that companies that are constantly involved in cooperative activities present a flow of knowledge that allows them to increase technologies' portfolio. This aspect is strongly studied in the case of SMEs because access to new technologies accelerates the R&D process, allows new suppliers and customers and creates conditions for them to use economies of scale. According to Skibinski and Sipa (2015), the dominant importance of SMEs in the economy is visible globally occupying around 99% of the world's businesses and contributing greatly to the growth of productivity and quality of market supply. They create employment, renew the business context, generate income, attract foreign capital and lead to the development of entrepreneurship in markets.

In the other hand, different authors have identified disadvantages of collaboration for SMEs. Raza-Ullah et al (2014) point out that one of the most relevant contradictions in their studies about cooperation with competitors is the dynamics between joint creation of value and the individual appropriation of that value. This contradiction is fundamentally due to the sharing of knowledge with a competitor and, at the same time, preventing its use by other competitors. During cooperation, firms are exposed to a risk of loss of competitive advantage which, in turn, limits their future capacity to share know-how and innovation. Further, Antolun-Lopez et al (2015) conclude that collaboration with universities and research centers has some negative aspects. This form of collaboration is based on public knowledge and accessible to other companies through scientific articles, conferences and transfer of HR, which limits the use of appropriability processes by startups to protect their know-how.

According to Hsu (2006), from the perspectives of startups there are four disadvantages or problems that limit the use of cooperation between startups and other

companies. On the one hand, startups face high research costs in finding the ideal partner with future strategic objectives aligned with their own. Second, their employees may not want to cooperate because of the uncertainty that they may lose control over their business. In addition, startups have a poor reputation in the market and/or their qualities are unknown to other companies, creating a lack of trust by potential partners and brand awareness limitations for the startups. Finally, startups may not have developed their resources sufficiently or be attractive to other companies. For these reasons, it becomes crucial to study the main barriers to innovation for startups and further identify different possible solutions or orientations that will increase their future chances of success.

5. Conceptual Model

Figure 1 is a representation of the objectives of this investigation, referring the main links between the concepts identified in the previous section. According to the literature review presented, the main sources of knowledge for technological startups located upstream of the value chain are research centers, universities and other companies, the latter being divided into big companies and SMEs. Downstream of the value chain, there are distributors, specialized suppliers and big companies that integrate startups products. For the purposes of this study, all entities belonging to the Markets are divided into big companies and SMEs. On both sides, collaborative links provide resources and skills for innovation in startups, whether these are product, process, marketing or organizational innovations. The aim of this study is to understand the main participants for Portuguese technological startups innovation, how they support innovation and what types of innovation are most developed as result. In addition, the study sought to understand the weight of the big companies compared to the other possible cooperation links because of their relevance in the literature reviewed. In the end, with reference in the barriers studied

by the European Community Innovation Survey (2008), this investigation aims to understand which of those are most relevant for Portuguese startups.

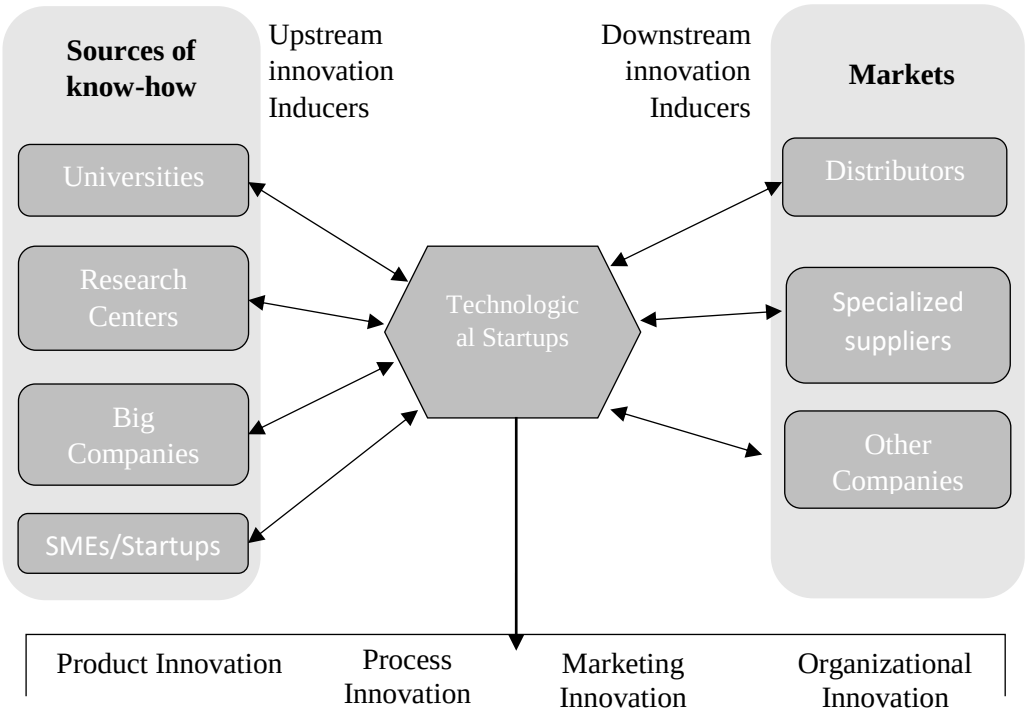

Figure 1 - Representation of the conceptual model of the present investigation. Source: own authorship (2017).

6. Research Questions

Since this dissertation presents an exploratory nature, the most appropriate research strategy would be based in research questions (Saunders et al, 2009). The research questions indicated below (RQ1, RQ2 and RQ3) were originated from the literature presented in the 1st section. In all cases, the geographical region defined for the study is Portugal. The research questions will be answered in the results analysis, presented in the 4th chapter.

RQ1) Which types of innovation can be induced by the startups cooperative links?

RQ2) What is the weight of the cooperative links between big companies and startups in relation to the other connections listed?

RQ3) What are the most relevant barriers to innovation for Portuguese startups?

3. RESEARCH METHODOLOGY

1. Target Population: Portuguese Technological Startups

According to Globalstat (2017), R&D expenditure in percentage of GDP in Portugal has more than doubled between 2000 and 2011 (from 0,73% to 1,49%). Pordata (2017) indicates that, in 2015, Portuguese R&D expenditures were slightly smaller, with 1,28% of its GDP. The data exhibited that the investment in innovation generally has increased in different sectors of activity in Portugal between 2000 and 2015. Additionally, Eurostat (2017) indicates that, after 2006, there was a higher growth by companies in the technology sectors. To have a broad perspective of this subject, the study includes startups from different industries founded and currently active in Portugal.

The database used in this study is of own authorship. It was created by a merger of the pre-made list by Pimentel (2016), which cites the technological startups to represent Portugal in the 2016 Web Summit. Further, to increase the size of this database, an online search was carried out with focus on the keywords *Startup, Portugal, Technology and Innovation*. Additionally, a list of startups based in the incubators listed by Almeida (2014) was used. The databased created resulted of a convenience sampling and not random sampling, limiting the results' conclusions to its size. In total, **354 Portuguese Technological Startups** were considered relevant and suited for this investigation.

Selecting the entities during the research phase was done by the condition of being presently active in Portugal. In the 4th chapter of this study, startups will be categorized according to their size. For this study, Medium, Small and Micro companies were defined by the number of effective workers and annual business volume, as shown in the table 2 (Pordata, 2016).

Table 2 - Categorization of companies' size with resource in two variables. Source: Pordata (2016).

Company categorization	Effective workers	Annual business volume
Medium	< 250	≤ 50 million euros
Small	< 50	≤ 10 million euros

Micro	< 10	≤ 2 million euros

As the information needed to respond to the questionnaire was focused on the management of partnerships between organizations, management of the long-term strategy and management of innovation, the contact was directed to the managers responsible for the partnerships and cooperation agreements of each startup.

2. Research data collection: self-administered online questionnaire

The data used for the study was collected through an online questionnaire. The same was sent by email to each of the startups listed in the database developed previously. The survey was created through the *Qualtrics* platform *(https://www.qualtrics.com/).* The choice of this platform was mainly due to the need to create a questionnaire with an interactive and fluid response process, professional design, but easy to manage and extract data. The use of a methodology of data collection by questionnaires has been used traditionally in studies related to the innovation of companies. Questionnaires allow the collection of both quantitative and qualitative information (Gunday et al, 2011). In addition, according to Saunders et al (2009), the use of questionnaires is a strategy generally associated with a deductive approach. This strategy allows the researcher to answer the questions "*who, what, where and how much*", and tends to be used for exploratory and descriptive research.

The development of the questionnaire used was done through a process of different stages. After an exploratory research of the innovation concepts studied so far and the main barriers for SMEs to continuously innovate, the buildup process began. The first stage was essential to understand how the concepts used in the model (figure 1) were related to each other. Then, an initial survey was developed with questions of own authorship, which were based on the literature review. To verify the reliability and validity, 14 startups present in the database were randomly selected to perform the pilot

test for evaluation of the questionnaire before starting the data collection phase. The pilot test consisted in face-to-face interviews with a duration of 20 minutes to startups founders. Language comprehension, relevance of open questions and open answers and time needed to respond the survey were recorded. From the 14 startups, only 4 showed availability to do the pilot test. Afterwards, the 14 startups were excluded from the database. After this process, the population sample was decreased to **340 Portuguese Technological Startups**.

The reformulation of the initial questionnaire by incorporating the improvement suggestions obtained in the pilot test gave rise to the final questionnaire (appendix A). Since the literature did not analyze innovation vs cooperation from the perspective of this dissertation, it was not possible to adapt an existing survey. Therefore, the pilot test referred was fundamental. Contrary, regarding the research question on barriers to innovation, since Austrian Institute Of Economic Research (WIFO) and Fraunhofer Institut für System und Innovationsforschung (2010) haven already analyzed the most relevant barriers in Europe, identified by the European Community Innovation Survey (2008), the barriers chosen for this study where considered validated.

Regarding the type of questions, open response, closed response (dichotomic variables - *Yes/No*) questions and scale questions were applied. For scale questions, a ranking category was used with 5 possible answers from "*Far too little*" to "*Far too much*, given its wide application and easy interpretation (Saunders et al, 2009). As suggested by Cox and Cox (2008), a simple, objective language was used throughout the questionnaire, excluding ambiguous terminology or technical jargon. With the objective of not rising complex and subjective answers by the respondents, open questions were used only when no other option was identified.

Finally, the questionnaire was divided in four different sections. The first one (Startup Characterization) included questions related to the personal data of respondents and characterization of the startup. The second part (Cooperation Links) ensured the identification of the different cooperation links and identification of the innovations present in the startup. The third (Advantages, Disadvantages and Limitations) included both questions related to the innovation barriers and cooperation incentives. The last section (Sustainability of Cooperation Links) inquired about the future perspective of respondents regarding their startup cooperation links.

3. Questionnaire administration

The procedure of submitting the questionnaires began on 3rd July, 2017 and was done through the email of the entities collected during the creation of the database. The email was divided in two sections (appendix B). Firstly, a brief explanation of the research topic and the importance of the participation of each startup was presented. The questionnaire link was then provided and the confidentiality of the participants was ensured. To encourage the participation, the survey was finalized with the option of receiving a report with the data obtained and conclusions drawn from this study. With the purpose of excluding the participants in the subsequent follow up processes, at the beginning of the questionnaire, a field was presented to place the startup name.

The process of sending and following up the questionnaire went through the following steps:

- 1st Step: On July 3, 2017, 340 emails were sent to the startups present in the database. Of the 340 emails sent, 12 were returned from failed delivery and 3 refused to participate in this study. In this stage, it was possible to collect 23 complete answers - Appendix C.

The follow up period started on the 12 July, 2017 in order to increase the response rate:

- 2nd Step: Nine days after the first submission, the first follow up was carried out. This time, 302 emails were sent to startups that had not yet responded. In this first follow up, a change was made in the email body highlighting the low response rate and reinforcing the importance of the collaboration of the respondents. From this second follow up, it was possible to collect 36 complete responses and 5 incomplete responses. In this phase, 2 startups referred their unavailability to answer the questionnaire. In sum, 59 complete answers and 5 incomplete answers were obtained - Appendix D.
- 3rd Step: On July 25, 2017, three weeks after the first attempt, the second follow up period was conducted. On this date, 257 emails were sent to startups that had not yet responded. In the final phase of the second follow up, 10 complete responses and 6 incomplete responses were obtained. In sum, 69 complete answers and 11 incomplete answers were obtained - Appendix E.
- 4th Step: In a last attempt to collect additional answers, a third follow up email was sent on August 2, 2017, to 241 startups. From this step, 5 complete responses and 3 incomplete responses were obtained. In the end, it was possible to collect 74 complete answers and 14 incomplete answers – Appendix F.

Summarizing, the effective response rate of this investigation was **21,8%** (74) and the rate of incomplete responses was **4,1%** (14). In the end, the collected answers from the survey were codified from 1 to 74 and linked to the startups of the database for analysis purpose.

4. Questionnaire validation procedures

As referred by Podasakoff et al (2003), there are strategies that can reduce *Common Method Bias* in academic investigations. In this study, respondents were informed that there were no right or wrong answers before they started the questionnaire. In addition, it

was guaranteed that the answers given would be anonymous and the identification of the startup name present in the 1st question of the survey would only be use for the follow up process. Further, some of the survey questions weren't mandatory to prevent a high number of incomplete responses due to participants giving up while in the process. Podasakoff et al (2003) recommend that the survey is designed with simple, specific and concise questions, avoid vague concepts and, in case such concepts must be used, define the terms and provide examples. In this investigation, the definitions of Innovation and Types of Innovation identified in the literature review where added to survey to prevent different interpretations and guarantee that the respondents understood the concepts homogeneously.

Because of the low response rate after the first contact attempt, it was found necessary to check for *nonresponse bias*. Armstrong and Overton (1997) underline that the most common and recommended protection against *nonresponse bias* "*has been the reduction of the nonresponse itself*". The authors suggest extrapolation methods to increase the response rate of online questionnaire. One possible method is to send the survey in successive waves (i.e. follow up), stimulating their interest in the subject. Thus, it was considered fundamental to carry out the follow up process above explained.

Regarding external validity, Saunders et al (2009) defend that purposive or judgmental sampling is used when the probability of each case being selected from the total population can't be known and because of this, generalization needs to be done by logic. This strategy enables the exploration of the research questions and gain theoretical insights, but the samples cannot be considered statistically representative of the total population. Hence, the results obtained in this study and its respective findings will only be applicable to the respondents and not generalized to the population.

5. Concepts definition

5.1. Innovation Barriers

The barriers to innovation used throughout this study were taken from the report developed by WIFO and ISI (2010). The authors analyzed the results of the European Community Innovation Survey (2008) and concluded the main barriers or limitations to innovation for companies, regardless of their size, are the ones listed in table 3.

Table 3 - Limitations to Innovation identified by WIFO and ISI institutes. Source: Adapted from WIFO and ISI institutes (2010).

Limitations to Innovation	Market knowledge
	Technical knowledge
	Innovative partners
	Financial resources
	Qualified employees
	Patenting processes (patents);
	Protection of knowledge through Secrets
	Protection of knowledge through continuous technological advancement or Lead Time
	Protection of knowledge by advances in the Learning Curve (advantage of the scale)
	Bureaucratic
	Regulation of markets and companies

5.2. *Research Centers*

Through the literature review, research centers are defined as public or private entities, not including universities, whose main objective is to help advance technology and knowledge. These research centers can hold key resources to support new projects and R&D of companies, enabling them, for example, to access qualified equipment, facilities, HR and financial support (Antolun-Lopez *et al*, 2015).

5.3. Startups categorization

The definition of startup used in this investigation originated from two complementary views. On the one hand, Ries (2011) defined a startup as a human institution, focused on innovation by developing and launching new products/services with the aim of revolutionizing the markets created in conditions of extreme uncertainty

and risk. For the author, the size of the organization and the industries it operates are not important components in defining enterprises as startups. On the other hand, Blank and Dorf (2012) define a startup as a temporary organization created with the goal of developing a scalable business model, which means growing more and more, without this influencing its business model but also be repeatable, i.e. capable of delivering the same product in scale, without requiring its high customization or adaptation. Since the authors refer that after 7 years' companies lose the designation of startups, for this study, the startups needed to have between 0 to 7 years of activity (Informa D&B, 2016).

4. ANALYSIS AND DISCUSSION OF RESULTS

In this study, the data treatment was carried out by a mixed qualitative and quantitative analysis. According to Carson et al (2001), qualitative analysis translates the need to understand a phenomenon in detail and to obtain knowledge about it and a quantitative analysis can help identify patterns. For this study, it was used an inductive approach where the theory emerges from the process of data collecting and the objectives are, first, to explore an initial theoretical framework and, second, identify relationships between the collected data and the research questions (Saunders et al, 2009).

For the quantitative analysis, the data was automatically transferred from *Qualtrics* survey platform to *SPSS*. The answers collected in the questionnaire were used for a direct analysis and descriptive statistic for the identification of patterns and trends. Additionally, since the data collected was mainly categorical – descriptive, *Pearson's Chi-square* and *Phi* tests were applied. The statistical results obtained were used to support the conclusions identified during the investigation.

1. Respondents' general characterization

As already mentioned, the final sample of this study included **74** startups. The activity sectors selected by the respondents are resumed in the table 4. The activity sectors

applied to the sample of this study were developed by a study of the markets listed by AngelList (2017), identifying the best sector match for each startup. This was done to be possible to categorize the startups according to their products/services and the markets where they operate. As the table shows, the main activity sectors of the startups included in the database were *Knowledge based and Services*, with a value of **37,8%** (28) and *IT*, with a value of **36,5%** (27).

Table 4 - Activity sectors where respondents believe their startups are working. The percentage is relative to the 74 responses collected. Source: Own authorship (2017).

	Activity Designation	Frequency	Relative percentage (%)
1st[1]	**Knowledge based and Service**	**28**	**37,8**
2nd	**IT**	**27**	**36,5**
3rd	Creative Industries	13	17,6
4th	Health	6	8,1
	Total	74	100,0

In SQ2 it was asked the respondents to identify the range of activity years that best represented the startup (table 5). It's possible to conclude that the startups present in the databased created for this study were dispersed between just created (0 to 1 year) and older startups (with up to 7 years), with the biggest value in *More than 2 to 4 years*. As expected, the proportion of startups that had more than 7 years of activity was considered small, with 9,5% of the total.

Table 5 – Characterization of the 74 respondents. Source: Own authorship (2017).

Range of Activity Years	Frequency	Relative percentage (%)
From 0 to 1 years	15	20,3
More than 1 to 2 years	18	24,3
More than 2 to 4 years	20	**27,0**
More than 4 to 7 years	14	18,9
More than 7 years	7	9,5
Position of respondent	**Frequency**	**Relative percentage (%)**
Founder/Cofounder/CEO	44	**59,5**
Other positions	24	32,4
Director	6	8,1
Enterprises characterization	**Frequency**	**Relative percentage (%)**
Micro	62	**84,9**
Small	10	13,7
Medium	1	1,3

[1] The first, included any startups working in industries based in knowledge (e.g. materials, extraction, agricultural production) or offers services (e.g. consulting, logistics). The next category represents any startup working in mobile, e-commerce, app, software, and other related. The third, included startups working in design, crafts, architecture, fashion, music, and other related. Health startups were separated from the 2nd since this sample was considered relevant (6). These are startups focused in the healthcare industry (hardware, software).

Total	74	100,0

Note: One response was concluded to be a large company resulting in a sample of 73 startups.

When analyzing the identified roles by respondents (SQ3) (table 5), it was possible to see that the main roles of the respondents were *Founder/Cofounder/CEO* (**59,5%**). This observation was expected since the contact was directed to the person responsible for the cooperation agreements of each startup. Additionally, in order to categorize the size of the startups accordingly with the literature review (Pordata, 2016), it was requested in SQ4 and SQ5 to identify the number of collaborators and the annual business volume of the startups. The results show that most of the startups used for this investigation were *Micro Enterprises*, with **84,9%** (62) of the total of respondents.

From the results of the SQ6 present in the survey, **90,4%** (66) startups claimed having innovation in at least one activity considering the innovation definition presented at the time. In contrast, 8,2% (6) of the startups claimed not having innovation and 1,4% (1) didn't know the answer/refused to respond. Since the purpose of this study requires startups with innovation, only the **66 startups** that stated having innovation were used in the further analysis.

2. Types of Innovation induced by the listed cooperative links (RQ1)

From the collected data in the SQ7, **86,4%** (58) of the respondents chose at least one collaboration link and 12,1% (8) declared not having collaboration links between their startup and the choices presented. In addition, it was possible to verify that the average number of collaborations per startups present in the sample is **2**. Observing the results in table 10 (appendix G), it's possible to refer that the number of collaboration links is greater for *Universities* (**54,5%**), *SMEs* (**45,5%**) and *Big Companies* (**43,9%**).

The below analysis was done looking at the results line by line to better understand which sector was more collaboration links with the different entities. Crossing the results, it's possible to observe that the values of collaboration with *Universities*, *SMEs* and *Big*

Companies are bigger for *Knowledge based and Services* startups (50,0%, 46,7% and 48,3%). For the remaining collaboration links, the values crossed with the respondents' sector was considered too small to make any conclusions. Analyzing the same data row by row, it's possible to observe that the activity sectors *Knowledge Based and Services* and *IT* had a greater relative percentage, with **36,7%** and **38,8%**, showing a large weight of these startups in the startups sample.

SQ8 questioned the respondents if their cooperative partners were localized in the same region/city than the startup. The number of responses was two times bigger for *Different Region* (**66,7% - 38**) compared to the *Same Region* (33,3% - 28). The collected answers from *Different Region* can be summarized as Portugal with **63,2%** (24), *Europe* with 28,9% (11), *other regions* with 21,1% (8) and *USA* with 13,2% (5). From table 6, it's possible to observe that, for the startups included in this sample, the focus is mostly *Lisbon* (**50,0%**) and *Porto* (**45,8%**).

Table 6 - Distribution of responses by regions in Portugal. The percentage is relative to the 24 responses for Portugal, collected in the multiple answer question. Source: Own authorship (2017).

Identified Portuguese regions	Total	Relative percentage (%)
Lisbon	**12**	**50,0**
Porto	**11**	**45,8**
Designation of Center	4	16,7
Designation of North (excluding Porto)	3	12,5
Braga	3	12,5
Non-specified/Portuguese territory	2	8,3
Aveiro	2	8,3
Coimbra	2	8,3
Designation of South	1	4,2

In order to understand deeper why Portuguese startups choose a particular entity for collaboration purposes, SQ9 asked the respondents to describe how they collaborate with the identified partners, SQ10 asked the main reasons of choosing them and SQ12 to identify the main advantages for the startup. The answers were analyzed individually for each collaboration links selected by the respondents. Collaboration links with *Universities* were made in order to access specialized HR by providing student internships or thesis projects inside the startup, facilitating the recruitment processes and help identify

talent. Additionally, startups have been decreasing costs by accessing scientific knowledge used in R&D thought universities. These equally have the facilities and equipment that startups need to develop and test new projects, as for example "*(we do) distribution and pilot testing of products thought universities"* (12th Startup, 2017). Some respondents have identified universities as collaboration links since these have supported the promotion and marketing of events, targeted for students and professionals in specific academic fields. Respondents have also identified universities as credible partners, with high quality services and capacity to follow up projects.

Regarding the collaboration with *SMEs*, respondents collaborate with them to shar space, equipment and know-how in order to cut R&D costs. Furthermore, the startups present in the database have co-developed new products/services and co-promoted these in new market. Together, respondents and SMEs have also been able to identify new opportunities for products/services and identify potential clients, as stated *"(we) access the equipment that we do not have and we use our partners as intermediaries so that we can present our product to new potential clients*" (6th Startup, 2017). In addition, SMEs have been identified as experienced partners in new markets targeted by startups and a way to expand to international markets. The geographic proximity of SMEs has encouraged respondents to collaborate with them.

In the other hand, startups that selected *Big Companies* as one of their collaboration links, mentioned that big companies can supply them with know-how about organizational, marketing and recruitment skills. Cooperating with this type of partners, startups can decrease costs and scale production. Big companies have sporadically invested in startups' projects and, because of the available new funds, startups could collect resources to support their growth. The availability of big companies to give mentoring and coaching sessions to startup collaborators was greatly stated. Additionally,

big companies were identified as credible partners, with the capacity to increase product fit to its clients' needs. Finally, respondents have described the collaboration with big companies as one way to test and improve products/services close to the clients. As stated by 49th Startup (2017), "*we collaborate with Big Companies for scalability reasons. Also, because they allow us to be exposed to the real business environment and at the same time, we can take advantage of the market knowledge they already have*".

Concerning the collaboration with *Research Centers*, while analyzing the answers collected, it was possible to conclude that the main incentive for this collaboration link was the access to know-how and equipment/infrastructures for R&D purposes. Respondents have decreases their costs and increased their production by cooperating with Research Centers. In the other hand, startups have chosen to collaborate with *Specialized Suppliers – SMEs* to access know-how and experience in the markets. Additionally, respondents have identified them as credible partners, allowing startups to engage new clients and enter new and international markets. The number of answers collected for the last three groups was considered too small and it was decided to not proceed with the analysis or draw any conclusions.

SQ11 gives a first description of the four types of innovation given by OECD (2005) and asks the respondents to mark which ones they have in their startups and to indicate the average number of innovations created so far. It's possible to observe, by the table 7, that *Product Innovation* (**72,7%**) and *Process Innovation* (**48,5%**), are the categories most selected by respondents.

Table 7 – Types of Innovation and their respective number. The percentage is relative to the 66 responses collected from the multiple answer question. Source: Own authorship (2017).

Type of Innovation	Average Number of Innovations	Count	Relative percentage (%)
Product Innovation	3	**47**	**71,2**
Process Innovation	1	**32**	**48,5**
Marketing Innovation	2	26	39,4
Organizational Innovation	1	17	25,8
Innovation is not observed	-	6	9,1

To further understand the connection between the types of innovation and the collaboration links used by respondents, the data was tested using the test of association *Pearson's Chi-square* in *SPSS*. The test was applied for all four types of innovation and for the three most relevant collaboration links identified previously, i.e. *Universities*, *SMEs* and *Big Companies*. According to Saunders et al (2009), this is a test for independence and it shows if there's an association between both variables. In order to use the *Pearson's Chi-square* test, the variables have to meet three assumptions. First, both variables must be categorical and each need to be separated in two or more groups. There must be no relationship between the variables and they can't be paired in any way, i.e. they should be independent. Finally, the sample must be relatively large, were the expected frequencies for each cell are at least 1 and the expected frequencies should be at least 5 for the majority (75%) of the cases. The authors defend that the *Pearson's Chi-square* test is the most indicated statistical test for the current study since the variables are Categorical - Descriptive. For this investigation, the level of significance used was 0,05 (95% of confidence of the relationship). Additionally, with the objective of understanding the size of the effect of the variables and considering that the result tables are 2x2, the *Phi* test was used. According to the authors, in this case, 0 represents no effect and 1 represents a stronger association between variables. Pallant (2007, in Cohen, 1988) proposes an interpretation of values with the following rule: 0,1 suggests a small effect, 0,3 suggests a medium effect and 0,5 suggests a large effect.

The results of the *Pearson's Chi-Square* test are resumed in the tables 13 to 24 (appendix G). It's possible to observe that, for *Product Innovation*, only when analyzing the collaboration with *SMEs* there was a relevant significance level, with of **0,047** (<0,05), leading to the conclusion that there's an association between the variables. Regarding the Phi test, the value was **0,244**, i.e. a medium effect was observed between these variables.

When analyzing *Organizational Innovation*, there was a relationship between this type of innovation and choosing *Big Companies*. The significance level in this case was **0,045** (<0,05) and the Phi test resulted in a value of **0,246**, i.e. a medium effect between these variables. For the last set of tests, *Marketing Innovation* had a relevant level of significance with *Universities*, with a value of **0,045** (<0,05) and the Phi test was **0,247**, i.e. a medium effect was observed between these variables. Further, the level of significance between *Marketing Innovation* and *SMEs* was **0,036** (<0,05) presenting a relationship between the variables and the Phi test was **0,259**, showing a medium effect.

SQ16 is the last survey question related to RQ1 and has the objective to collect information about the collaboration links that respondents want to increase in the future. It's possible to observe in table 11 (appendix G) that startups intent to increase collaboration with *Big Companies* (**65,2%**) and show an interest in keeping the collaborations with *SMEs* (**53,0%**) and *Universities* (**48,5%**), both with values similar to the ones observed previously in table 10. In the other hand, the percentage of respondents that intent to not collaborate with any entity listed is only 3%, a value smaller than the one observed in table 10. The average number of future collaborations per startups present in the sample is **3**, which is bigger than the resulting average number of collaboration previously presented (i.e. 2). Crossing the results with the activity sector of respondents and keeping a line by line interpretation, it's possible to observe an increase in *Knowledge based and Services* startups for all the main collaboration links. Further, this sector continued to be the sector with most interest in collaborating with other entities, followed by the *IT* sector, with a smaller increase in half of the listed entities. Additionally, in a row by row analysis, it's possible to observe an increase in the K*nowledge based and Services* and the *IT* sectors weight compared to the data from table 10, with values of **27,8%** and **44,3%** of the total answers.

3. Weight of the cooperative connection of Big Companies and Startups (RQ2)

The following section aims to understand if there's a distinctive connection between startups and *Big Companies*, compared to the remaining collaboration links. From the results of SQ7 presented in table 10 (appendix G), *Big Companies* is one of the most selected collaboration link by respondents. Nevertheless, it's in the 3rd position and *Universities* and *PMEs* have greater results showing that *Big Companies* may not be the most relevant connection for respondents. From table 11 (appendix G), it's possible to observe that the collaboration link *Big Companies* has an increased importance for respondents in a future of 5 to 10 years of activity. In the case of future perspective (table 8), the collaboration link *Big Companies* is in the 1st position and has an increase of **21,3%** in relative percentage compared to the present perspective.

Table 8 – Comparison of the results for the collaboration link Big Companies. The percentage is relative to the 66 responses from the multiple answer question. Source: Own authorship (2017).

	Position in the list	**Count**	**Relative percentage (%)**
Present perspective	3rd	29	43,9
Future perspective (5 to 10 years)	1st	43	65,2
Variance	**↑ 2**	**+ 14**	**+ 21,3**

According to the literature review previously presented (Schilling, 2013; Beaver and Prince, 2002), startups have showed interest in collaborating with large companies and intent to increase the relationships, since these partners can provide a greater amount of resource and advantages for their grow. In the present, collaborating with big companies had a weight of **43,9%** and, in a future perspective, a weight of **65,2%.** Thus, it's possible to observe that the results analyzed in table 8 meet the theory previously studied.

4. Barriers to innovation for Portuguese Technological Startups (RQ3)

The following section analysis aims to identify the most relevant barriers to innovation for Portuguese technological startups. SQ13 asks respondents if their startups went thought any situation where they couldn't collaborate with another entity and, in

SQ14, which were the main reasons for the limitations. Respondents that, in the SQ7, mentioned not having collaboration links with any of the entities listed (i.e. 9 respondents) were excluded from the further analyze. As table 9 shows, the percentage of respondents that went thought a situation where they couldn't collaborate is **35,1%.** Nevertheless, this value is close to the correspondent value for respondents that didn't went thought the situation.

Table 9 – Responses collected regarding situations where startups couldn't collaborate. The percentage is relative to the 57 responses collected. Source: Own authorship (2017).

Possible answer	Count	Relative percentage (%)
Yes	**20**	**35,1**
No	17	29,8
Don't know/Refuse to answer	20	35,1
Total	57	100

From respondents' perspective, the main reasons that limited the collaboration between respondents' startups and other entities were, on one hand, the difficulty startups face when trying to contact the entities and, on the other hand, the mistrust of other entities regarding new startups that hadn't yet build up credibility. Additionally, other companies can see startups as their competitor and, to protect their advantages, refuse to collaborate. Further, respondents have identified HR and financial constraints of other entities, that normally are invested in new projects, as a limitation to collaborate with them.

Finally, SQ15 gives a list of possible barriers to innovation and asks respondents to select how these barriers affect their startups from a scale of "*Far too little*", "*Too little*", "*About right*", "*Too much*" to "*Far too much*". The scale was converted in values from 1 to 5 for analysis purpose. Table 24 (appendix G) resumes the descriptive statistics of the 20 responses collected. It's possible to observe that the data appears to be centered.

Analyzing the same table, *Financial resources* barrier had the biggest relative frequency (**50%**) for the scale item "*Far too much*" and this can lead to the conclusion that startups from the sample encounter high financial constrains when trying to innovate. The following barriers *Market knowledge* (**45%**), *Innovative partners* (**35%**), *Qualified*

employees (**35%**), *Regulation of markets and companies* (**40%**), *Protection of knowledge through continuous technological advancement* (**30%**) and *Protection of knowledge by advances in the Learning Curve* (**50%**) had the highest relative frequency for the scale item "*About right"*. These results show that respondents have a neutral attitude towards these barriers. Either *Protection of knowledge through Secrets* (**45%**) or *Patenting processes (patents)* (**40%**) had their biggest relative percentage for the scale item *"Far too little"* meaning that respondents almost don't perceive these barriers as limitations to innovation for their startups.

5. CONCLUSIONS, LIMITATIONS AND FUTURE RESEARCH

1. Theoretical and practical conclusions

This work had the objectives of identifying the main collaboration links between Portuguese Technological Startups and other entities and what forms of innovation resulted. At the same time, whether there was a distinction between the links with *Big Companies* and the remaining. To do so, a questionnaire was sent through a database composed of Portuguese technological startups and, based on the information collected, those that presented collaborative links with other entities were studied. First, this study gave insights of the regions where Portuguese startups from the database have more collaborative focus, namely Lisbon and Porto.

In general, the results obtained go according to the literature. First, they confirmed that there are three predominant collaboration links with the respondents and these are *Universities, SMEs* and *Big Companies*. Regarding the Types of Innovation identified by respondents, *Product* and *Process Innovations* where the categories with the greatest values. When analyzing these results with the activity sector of respondents, it was possible to conclude that *Knowledge based and Services* and *IT* startups are increasing the collaboration with all the entities listed. Through the statistical *Pearson's Chi-square*

and *Phi* tests performed, *Product Innovation - SMEs, Organizational Innovation - Big Companies, Marketing Innovation – Universities* and *SMEs* obtained statistical results that represented an association between variables with a medium effect.

Regarding the first association, the information collected throughout the survey lead to the conclusion that respondents have been focused on SMES in order to co-develop new products/services but also to identify new market opportunities, leading to their product innovation. Respondents have identified big companies as partners that allow them new ways to organize tasks and manage HR, leading to their organizational innovation. Concerning the collaboration with universities, respondents' startups have accessed support for events' marketing and promotion, designed for students and professionals in academic fields, leading to their startups' marketing innovation. Finally, the association between SMEs and marketing innovation was justified by respondents as partners that enable the identification of new markets and customers, receiving support to promote their products/services. Thus, it can be concluded that the information collected regarding the collaboration links selected by respondents goes according with the statistical findings.

From the analyzed data, it's possible to conclude that respondents are willing to increase their collaboration with all the listed entities. Yet, the collaboration link *Big Companies* has showed a greater increase, reaching the first place in the list. This lead to the conclusion that respondents' startups have a future focus of partnering with *Big Companies* to increase their advantages, as stated by Beaver and Prince (2002). Additionally, the data can be interpreted has respondents willing to keep the collaboration with *Universities* and *SMEs*. The survey developed had also the objective of recognizing the main barriers to innovation that limited startups growth. For the used sample, the results identified the financial limitations of startups as the main barrier to innovation.

This research has also it's practical implications to the business realm. First, it provides a better understanding of the more commonly chosen partners and how they can benefit or limit the technological startups in the future. Second, it allows entrepreneurs to acquire useful knowledge regarding their actions towards innovation. These insights can be an advantage not only for entrepreneurs already in the business, but also for those who are planning to create a startup. These findings may be favorable for existing entrepreneurs since they provide potential guidelines for choosing collaborative partners. If startups are planning to be more collaborative, entrepreneurs should be aware of the different characteristics that other organizations can have as partners and what are the potential benefits of cooperating with them. On the other hand, these contributions can also be beneficial to potential founders. These findings can help founders understand which will be the most relevant limitations to their innovation and find in advance possible strategies to reduce the barriers.

2. Research Limitations and future recommendations

One of the main limitations of this study was the fact that the size and constitution of the database used may not be representative of Portuguese technological startups. The findings and conclusions above presented are limited to the group of 66 startups who participated in the survey and claimed having innovation. This is mainly due to the sampling method used in this study, a non-probability, purposive technique (Saunders et al, 2009). To categorize the answers obtained by the questionnaire and also because of time limitations, it was necessary to soften the test of the survey.

Saunders et al (2009) mention that, in business and management research, the researcher should consider the possible error of coming to a decision that something is true when in practice is not. This situation is called an error Type I. In the other hand, concluding that something is not true or related when in fact is, is called a Type II error.

Researchers usually consider Type I errors more serious and so, to reduce them, the authors recommend setting a significance level of 0,01 instead of 0,05 in the *Pearson's Chi-square* test. Considering the dataset limitations, it was decided to proceed with a level of significance of 0,05, meaning that some of the relationships found between a type of innovation and a collaboration link can be a possible error.

The technique of data collection used can limit the study as well since it is not possible to control the number of responses obtained, being those closely related to the respondents' interest in participating. Despite the efforts made, the expected level of responses was not obtained. In addition, it should be noted that this method of data collection through questionnaires, can lead to possible misinterpretation of the questions raised. In order to overcome this situation, a survey test was conducted thought interviews with potential respondents in order to improve and clarify the language and concepts.

Regarding the methodology designed for this research, Saunders et al (2009) state a longitudinal study would have allowed to draw stronger conclusions compared to a cross-sectional study. This situation is because, over time, any cross-sectional study fails to capture the behavioral changes of companies. Thus, it is suggested to carry out a longitudinal analysis to see if there is relationship between the collaborative behavior of Portuguese Technological Startups and their development phase. Additionally, it would be interesting to analyze the barriers to innovation for each startup industry and identify similarities or differences between sectors. Further, it would be interesting to develop a more quantitative survey, with scale questions that would result in numerical data, to apply other statistical tests and inquire possible data patterns. Finally, it would be an asset to make an in-depth study of, in one hand, how collaboration leads to innovation and, in the other hand, of the limitations and barriers experienced by startups through follow-up interviews.

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7. APPENDIX A: SELF-ADMINISTERED ONLINE QUESTIONNAIRE

O presente questionário será a base para a realização de uma dissertação no âmbito do Mestrado de Gestão e Estratégia Industrial do Instituto Superior de Economia e Gestão - Lisboa. A sua colaboração é imprescindível levando-me a agradecer-lhe atempadamente pela

disponibilidade. Esta investigação enquadra-se nas áreas de Gestão da Inovação, Estratégia e Tecnologia e tem como principal objetivo estudar a Inovação resultante das ligações cooperativas que as Startups Portuguesas desenvolvem com outras entidades, numa vertente *Business-to-Business* (*B2B*). Por outro lado, este estudo procura identificar as principais Barreiras à Inovação que as Startups enfrentam. Note que, neste questionário, não há respostas certas ou erradas. Selecione, por favor, a opção que melhor representa a sua situação. Após a finalização do questionário, ser-lhe-á apresentada a opção de receber um relatório sumarizado sobre este estudo.

Parte 1: Caracterização da Startup

1) **Para garantir que não ocorre duplicação de respostas entre entidades escreva, por favor, o nome da sua Startup.**

_____

2) **Assinale, por favor, o intervalo que engloba o nº de anos de atividade referente à sua Startup.**

	De 0 a 1 ano
	Mais de 1 ano a 2 anos
	Mais de 2 anos a 4 anos
	Mais de 4 anos a 7 anos
	Mais de 7 anos

3) **Qual a sua posição como colaborador(a) na Startup?**

_____

4) **Qual o intervalo atual do número de colaboradores na Startup?** Note que esta informação é fundamental para que seja possível categorizar a sua empresa quanto ao tamanho.

	0 a 9 colaboradores
	10 a 49 colaboradores
	50 a 249 colaboradores
	250 ou mais colaboradores

5) **Qual o intervalo representativo do volume de negócios anual?** Note que esta informação é fundamental para que seja possível categorizar a sua empresa quanto ao tamanho.

	0€ a 100 000€
	100 001€ a 500 000€
	500 001€ a 1 000 000€
	1 000 001€ a 2 000 000€
	2 000 001€ a 5 000 000€
	5 000 001€ a 10 000 000€
	10 000 001€ a 50 000 000€
	Superior a 50 000 000€

6) **Considera que existe inovação em pelo menos um dos negócios da sua Startup? Nota**: Inovação deve ser considerada como uma melhoria ou mudança radical para criação de um produto/serviço (desde a conceção da ideia, promoção desse mesmo produto/serviço ao pós-venda) ou uma melhoria/mudança radical de um processo, operações e alterações organizacionais.

	Considero que existe inovação
	Não considero que exista inovação (Finalizar o questionário)
	Não sei/Não respondo (Finalizar o questionário)

Parte 2: Ligações de Cooperação

7) **A sua Startup realizou ou encontra-se a realizar atividades de colaboração com alguma das seguintes entidades? Nota**: Atividades de colaboração englobam qualquer tipo de atividade/projeto onde, para a sua finalização, seja necessário recorrer a outra entidade que não a sua Startup. Por exemplo, pode ocorrer partilha de informação tecnológica, rotinas de trabalho, recursos humanos, recursos financeiros, instalações de fabricação ou montagem, etc.

	Centros de Investigação
	Universidades
	PME's
	Grandes Empresas
	Distribuidores - PME's
	Distribuidores - Grandes Empresas
	Integradores de Sistemas - PME's
	Integradores de Sistemas - Grandes Empresas
	Não colabora ou colaborou com outras entidades (Passar à questão nº 12)

8) **Assinale, por favor, a opção que melhor representa a situação da sua Startup.**

	Cooperação com entidades localizadas na mesma região/cidade
	Cooperação com entidades localizadas em diferentes regiões. Indique a região/regiões:_____

9) **Descreva sucintamente de que forma a sua Startup colaborou ou colabora com as entidades assinaladas.** No caso de ter assinalado mais do que uma entidade, responda, por favor, em separado.

10) **Indique, por favor, duas principais razões que levaram a sua Startup a colaborar com as entidades assinaladas.** No caso de ter assinalado mais do que uma entidade, responda, em separado.

Tendo em conta a seguinte informação:

- A **Inovação de Produtos** é considerada quando há introdução de um produto ou serviço, novo ou melhorado em relação às características/usabilidade anteriores;
- A **Inovação de Processos** trata-se da aplicação de um novo método de produção, transporte ou de melhorias significativas do método inicialmente utilizado (e.g. mudanças técnicas, metodologias de trabalho, equipamentos e/ou software);
- A **Inovação de Marketing** é a implementação de um novo conceito ou estratégia de Marketing que envolva mudanças significativas ao nível de design ou embalagem do produto, exposição do produto, promoção ou preço;
- A **Inovação Organizacional** é considera como a implementação de um novo método organizacional nas práticas de trabalho da Startup, uma nova forma de organização do trabalho ou um novo nível das relações internas/externas (e.g. promover recursos humanos qualificados, criar novos ambientes de autoaprendizagem, criar ferramentas de comunicação interna).

11) **Assinale quais das seguintes dimensões de inovação são resultantes das atividades da sua Startup. Indique na caixa de texto abaixo o nº de inovações observadas em cada dimensão, nos últimos 5 anos.**

	Inovação de Produtos
	Inovação de Processos
	Inovação Organizacional
	Inovação no Marketing
	Não se observa inovação. (Passar à questão nº 18)

Parte 3: Vantagens, Desvantagens e Dificuldades

12) **Refira, por favor, quais as duas principais vantagens competitivas que a sua Startup alcançou através da colaboração com outras entidades?**
13) **Existiu alguma situação onde a sua Startup procurou colaborar com uma entidade, mas não lhe foi possível?**

	Sim
	Não
	Não sei/Não respondo

14) **Indique, por favor, quais foram as duas principais razões que impediram ou limitaram a colaboração.**
15) **Assinale, por favor, para as barreiras ou limitações à Inovação listadas abaixo, se estas afetam a sua startup.**

	As barreiras afetam:				
	Muito pouco	Pouco	Indiferente	Muito	Bastante
Financeiras					
De conhecimento dos mercados					
De conhecimento técnico					
Ao nível de parceiros inovadores					
De colaboradores qualificados					
Nos processos de obtenção de patentes					
Na proteção do conhecimento através do Segredo					
Na proteção do conhecimento através do Lead Time (ser o primeiro a entrar no mercado)					
Na proteção do conhecimento através de avanços na Curva de Aprendizagem (vantagem de escala)					
Burocráticas					
Na regulamentação de mercados e funcionamento de empresas					

Parte 4: Sustentabilidade das Ligações de Cooperação

Para a próxima questão, por favor, tenha em conta uma visão da sua Startup de médio e longo prazo (entre 5 e 10 anos de atividade).

16) **Assinale, por favor, com que entidades a sua Startup pretende vir a colaborar.**

	Centros de Investigação
	Universidades
	PME's
	Grandes Empresas
	Distribuidores - PME's
	Distribuidores - Grandes Empresas
	Integradores de Sistemas - PME's
	Integradores de Sistemas - Grandes Empresas
	Não vir a colaborar com outras entidades

Chegou ao final deste questionário. Refira, por favor, se existe alguma informação que acredite que seja relevante para o estudo em questão. Se gostaria de receber um relatório sumarizado do estudo efetuado, indique abaixo um email de contato.

8. APPENDIX C: FIRST EMAIL

A/C do(a) responsável pelas parcerias e acordos de cooperação,
Exmo.(a) colaborador(a) da «EMPRESA»,
Boa tarde,

Desde já, gostaria de agradecer toda a sua atenção e disponibilidade.

Venho solicitar a contribuição da «EMPRESA» para um projeto de investigação realizado no âmbito do Mestrado em Gestão e Estratégia Industrial, do Instituto Superior de Economia e Gestão, Lisboa.
Em suma, a minha investigação tem como objetivo estudar as ligações de cooperação que as startups portuguesas utilizam com outras organizações/entidades nos mercados e quais os resultados em inovação observados.

A sua colaboração é essencial para o sucesso deste estudo, pelo que lhe solicito o preenchimento do inquérito ao qual poderá aceder através do seguinte endereço: «SURVEYURL».

Toda a informação fornecida é estritamente confidencial. Não será possível fazer a identificação individual das pessoas envolvidas no estudo e os dados recolhidos serão utilizados unicamente para fins de tratamento estatístico e apresentados de forma agregada.

O tempo estimado de preenchimento do questionário é de 10 minutos.

No caso de surgir alguma questão ou deseja fornecer feedback, por favor não hesite em contactar-me.

Votos de um excelente trabalho,
Roberta Vittiglio
+ 351 935 399 266
Mestrado em Gestão e Estratégia Industrial
https://pt.linkedin.com/in/robertavittiglio

9. APPENDIX D: 1st FOLLOW UP EMAIL

A/C do(a) responsável pelas parcerias e acordos de cooperação,
Exmo.(a) colaborador(a) da «EMPRESA»,
Boa tarde,

Desde já, gostaria de agradecer toda a sua atenção e disponibilidade.

Há cerca de uma semana foi enviado um email com o pedido de participação numa investigação académica sobre as ligações de cooperação que as startups portuguesas utilizam com outras organizações/entidades nos mercados e como estas induzem a inovação.

Venho, desta forma, pedir-lhe novamente que preencha o seguinte questionário online, uma vez que o contributo da «EMPRESA» é muito importante para a realização desta investigação e o nº de respostas alcançado não é satisfatório.
Tenho consciência de que têm inúmeras solicitações, mas apelo à importância do presente estudo. **Em forma de agradecimento pela sua participação, existe a possibilidade de enviar um relatório com as conclusões finais do estudo.**

O questionário tem uma duração de aproximadamente 10 minutos.
Por favor, aceda ao mesmo através do seguinte endereço: «SURVEYURL».

Toda a informação fornecida é estritamente confidencial. Não será possível fazer a identificação individual das pessoas envolvidas no estudo e os dados recolhidos serão apresentados de forma estatística.

Votos de um excelente trabalho,
Roberta Vittiglio
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10. APPENDIX E: 2nd FOLLOW UP EMAIL

A/C do(a) responsável pelas parcerias e acordos de cooperação,
Exmo.(a) colaborador(a) da «EMPRESA»,
Boa tarde,

Desde já, gostaria de agradecer toda a sua atenção e disponibilidade.

Venho solicitar mais uma vez a contribuição da «EMPRESA» para um projeto de investigação realizado no âmbito do Mestrado em Gestão e Estratégia Industrial, do Instituto Superior de Economia e Gestão, Lisboa.

Tenho consciência de que têm inúmeras solicitações, mas apelo à importância do presente estudo. Apenas com a contribuição de um elevado número de empresas será possível perceber o fenómeno da cooperação e inovação das Startups em Portugal. De momento, o nº de respostas alcançado não é satisfatório. **Em forma de agradecimento pela sua participação, existe a possibilidade de enviar um relatório com as conclusões finais do estudo.**

O questionário tem uma duração de aproximadamente 10 minutos.
Por favor, aceda ao mesmo através do seguinte endereço: «SURVEYURL».

Toda a informação fornecida é estritamente confidencial. Não será possível fazer a identificação individual das pessoas envolvidas no estudo e os dados recolhidos serão apresentados de forma estatística.

Votos de um excelente trabalho,
Roberta Vittiglio
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11. APPENDIX F: 3rd FOLLOW UP EMAIL

A/C do(a) responsável pelas parcerias e acordos de cooperação,
Exmo.(a) colaborador(a) da «EMPRESA»,
Boa tarde,

Desde já, gostaria de agradecer toda a sua atenção e disponibilidade.

Venho solicitar pela última vez a contribuição da «EMPRESA» para um projeto de investigação realizado no âmbito do Mestrado em Gestão e Estratégia Industrial, do Instituto Superior de Economia e Gestão, Lisboa.

Tenho consciência de que têm inúmeras solicitações, mas apelo à importância do presente estudo. Apenas com a contribuição de um elevado número de empresas será possível perceber o fenómeno da cooperação e inovação das Startups em Portugal. De momento, o nº de respostas alcançado não é satisfatório. **Em forma de agradecimento pela sua participação, existe a possibilidade de enviar um relatório com as conclusões finais do estudo.**

O questionário tem uma duração de aproximadamente 10 minutos.
Por favor, aceda ao mesmo através do seguinte endereço: «SURVEYURL».

Toda a informação fornecida é estritamente confidencial. Não será possível fazer a identificação individual das pessoas envolvidas no estudo e os dados recolhidos serão apresentados de forma estatística.

Votos de um excelente trabalho,
Roberta Vittiglio
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12. APPENDIX G: DESCRIPTIVE STATISTICS AND TESTS

Table 10 - Results of Collaboration Links present in the startups displayed for an analysis by lines. The percentage is relative to the 66 responses collected from the multiple answer question. Source: Own authorship (2017).

Collaboration Link designation	N	Relative percentage (%)	IT		Health		Knowledge based and Services		Creative Industries		T	%
			N	%	N	%	N	%	N	%		
Universities	**36**	**54,5**	9	25,0	5	13,9	**18**	**50,0**	4	11,1	**36**	100
SMEs	**30**	**45,5**	10	33,3	3	10,0	**14**	**46,7**	3	10,0	**30**	100
Big Companies	**29**	**43,9**	11	37,9	2	6,9	**14**	**48,3**	3	10,3	**29**	100
Research Centers	24	36,4	7	29,2	4	16,7	**11**	**45,8**	2	8,3	24	100
Specialized Suppliers – SMEs	18	27,3	6	33,3	1	5,6	7	38,9	5	27,8	18	100
No collaboration	8	12,1	5	62,5	0	0,0	2	25,0	1	12,5	8	100
Distributors - SMEs	5	7,6	3	60,0	0	0,0	1	20,0	1	20,0	5	100
Distributors – Big Companies	5	7,6	2	40,0	0	0,	2	40,0	1	20,0	5	100
Specialized Suppliers – Big Companies	4	6,1	1	25,0	1	25,0	2	50,0	0	0,0	4	100
T			**54**		16		**57**		20		-	-
%			**36,7**		10,9		**38,8**		13,6			

Table 11 – Results of Future Collaboration Links wanted by the startups displayed for an analysis by lines. The percentage is relative to the 66 responses that had collaborative links, collected from the multiple answers question. Source: Own authorship (2017).

Collaboration Link designation	N	Relative percentage (%)	IT	Health	Knowledge based and Services	Creative Industries	T	%

			N	%	N	%	N	%	N	%		
Big Companies	**43**	**65,2**	13	30,2	5	11,6	**19**	**44,2**	6	14,0	**43**	100
SMEs	**35**	**53,0**	8	22,9	3	8,6	**17**	**48,6**	7	20,0	**35**	100
Universities	**32**	**48,5**	8	25,0	4	12,5	**14**	**43,8**	6	18,8	**32**	100
Research Centers	27	40,9	9	33,3	3	11,1	11	40,7	4	14,8	27	100
Specialized Suppliers – SMEs	21	31,8	7	33,3	1	4,8	8	38,1	5	23,8	21	100
Specialized Suppliers – Big Companies	18	27,3	4	22,2	3	16,7	8	44,4	3	16,7	18	100
Distributors – Big Companies	17	25,8	6	35,3	3	17,6	7	41,2	1	5,9	17	100
Distributors - SMEs	17	25,8	3	17,6	2	11,8	9	52,9	3	17,6	17	100
No collaboration	2	3,0	1	50,0	0	0,0	1	50,0	0	0,0	2	100
T			**59**		24		**94**		35		-	
%			**27,8**		11,3		**44,3**		16,5		-	

Table 12 – Crosstabulations and Pearson's Chi-square test for *Product Innovation* and *Universities*. Source: Own authorship (2017).

Pearson's Chi-square test for *Product Innovation* and *Universities*

	Value	df	Asymptotic Significance (2 sides)	Exact Significance (2 sides)	Exact Significance (1 side)
Pearson Chi-square	3,373[a]	1	**,066**		
Continuity correlation [b]	2,445	1	,118		
Likelihood Ratio	3,384	1	,066		
Fisher's Exact Test				,101	,059
Linear-by-Linear Association	3,322	1	,068		
N of Valid Cases	66				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 8,64.
b. Computed only for 2x2 table.

Table 13 – Crosstabulations and Pearson's Chi-square test for *Product Innovation* and *SMEs*. Source: Own authorship (2017).

Pearson's Chi-square test for *Product Innovation* and *SMEs*

	Value	df	Asymptotic Significance (2 sides)	Exact Significance (2 sides)	Exact Significance (1 side)
Pearson Chi-square	3,942[a]	1	**,047**		
Continuity correlation [b]	2,932	1	,087		
Likelihood Ratio	4,084	1	,043		
Fisher's Exact Test				,059	,042
Linear-by-Linear Association	3,882	1	,049		
N of Valid Cases	66				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 8,64.
b. Computed only for 2x2 table.

Symmetric Measures for *Product Innovation* and *SMEs*

		Value	Approximate Significance
Nominal by Nominal	Phi	**,244**	,047
	Cramer's V	,244	,047
N of Valid Cases		66	

Table 14 – Crosstabulations and Pearson's Chi-square test for *Product Innovation* and *Big Companies*. Source: Own authorship (2017).

Pearson's Chi-square test for *Product Innovation* and *Big Companies*

	Value	df	Asymptotic Significance (2 sides)	Exact Significance (2 sides)	Exact Significance (1 side)
Pearson Chi-square	3,364[a]	1	**,067**		

Continuity correlation [b]	2,434	1	,119		
Likelihood Ratio	3,488	1	,062		
Fisher's Exact Test				,100	,058
Linear-by-Linear Association	3,313	1	,069		
N of Valid Cases	66				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 8,35.
b. Computed only for 2x2 table.

Table 15 - Crosstabulations and Pearson's Chi-square test for *Process Innovation* and *Universities*. Source: Own authorship (2017).

Pearson's Chi-square test for *Process Innovation* and *Universities*

	Value	df	Asymptotic Significance (2 sides)	Exact Significance (2 sides)	Exact Significance (1 side)
Pearson Chi-square	3,076[a]	1	**,079**		
Continuity correlation [b]	2,269	1	,132		
Likelihood Ratio	3,103	1	,078		
Fisher's Exact Test				,090	,066
Linear-by-Linear Association	3,029	1	,082		
N of Valid Cases	66				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 14,55.
b. Computed only for 2x2 table.

Table 16 - Crosstabulations and Pearson's Chi-square test for *Process Innovation* and *SMEs*. Source: Own authorship (2017).

Pearson's Chi-square test for *Process Innovation* and *SMEs*

	Value	df	Asymptotic Significance (2 sides)	Exact Significance (2 sides)	Exact Significance (1 side)
Pearson Chi-square	2,920[a]	1	**,087**		
Continuity correlation [b]	2,136	1	,144		
Likelihood Ratio	2,940	1	,086		
Fisher's Exact Test				,137	,072
Linear-by-Linear Association	2,876	1	,090		
N of Valid Cases	66				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 14,55.
b. Computed only for 2x2 table.

Table 17 - Crosstabulations and Pearson's Chi-square test for *Process Innovation* and *Big Companies*. Source: Own authorship (2017).

Pearson's Chi-square test for *Product Innovation* and *Big Companies*

	Value	df	Asymptotic Significance (2 sides)	Exact Significance (2 sides)	Exact Significance (1 side)
Pearson Chi-square	,926[a]	1	**,336**		
Continuity correlation [b]	,510	1	,475		
Likelihood Ratio	,928	1	,335		
Fisher's Exact Test				,457	,238
Linear-by-Linear Association	,912	1	,340		
N of Valid Cases	66				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 14,06.
b. Computed only for 2x2 table.

Table 18 - Crosstabulations and Pearson's Chi-square test for *Organizational Innovation* and *Universities*. Source: Own authorship (2017).

Pearson's Chi-square test for *Organizational Innovation* and *Universities*

	Value	df	Asymptotic Significance (2 sides)	Exact Significance (2 sides)	Exact Significance (1 side)
Pearson Chi-square	,953[a]	1	**,329**		
Continuity correlation [b]	,481	1	,488		
Likelihood Ratio	,967	1	,325		
Fisher's Exact Test				,403	,245
Linear-by-Linear Association	,939	1	,333		
N of Valid Cases	66				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 7,73.
b. Computed only for 2x2 table.

Table 19 - Crosstabulations and Pearson's Chi-square test for *Organizational Innovation* and *SMEs*. Source: Own authorship (2017).

Pearson's Chi-square test for *Organizational Innovation* and *SMEs*

	Value	df	Asymptotic Significance (2 sides)	Exact Significance (2 sides)	Exact Significance (1 side)
Pearson Chi-square	3,423[a]	1	**,064**		
Continuity correlation [b]	2,457	1	,117		
Likelihood Ratio	3,437	1	,064		
Fisher's Exact Test				,091	,059
Linear-by-Linear Association	3,371	1	,066		
N of Valid Cases	66				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 7,73.
b. Computed only for 2x2 table.

Table 20 - Crosstabulations and Pearson's Chi-square test for *Organizational Innovation* and *Big Companies*. Source: Own authorship (2017).

Pearson's Chi-square test for *Organizational Innovation* and *Big Companies*

	Value	df	Asymptotic Significance (2 sides)	Exact Significance (2 sides)	Exact Significance (1 side)
Pearson Chi-square	4,009[a]	1	**,045**		
Continuity correlation [b]	2,954	1	,086		
Likelihood Ratio	4,011	1	,045		
Fisher's Exact Test				,054	,043
Linear-by-Linear Association	3,948	1	,047		
N of Valid Cases	66				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 7,47.
b. Computed only for 2x2 table.

Symmetric Measures for *Organizational Innovation* and *Big Companies*

		Value	Approximate Significance
Nominal by Nominal	Phi	**,246**	,045
	Cramer's V	,246	,045
N of Valid Cases		66	

Table 21 - Crosstabulations and Pearson's Chi-square test for *Marketing Innovation* and *Universities*. Source: Own authorship (2017).

Pearson's Chi-square test for *Marketing Innovation* and *Universities*

	Value	df	Asymptotic Significance (2 sides)	Exact Significance (2 sides)	Exact Significance (1 side)
Pearson Chi-square	4,036[a]	1	**,045**		
Continuity correlation [b]	3,069	1	,080		
Likelihood Ratio	4,132	1	,042		
Fisher's Exact Test				,071	,039
Linear-by-Linear Association	3,974	1	,046		
N of Valid Cases	66				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 10,91
b. Computed only for 2x2 table.

Symmetric Measures for *Marketing Innovation* and *Universities*

		Value	Approximate Significance
Nominal by Nominal	Phi	**,247**	,045
	Cramer's V	,247	,045
N of Valid Cases		66	

Table 22 - Crosstabulations and Pearson's Chi-square test for *Marketing Innovation* and *SMEs*. Source: Own authorship (2017).

Pearson's Chi-square test for *Marketing Innovation* and *SMEs*

	Value	df	Asymptotic Significance (2 sides)	Exact Significance (2 sides)	Exact Significance (1 side)
Pearson Chi-square	4,420[a]	1	**,036**		
Continuity correlation [b]	3,405	1	,065		
Likelihood Ratio	4,447	1	,035		
Fisher's Exact Test				,043	,032
Linear-by-Linear Association	4,353	1	,037		
N of Valid Cases	66				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 10,91
b. Computed only for 2x2 table.

Symmetric Measures for *Marketing Innovation* and *SMEs*

		Value	Approximate Significance
Nominal by Nominal	Phi	**,259**	,036
	Cramer's V	,259	,036
N of Valid Cases		66	

Table 23 - Crosstabulations and Pearson's Chi-square test for *Marketing Innovation* and *Big Companies*. Source: Own authorship (2017).

Pearson's Chi-square test for *Marketing Innovation* and *Big companies*

	Value	df	Asymptotic Significance (2 sides)	Exact Significance (2 sides)	Exact Significance (1 side)
Pearson Chi-square	1,601[a]	1	**,206**		
Continuity correlation [b]	1,015	1	,314		
Likelihood Ratio	1,599	1	,206		
Fisher's Exact Test				,303	,157
Linear-by-Linear Association	1,577	1	,209		
N of Valid Cases	66				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 10,55
b. Computed only for 2x2 table.

Table 24 – Descriptive statistics of responses for the Barriers to Innovation. The percentage is relative to the 20 responses collected from the non-mandatory question. Source: Own authorship (2017).

Nº	**Innovation Barriers**	**Relative percentage (%)**					$\bar{x}$	$\tilde{x}$	**Mo**[1]	σ_X^2	$\sigma^{2\,3}$
		1	**2**	**3**	**4**	**5**					
1	**Financial resources**	5,0	15,0	10,0	20,0	**50,0**	3,95	4,5	5	1,317	1,734
2	**Market knowledge**	5,0	20,0	**45,0**	30,0	0	3,00	3,0	3	0,858	0,737
3	**Technical knowledge**	**35,0**	25,0	**35,0**	5,0	0	2,10	2,0	1[a]	0,968	0,937
4	**Innovative partners**	10,0	25,0	**35,0**	25,0	5,0	2,90	3,0	3	1,071	1,147
5	**Qualified employees**	15,0	15,0	**35,0**	25,0	10,0	3,00	3,0	3	1,214	1,474
6	**Protection of knowledge through Secrets**	**45,0**	20,0	30,0	0	5,0	2,00	2,0	1	1,124	1,263
7	**Bureaucratic**	0	20,0	**30,0**	**30,0**	20,0	3,50	3,5	3[a]	1,051	1,105
8	**Regulation of markets and companies**	5,0	30,0	**40,0**	20,0	5,0	2,90	3,0	3	0,968	0,937
9	**Patenting processes (patents)**	**40,0**	15,0	25,0	20,0	0	2,25	2,0	1	1,209	1,461
10	**Protection of knowledge through continuous technological advancement or Lead Time**	10,0	25,0	**30,0**	15,0	20,0	3,10	3,0	3	1,294	1,674
11	**Protection of knowledge by advances in the Learning Curve (advantage of the scale)**	5,0	20,0	**50,0**	25,0	0	2,95	3,0	3	0,826	0,682

[1] There are several modes (Mo). The lowest value is shown.
[2] Standard Deviation.
[3] Variance.