UNIVERSITY OF CAXIAS DO SUL

VANESSA DE CAMPOS MACHADO

TECHNOLOGY ENTREPRENEURSHIP: AN EXPLORATORY STUDY

CAXIAS DO SUL
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Masters dissertation presented to the Postgraduate program in Administration at University of Caxias do Sul as a partial requirement in order to obtain the Master's degree in Administration. Research field: innovation and competitiveness.

Research Director: Prof. Dr. Eric Charles Henri Dorion

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Approved in 03/28/2018.

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To my parents Catarina and Orotildes, who always supported my dreams. To my sister Andressa and my boyfriend Bruno, who understood my absence during my master of science.

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“I would give everything I know for half of what I ignore.”

René Descartes

RESUMO

Empreendedorismo tecnológico refere-se ao uso de tecnologia para criar e explorar oportunidades de forma a gerar valor, baseado nos conceitos de empreendedorismo, e tecnologia que podem gerar inovação. Com base nessa definição, o CNPq demonstrou necessidade de entender as empresas empreendedoras tecnológicas, uma vez que estas podem ser solução para a crise econômica nacional. Por isso, esta dissertação objetivou explorar o processo empreendedor tecnológico nas empresas do SIMPLÁS. Portanto, a revisão da literatura abrangeu os temas empreendedorismo, inovação e empreendedorismo tecnológico, bem como seus processos. O método de pesquisa foi de natureza aplicada, abordagem qualitativa e objetivo exploratório, sendo que para tanto foram realizadas entrevistas em profundidade a partir de roteiro semiestruturado. Finalmente, as entrevistas foram analisadas por meio de análise de conteúdo, o que resultou em três modelos de processo, os quais foram separados de acordo com a rotina e a maturidade do processo empreendedor tecnológico. Os resultados mostram que o processo empreendedor tecnológico nas empresas embrionárias possui risco e incerteza como ameaças constantes, os quais podem forçar as empresas a encecrrar o processo, mesmo que elas estejam cientes da importância de perseguir oportunidades tecnológicas. Já as empresas baseadas em tecnologia preocupam-se constantemente em perseguir novas oportunidades, mesmo que nem sempre tenham procedimentos e estruturas adequadas. Finalmente, as empresas maduras possuem rotinas definidas para perseguir oportunidades tecnológicas, as quais resultam em inovações de produto e processo, dessa forma são consideradas pioneiras nos mercados em que atuam. Entretanto, a estratégia da empresa determina a necessidade de prospectar e buscar oportunidades tecnológicas independente do nível de maturidade do processo empreendedor tecnológico.

Palavras-chave: Empreendedorismo tecnológico. Inovação tecnológica. Estratégia. Processo empreendedor tecnológico. Níveis de maturidade.

ABSTRACT

Technology entrepreneurship refers to the use of technology to create and explore business opportunities in order to generate value, based on entrepreneurship and technology that may generate innovation. Based on this definition, CNPq indicated the need to understand technology-based firms, since they may be a solution to the national economic crisis. Thus, this master dissertation aimed to explore the technology entrepreneurial process in SIMPLÁS companies. Therefore, the literature review comprehended entrepreneurship, innovation, technology entrepreneurship as well as their processes. The research method was of applied nature, qualitative approach and exploratory objective, with in-depth interviews conducted based on a semi structured questionnaire. Finally, interviews were analyzed by content analysis, what resulted in three process models, which were arranged according to routines and technology entrepreneurial process maturity. Findings show that the technology entrepreneurial process in embryonic companies has risk and uncertainty as constant threats, what may force companies to stop the process, even though they are aware of the importance of pursuing technological opportunities. On the other hand, technology-based companies are constantly concerned in pursuing new opportunities, even though they may not always have infrastructure and procedures required. Finally, mature companies have defined routines to pursue technological opportunities, which result in product and process innovation, thus, they are considered pioneers in their markets. Nevertheless, the company's strategy determines the need to prospect and pursue technological opportunities regardless of their technology entrepreneurial process maturity level.

Keywords: Technology entrepreneurship. Technology innovation. Strategy. Technology entrepreneurial process. Maturity levels.

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1 INTRODUCTION

Entrepreneurship combines concepts derived from sociology, behavioural sciences and economy, so it can be defined as the creation of new companies (GARTNER, 1988; BARON; SHANE, 2007). Factors related to personality, historical context, working environment, institutional support, market, technology, as well as family context affect the creation of new companies (TIDD; BESSANT; PAVITT, 2008). In fact, entrepreneurship in Brazil happens spontaneously even though just minimal conditions are offered (FILION, 1991), justifying the fact that two out of ten adult Brazilians took entrepreneurial initiatives in 2016 (GEM, 2016).

One of the branches of entrepreneurship is technology-based entrepreneurship, or technology entrepreneurship, which is considered the engine for economic development (PHAN; FOO, 2004; VENKATARAMAN, 2004), since it pictures the result from the combination of human resources and varied assets related to scientific and technology advances in order to create and capture value for the company (BAILETTI, 2012). Thus, National Council for Technological Development (CNPq - Conselho Nacional de Desenvolvimento Tecnológico) announced the establishment of a strategy to implement technology entrepreneurship nation-wide (CNPq, 2017), which recalls the model developed by Singapore's government (TANG; YEO, 1995).

Moreover, Gilsing, Van Burg and Romme (2010) consider that technology entrepreneurship implies in the creation of new companies that explore opportunities brought by technology innovations, therefore promoting technology entrepreneurship has become an important topic for political strategists, since technology entrepreneurship represents a way of exploring opportunities given by unexplored technologies available on the market, which is done by the combination of resources. Within these opportunities, one can highlight the ones related to: global warming, urban mobility, energy, population growth and globalization, thus justifying the importance governments and society accredit to the union of science, industry and entrepreneurs (SPIEGEL; MARXT, 2011).

Furthermore, researches which results are not transferred to the market translate into high costs for society, since the need and validity of such process and investment may be questioned (OLIVEIRA; FILION, 2008). On the other hand, commercializing technology to companies benefits society as well (OLIVEIRA; FILION, 2008). To that end, Brazilian entrepreneurs must use available technology knowledge in order to generate social and economic benefits (CNPq, 2017). Provided that, it is necessary to change the current culture,

since entrepreneurs have to understand science as a source of business change, as well as researchers have to understand that their projects must deliver economic benefits (CNPq, 2017).

The Brazilian government also believes that technology entrepreneurship can be a solution for the current economic crisis (CNPq, 2017), since entrepreneurship that features innovation allows the exploration of changes that generate new products or services (DRUCKER, 1986). In fact, innovation activities in Brazil are oriented towards research and development (R&D), as well as goods, services and foreign knowledge purchasing (IBGE, 2013).

Thus, it is noticeable the need to understand the characteristics that distinguish entrepreneurship that generates innovation from entrepreneurship that works only as a source of employment to the entrepreneur. As a matter of fact, the Global Entrepreneurship Monitor (GEM) cites six innovative enterprise characteristics, related to: the level of knowledge applied to products or services; the number of competitors; development of products and services towards international markets; the amount of time passed since the process or technology has been released to the market; jobs creation anticipation; and finally, the income obtained from such innovations (GEM, 2014). When it comes to innovation, the most recent GEM report shows that Brazil presents the second worst innovative potencial, just above Russia (GEM, 2016).

In order to address the issues of innovation, entrepreneurship and technology entrepreneurship in Brazil, this master dissertation introduces its central theme - technology entrepreneurship - followed by the research question. The first section also approaches the general objective and specific objectives, followed by the justification that indicates the importance of the subject for the scientific community and society in general. The second section presents the theoretical framework by addressing the concepts and processes related to entrepreneurship, technology entrepreneurship, as well as innovation. The third session presents the research method applied to answer the research question. The fourth session shows the results obtained from analysis performed on data collected. Finally, the fifth session presents the conclusions, and limitation to this research.

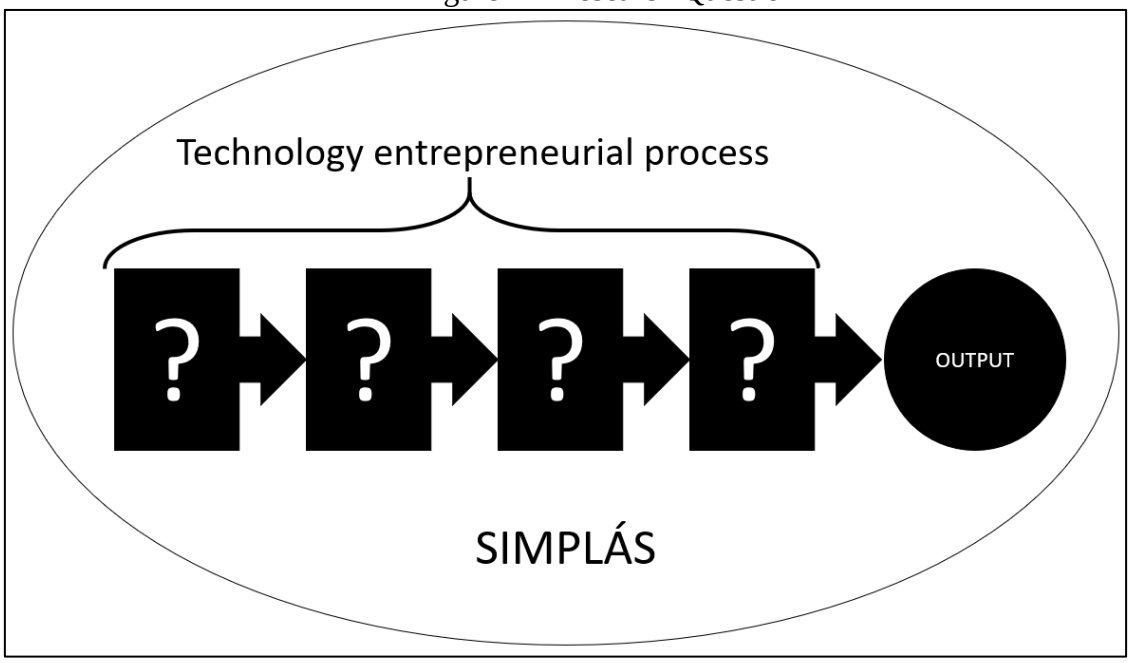
1.1 RESEARCH QUESTION

The research question formulation influences the entire research process, including research methods choice regarding data collection and interpretation, so the researcher must have a clear idea of the question and remain open to unexpected results (FLICK, 2004).

Therefore, the research question that guided this master dissertation, as depicted in Figure 1 is:

How does the technology entrepreneurship process occur in SIMPLÁS companies?

Figure 1 – Research Question



Source: author's own (2018).

1.2 OBJECTIVES

The general objective of this dissertation was to study the technology entrepreneurial process in SIMPLÁS companies. For this purpose, the following specific objectives were observed:

a) to identify the technology entrepreneurial process in SIMPLÁS companies;
b) to identify technology innovation from the technological entrepreneurial process in SIMPLÁS companies;
c) to analyze the technology entrepreneurial process;
d) to analyze the technology innovations in the technology entrepreneurial context.

1.3 RESEARCH JUSTIFICATION AND RELEVANCE

Research helps understanding a subject studied, since it deals with gathering information in order to answer the proposed research problem, so it generates results accessible to the scientific community. Therefore, new knowledge about a theme is a product of the explanation of its causes, effects, properties, and how they happen in the social or natural world,

that is, the human being depends on the understanding and interpretation of the theme related to the world (BOOTH; COLOMB, WILIAMS, 2000).

The theme of this master dissertation, technology entrepreneurship, has its importance related to efficiency-driven countries, such as Brazil, especially because it presents entrepreneurship rates comparable to those countries driven by innovation (ALBUQUERQUE, 2007; GEM, 2014). In this context, innovation and technology development policies depend on what is known about the scale, characteristics, internal and systemic factors of innovative companies (OECD, 2005), since science-based industries serve as the basis for knowledge-based economies (MAINE; GARNSEY, 2006). Consequently, technology entrepreneurship has attracted the interest of researchers and strategists, since it represents a significant impact on economic progress as a consequence of the integration of entrepreneurship and technological innovation (MOSEY; GUERRERO; GREENMAN, 2017).

Moreover, the level of technological innovations has proven its contribution to economic performance (KHEFACHA; BELKACEM, 2016), since technological innovations maximize corporate profits, so technology entrepreneurship can be a source that generates new values, keeps continuous growth to the company and helps private companies to survive (YUN; PARK; MOHAN, 2016). However, there seems to be differences between what policy makers set to be achieved by technology entrepreneurship, with Silicon Valley as standard, and what it really does (GIONES VALLS, 2016). Hence, policies may be improved in order to let technology entrepreneurship achieve what it is meant to (GIONES VALLS, 2016). Therefore, it is necessary to understand how the process through which technology entrepreneurship happens in order to make it more profitable for both companies and society (GIONES VALLS, 2016).

In order to analyze the technology entrepreneurial process, this master dissertation was applied to SIMPLÁS (Sindicato das Indústrias de Material Plástico do Nordeste Gaúcho – Plastic Materials Industry Union of Rio Grande do Sul Northeast), which represents 436 plastic processing industries. Since its beginning, SIMPLÁS has dedicated efforts towards industry growth through sustainable development promotion as well as helping companies to keep competitive. Therefore, SIMPLÁS values include its concerns towards innovation. Hence, its interest in participating of this research.

Finally, it is necessary to understand how such companies become innovative, since politicians have realized that economic and social development depend on policies towards science, technology and innovation (CAVALCANTE; DE NEGRI, 2011). After all, entrepreneurship and innovation are related (PLONSKI, 2007), even though there is no single

and precise definition of what technology entrepreneurship is (BAILETTI, 2012). Therefore, this master dissertation intended to explore the topic of technology entrepreneurship, specifically in relation to its process, so that it was possible to analyze and relate technological entrepreneurship to the generation of innovation.

2 THEORETICAL BACKGROUND

In order to fulfil this dissertation' objectives, it is necessary to understand concepts related to entrepreneurship, technology entrepreneurship, innovation and technology as well. Therefore, this section presents the concepts, researches and processes associated to them according to classic and current scientific literature. Finally, the theoretical framework used for this dissertation is shown. As to approach both classic and current literature on these themes, searches on databases were carried.

The process started by understanding classic literature for entrepreneurship, innovation and technology entrepreneurship. First, three searches were carried on BDTD (Banco Digital de Teses e Dissertações – Theses and Dissertations Digital Database) and NDLTD (Networked Digital Library of Theses and Dissertations) using as keywords for each search: entrepreneurship, innovation, and technology entrepreneurship, and sorting documents from most recent to oldest. Second, the abstracts of the first results were read as to identify the main purpose of the dissertation. Third, the first documents read, whose themes were alike this dissertation, were downloaded. The number of documents downloaded was decided according to the amount of information that was extracted for each theme, so this process was repeated until the goal was achieved. Fourth, the literature section of each document downloaded and read was analyzed in order to find which authors were considered classic for each theme. Finally, most cited authors had its publications consulted, either digital or paper copies, as to construct the theoretical background. The fluxogram of this process as well as the screenshots that depict each part of the procedure are shown on Appendices A and B.

As to identify current literature on the themes of entrepreneurship, innovation and technology entrepreneurship, three searches were carried on Scopus Database using as keywords for each search entrepreneurship, innovation, and technology entrepreneurship that should appear in the title, abstract or keywords of the document. First, each search results were sorted from most recent to oldest. Second, the abstracts of the first results were read as to identify the main purpose of the document. Third, the first documents read, whose themes were alike this dissertation, were downloaded. The number of documents downloaded was decided according to the amount of information that was extracted for each theme, so this process was repeated until the goal was achieved. Fourth, the results and conclusions sections of each document downloaded and read were analyzed in order to find most recent contributions for each theme. The fluxogram of this process as well as the screenshots that depict each part of the procedure are shown on Appendices C and D.

Finally, the same analysis process was performed to the most cited documents. Such process intended to fill up any gaps on classic authors on the three themes approached. As well as the first two parts of the literature framework, the fluxogram of this process as well as the screenshots that depict each part of the procedure are shown on Appendices E and F. The results of these three processes were finaly combined in the text that is shown on this chapter. The goals were to distinguish and present the three themes, as well as their processes, including at least 50% of recent literature (no more than 10 years of published time) as to justify their current relevance.

2.1 ENTREPRENEURSHIP

The term entrepreneurship has its Latin origin divided between *entre* that designates the space that goes from one place to another, representing interaction, while the term *prendre* means to take possession, to employ, to take an attitude, whereas the French term *entreprendre* is associated with doing something (HOSELITZ, 1951). On the other hand, the contemporary definition brought by Oxford Online Dictionary defines entrepreneurship as "the activity of setting up a business or businesses, taking on financial risks in the hope of profit (OXFORD, 2016, unpaginated). Consequently, the term also differs from understanding according to the different authors and approaches that address it.

Richard Cantillon in 1755 is considered the pioneer to the entrepreneurial field of study with an economical approach, since he considered the entrepreneur as the person who buys means of production and combines them into a new product. In addition, Cantillon claimed that taking risks was a consequence of entrepreneurship, since there is uncertainty on the sale price. In 1880, Jean Baptiste Say added entrepreneurs' management skills and moral qualities that allow them to transfer resources from less productive areas to more productive areas. Later, Marshall (1920) added innovation and progress as results of the entrepreneurial process, with the entrepreneur being responsible and controlling actor of innovation. While Knight, in 1921, distinguished risk and uncertainty, since the entrepreneur takes risks to be rewarded with profit later (HOSELITZ, 1951).

However, it was Schumpeter's approach in 1934 that defined innovation as the result from entrepreneurship that produces new things, or existing things in a new way, under the leadership of an entrepreneur that combines existing knowledge and new forms of production. Based upon the work of Schumpeter, the term entrepreneurship conquered mores adepts in the treatment of the subject as a function of market equilibrium and imbalance (Schumpeter, 1961).

Thus, Kirzner (1973) defines entrepreneurship as the ability to perceive new opportunities that tend to balance the market. On the other hand, Casson (1982) relates entrepreneurship to decision-making linked to the scarcity of resources, in a process of market construction. However, resource scarcity should be ignored as entrepreneurship is the pursuit of opportunity regardless of other factors (STEVENSON; ROBERTS; GROUSBECK, 1985).

Once more, the relationship between entrepreneurship and innovation is resumed by relating existing resources to new wealth production capacities (DRUCKER, 1986). Accordingly, Chua, Chrisman and Sharma (1999) add that entrepreneurship is the association between acts of organisational innovation, whether in a new or existing organisation. Furthermore, GEM report (2016) corroborates this definition, since GEM characterizes entrepreneurship as the creation (or attempted creation) of a new business or even the expansion of an existing enterprise.

Some authors address entrepreneurship as a matter of entrepreneurs' behaviour. Therefore, entrepreneurs are characterized by need for: success, recognition, power; strong character (BROCKHAUS, 1980), creativity, persistence, leadership, initiative, flexibility, ability to manage situations and resources use (FILION, 1991), ability to recognize and exploit opportunities (AUDRETSCH, 2012). In addition, Aldrich (2008) affirms that entrepreneurship is influenced by the results of individual actions in a structured social context.

Entrepreneurship has also been addressed as a matter of enterprise creation. As for example, Rumelt (1987) defines entrepreneurship as the creation of new businesses, nevertheless, they cannot be just copies of existing ones, that is, they must present something new. In contrast, Low and Macmillan (1988) define entrepreneurship as the creation of a new company, regardless of its novelty aspects. Accordingly, Gartner (1988) adds that entrepreneurship is the process by which companies come into existence, with such process being characterized by the entrepreneur's behaviour.

Moreover, Watson (2012) argues that entrepreneurship is based upon individuals that initiate a company, for this purpose, entrepreneur and its company must be part of a social context. In contrast, Van Praag and Cramer (2001) claim the enterprise depends on the production factors controlled by the entrepreneur. Finally, Ruef and Lounsbury (2007) define entrepreneurship as not only creating a new organisation, but also about the shapes it can take regarding its innovation routines, technological and social institutions associated with it.

Entrepreneurship can also happen within existing companies, thereupon, Drucker (1986) argues that entrepreneurial management of the organisation is a technology that helps to perpetuate transformation in society, attitudes, values and behaviours. Moreover, Mintzberg

(1989) characterizes as innovative organisations those that respond continuously to the complex and unpredictable environment, with entrepreneurs being small businesses that develop simple innovations.

Entrepreneurs are also considered psychologically different from other people. From this perspective, entrepreneurs are: innovative, leaders, flexible, risk takers, independent, creative, tenacious, original, optimistic, flexible, results-oriented, self-confident, tolerant to ambiguity and uncertainty, and proactive (Filion, 1997), tend to be in control of the situation, prone to take risks, problem solvers, have strong values, power oriented, socialize and have experience (THORNTON, 1999), differentiated by unusual performance (FRESE, 2009).

In order to summarize the field of entrepreneurship research, Framework 1 presents contributions to the entrepreneurial field of study, as well as recent studies that show research trends to the entrepreneurial field of study.

Framework 1 – Entrepreneurship summary

(to be continued)

Author	Year	Mains contribution to the entrepreneurial field
Cantillon*	1755	The entrepreneur is the responsible for buying means of production and combining them into a new product.
Say*	1880	Entrepreneurs have specific management skills and moral qualities.
Marshal	1920	The entrepreneur is the responsible and controlling actor of innovation.
Knight*	1921	Distinguished risk and uncertainty.
Schumpeter	1934	First proposed innovation and related to entrepreneurship.
Kirzner	1973	Entrepreneurship as a source to balance the market.
Brockhaus	1980	Entrepreneurs are characterized by need for success, recognition, power and strong character.
Casson	1982	Entrepreneurship is related to decision-making and scarcity of resources.
Stevenson, Roberts and Grousbeck	1985	Entrepreneurship is the pursuit of opportunity regardless of other factors.
Drucker	1986	Innovation and entrepreneurship are related and may help to perpetuate transformation in society, attitudes, values and behaviours.
Rumelt	1987	Entrepreneurship is the creation of new businesses that present something new.
Low and Macmillan	1988	Entrepreneurship is the creation of a new company, regardless of its novelty aspects.
Gartner	1988	Entrepreneurship is the process by which companies come into existence.
Mintzberg	1989	Innovative organisations are those that respond continuously to the complex and unpredictable environment.
Filion	1991	Entrepreneurs are characterized by creativity, persistence, leadership, initiative, flexibility, ability to manage situations and resources use.

(continuation)

Chua, Chrisman and Sharma	1999	Entrepreneurship is the association between acts of organisational innovation.
Thornton	1999	Entrepreneurs are characterized by being in control of the situation, prone to take risks, problem solvers, have strong values, power oriented, socialize and have experience.
Van Praag and Cramer	2001	Enterprise creation depends on the production factors controlled by the entrepreneur.
Ruef and Lounsbury	2007	Entrepreneurship is also about innovation routines, technology and social institutions associated with entrepreneurship.
Aidis, Estrin, and Mickiewicz	2008	Negative environment for business and entrepreneurial activity lead to low levels of entrepreneurship.
Aldrich	2008	Entrepreneurship depends on a structured social context.
Frese	2009	Entrepreneurs are differentiated by unusual performance.
Acs et al	2009	Entrepreneurial activity also involves the exploitation of intra-temporal knowledge spillovers.
Braunerhjelm et al	2009	Policies facilitating entrepreneurship are an important tool to enhance knowledge diffusion and promote economic growth.
Caliendo, Fossen and Kritikos	2009	Individuals with lower risk aversion are more likely to become self-employed, if they are coming out of regular employment. On the other hand, risk attitudes do not seem to play a role in the decision process for individuals coming out of unemployment or inactivity.
Zhao, Seibert And Lumpkin	2010	Entrepreneurial intentions and entrepreneurial performance are associated with the personality constructs openness to experience and conscientiousness. On the other hand, risk propensity is not associated to entrepreneurial performance.
Henrekson	2010	Rapidly growing firms generate more new jobs than firms that do not rapidly grow.
Delgado, Porter and Stern	2010	Higher growth rates in the formation of new firms and start-up employment are related to strong clusters.
Van Der Zwan, Thurik and Grilo	2010	The perception of lack of financial support does not influence entrepreneurial engagement level, however age may influence entrepreneurial engagement level.
Audretsch	2012	Entrepreneurs have the ability to recognize and exploit opportunities.
Watson	2012	Entrepreneur and its company must be part of a social context.
Park and Steensma	2012	Corporate Venture Capital funding is beneficial for new ventures when they need complementary assets or operate in uncertain environments.
Landström, Harirchi and Åström	2012	Mapped the entrepreneurial field of study and suggested that it is important to know what parts are less comprehended in researches.
Martin, McNally and Kay	2013	Entrepreneurship Education and Training is associated with higher levels of human capital assets, knowledge and skills, positive perceptions of entrepreneurship, and intentions to become an entrepreneur.

(conclusion)

Hui-Chen, Kuen-Hung and Chen-Yi	2014	Personal attitude, perceived behaviour, subjective norms, motivation, ability and subjective norms are either directly related or affect entrepreneurial intentions.
De Jong and Marsili	2015	Larger ventures are usually based on Schumpeterian opportunities, whereas Kirznerian opportunities are more frequently pursued by small ventures.
GEM	2016	Entrepreneurship is the creation (or attempted creation) of a new business or even the expansion of an existing enterprise.
Prashantham, Eranova, and Couper	2018	Globalization can be a force for good by enabling forms of entrepreneurship that enable important institutional change.
Al Omoush, Al-Qirem, and Al Hawatmah	2018	There is a direct relationship between the degree of e-business entrepreneurship and the actual usage of e-business innovations, that combined impact on long-term sustainability.
Martens et al	2018	Practices of project management influence on a firm's entrepreneurial orientation, so firms are able to achieve better results and generate a competitive advantage.
Chandra	2018	Five topics are persistent on the entrepreneurship field of research: institutions and institutional entrepreneurship, innovation and technology management, policy and development, entrepreneurial process and opportunity, and new ventures

Source: author's own (2018).
*As reported by Hoselitz (1951).

As shown in Framework 1, entrepreneurship researches approach different themes through time (CHANDRA; 2018) and what is known about them may help the field of study (LANDSTRÖM; HARIRCHI; ÅSTRÖM, 2012), such as: the entrepreneurs' role (CANTILLON, 1755 apud HOSELITZ, 1951; SAY, 1880 apud HOSELITZ, 1951; MARSHAL, 1920); risk, uncertainty and profit (KNIGHT, 1921; PARK; STEENSMA, 2012); innovation (SCHUMPETER; 1934; DRUCKER, 1986; MINTZBERG, 1989; RUEF; LOUNSBURY, 2007); market structure (KIRZNER, 1973;); social context (ALDRICH, 2008; AIDIS; ESTRIN; MICKIEWICZ, 2008; DELGADO; PORTER; STERN, 2010; WATSON, 2012; PRASHANTHAM; ERANOVA; COUPER, 2018); entrepreneurs' characteristics and abilities (BROCKHAUS, 1980; FILION, 1991; THORNTON, 1999; FRESE, 2009; CALIENDO; FOSSEN; KRITIKOS, 2009; ZHAO; SEIBERT; LUMPKIN, 2010; VAN DER ZWAN; THURIK; GRILO, 2010; AUDRETSCH, 2012; HUI-CHEN; KUEN-HUNG; CHEN-YI, 2014); resources availability (CASSON; 1982; VAN PRAAG; CRAMER, 2001), opportunity (STEVENSON; ROBERTS; GROUSBECK, 1985; ACS et al., 2009; DE JONG; MARSILI, 2015); new business formation (RUMELT, 1987; LOW; MACMILLAN, 1988; GARTNER, 1988; GEM, 2016); entrepreneurship in existing companies (CHUA; SHARMA;

CHRISMAN, 1999); policies (BRAUNERHJELM et al., 2009); jobs generation (HENREKSON, 2010), funding (PARK; STEENSMA, 2012); entrepreneurship education (MARTIN; MCNALLY; KAY, 2013); e-business (AL OMOUSH; AL-QIREM; AL HAWATMAH, 2018); and project management (MARTENS et al., 2018).

Finally, as to map the most current and the most relevant literature on entrepreneurship, a bibliometric search was performed on Scopus Database. The criteria and results found are shown on Appendix G. Therefore, the current exploratory study focused on the entrepreneurial process, as presented in the next section.

2.2 ENTREPRENEURIAL PROCESS

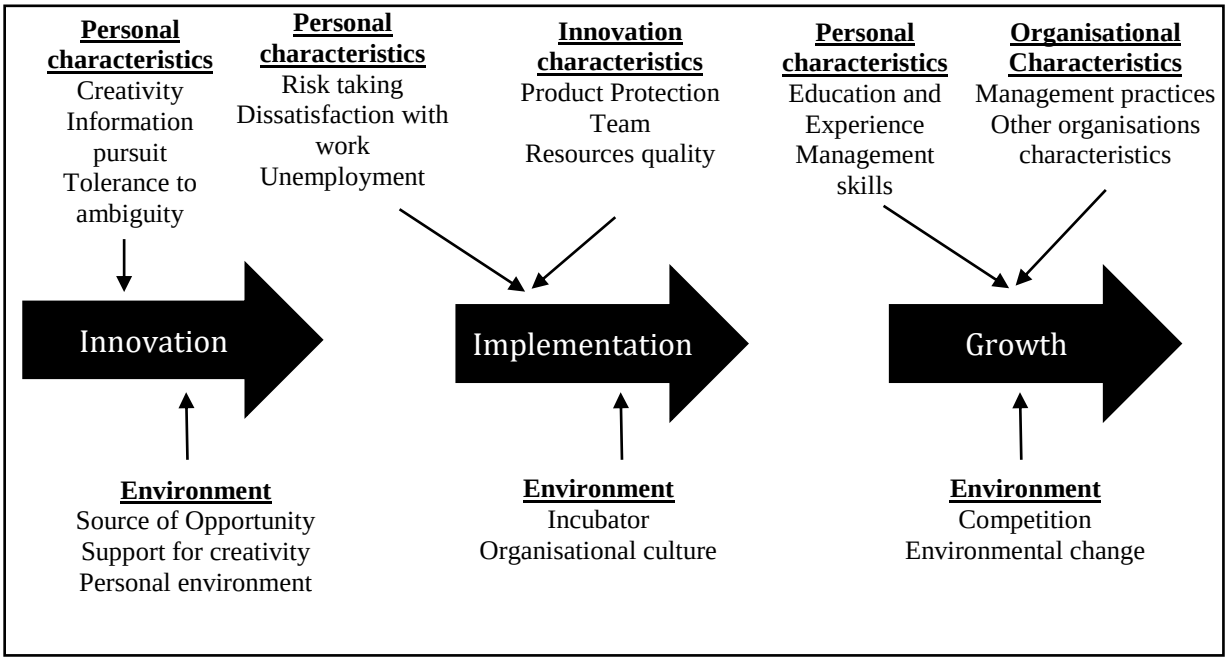
Entrepreneurship can be considered as the process by which business opportunities are explored through the combination of new or existing resources, which results in the marketing and development of new products or services (HITT et al., 2011). As for opportunities, there are five types of opportunities to be explored: new products or new qualities in existing products, new production methods, new forms of industrial organisation, opening of new markets and new sources of supply (SCHUMPETER, 1961). Later, the studies about the entrepreneurial process evolved through time, with the first entrepreneurial process model claimed by Wilken (1979), who argued it was composed by motivation, planning and set up stages. Therefore, this section introduces different approaches to the entrepreneurial process through time, that is, entrepreneurial process models, process phases, metaphors comparison, variables that interfere in the process and taxonomy approach.

Afterwards, new ventures creation was explained by the integration of environment variables, such as processes, people and organisations, with the entrepreneur responsible for the process (GARTNER, 1988). Even though the process is not linear, the phases proposed were: find business opportunity, gather resources, deliver products or services to the market, produce, build the organisation, and respond to government and society (GARTNER, 1988). Once more entrepreneurial new process phases were proposed: innovation, implementation and growth, which are subject to personal, organisational, innovative and environmental characteristics at each stage (MOORE, 1986).

Figure 2 shows the entrepreneurial process proposed by Moore (1986), which starts from the innovation phase, that seeks to achieve the greatest number of ideas with market potential, hence, it is affected by personal and environmental characteristics. The implementation phase is related to the introduction of an innovation, and requires the

commitment of the entrepreneur, associated with personal characteristics and innovation, in which the lack of financial resources is one of the major constraints to phase completion. When reaching the growth stage, the entrepreneur should feature managerial and organisational abilities, as well as organisational culture should be strength. Environment can influence the process through unexpected changes and competitors entrance or strengthening (MOORE, 1986).

Figure 2 – Entrepreneurial process



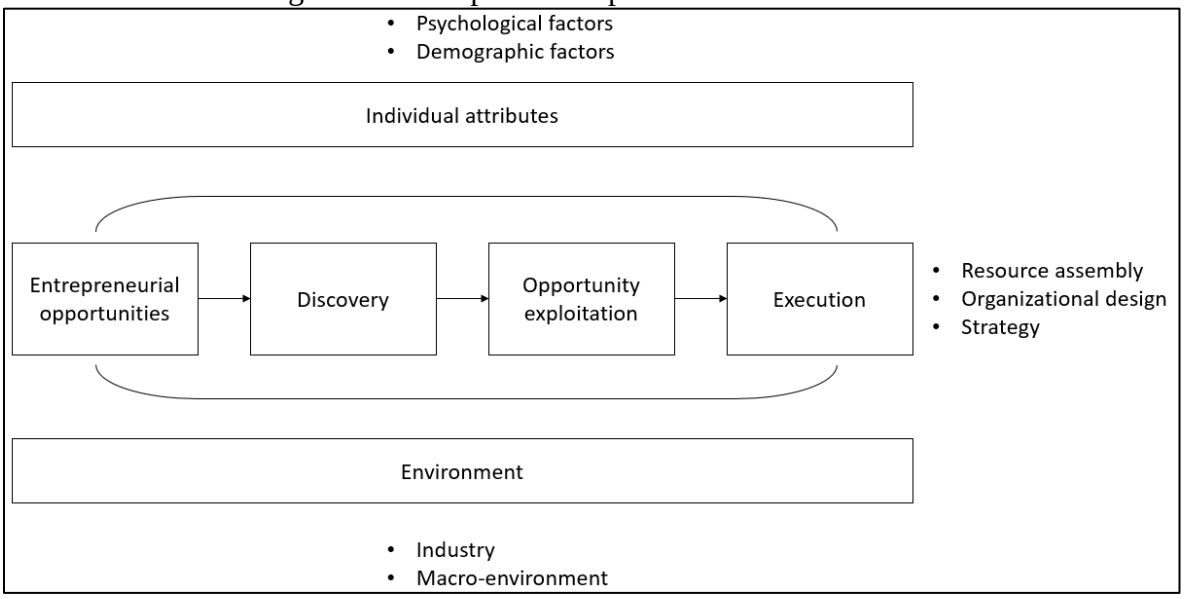
Source: Moore (1986, p. 67).

In the same way, the role of the entrepreneur in the entrepreneurial process was highlighted, since it was understood as the set of entrepreneurs' behaviours (GARTNER, 1988), with the entrepreneur represented by individuals or teams that create value by gathering resources in order to explore opportunities in the environment (MORRIS, 1998). From this perspective, seven creation possibilities arise from the entrepreneurial process: wealth, company, innovation, change, employment, value and growth (MORRIS, 1998). For this purpose, the entrepreneurial process should be considered as the analysis basis (GARTNER, 1988).

Once again, the stages of the entrepreneurial process were claimed to be discovery, evaluation and exploration of opportunities and execution, with the entrepreneur as responsible actor for such process (SHANE; VENKATARAMAN, 2000; SHANE, 2003). Also, Schlemm and Duclós (2003) defined the entrepreneurial process stages to be: identification of a new

opportunity, organisation and arrangement of resources needed to explore the new business. Consequently, the result of the non-linear process should be success (BROCKNER; HIGGINS; LOW, 2004), however, there are several variables that interfere in the whole process: environment, that is related to industry and the Macro-environment; the individual attributes, which is associated with psychological and demographic factors; and, execution variables that only affect this specific part of the process, that is resource assembly, organisational design and strategy (SHANE, 2003). The entrepreneurial process as proposed by Shane (2003) is depicted in Figure 3.

Figure 3 – Entrepreneurial process and its variables



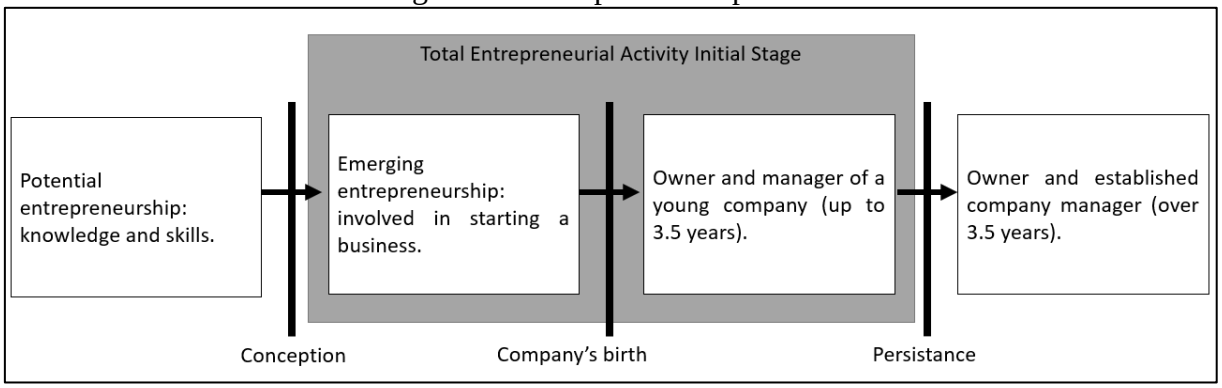
Source: Shane (2003).

In contrast, the entrepreneurial process as proposed by Brockner, Higgins and Low (2004), consists of a non-linear process begins with the conception of an idea that must be tested against reality, if it is approved, the next stage deals with resources gathering as to turn the idea into reality. The third stage consists of proving the business model to be feasible, which may involve prototypes testing. Finally, the idea must be produced in large scale, and then presented to market. From the moment the company reaches the life cycle, it is finally able to reach maturity, followed by renewal and growth or declining (BROCKNER; HIGGINS; LOW, 2004).

Nonetheless, the GEM report considers the entrepreneurial process (as shown in Figure 4) from the entrepreneur's role, that is, the first stage identifies potential entrepreneurs who have not yet taken any actions towards entrepreneurship. As soon as the first barrier, conception, is overcome, the entrepreneurship level at the initial stage is reached. The second

stage involves the activities related to the enterprise's beginning. Finally, the third phase, after the company's birth, represents its first three and a half years of operation. The last barrier to be broken refers to persistence, which is represented by companies established for more than three and a half years (REYNOLDS et al, 2005).

Figure 4 – Entrepreneurial process



Source: Reynolds et al. (2005, p. 5).

Although, other researches define the entrepreneurial process by using metaphors. In fact, the entrepreneurial process can be compared to a long road, which transforms a common individual into an entrepreneur by going through various stages of entrepreneurial process (VAN DER ZWAN; THURIK; GRILO, 2010). Based upon this approach, the entrepreneurial process is based on motivations and barriers encountered by entrepreneurs, with men being more motivated to go through the entrepreneurial process than women (VAN DER ZWAN; THURIK; GRILO, 2010). Likewise, the entrepreneurial process, based on the entrepreneurs' emotional motivation, can be compared to the parents and children metaphor, with the entrepreneur compared to the father (CARDON et al., 2005). Consequently, the stages identified according to this metaphor are: conception, gestation, early childhood, childhood and adolescence, maturity and bankruptcy (CARDON et al., 2005).

As a result of previous research on the entrepreneurial process, its subprocesses started being studied as well. One of these subprocesses concerns about how the resources will be gathered to fund the enterprise, which is subdivided in two stages: selection made by the founders and selection made by the investors (ECKHARDT; SHANE; DELMAR, 2006). Another subprocess identified and added to entrepreneurial process refers to the exit phase, that is, when founders leave their company (DeTIENNE, 2010), therefore private equity buyout governance is a key element to sustain the entrepreneurial transition, once it aligns family interests and goals (DI TOMA; MONTANARI, 2017). Likewise, another variable that interferes in the process regards different engagement levels according to each step of the

process (GRILO; THURIK, 2006).

However, researches regarding opportunity are highlight by Alvarez and Barney (2007), who claim that there are different assumptions regarding opportunity identification: discovery theory and creation theory. According to the discovery theory, opportunities exist, entrepreneurs are different from non-entrepreneurs, and decision-making context is characterized by risk as proposed by Kirzner (1997). On the other hand, the creation theory advocates that opportunities do not exist independent of entrepreneurs, who may or may not differ from non-entrepreneurs. Therefore, decision making is characterized by uncertainty as proposed by Knight (1921). Also, McCann and Vroom (2015) argue that the nascent stage of the entrepreneurial process is characterized by changes in beliefs when evaluating opportunities.

Other types of entrepreneurial process models were identified in previous literature, such as family businesses successions that can be considered entrepreneurial processes, so when succession happens between family members, it is associated with family commitment to the enterprise. In contrast, the succession by someone outside the family can be considered as a new entrepreneur process of entry, that is, there are new business owners, as well as an exit perspective, in view of the former enterprise's owners (NORDQVIST et al, 2013). Coopetion is also considered a type of entrepreneurial process, however, it is characterized by coping with uncertainty and risk-taking behaviour (GALKINA; LUNDGREN-HENRIKSSON, 2017).

As mentioned earlier, some researches investigate variables that interfere on the entrepreneurial process. In fact, when dealing with the social capital dimensions: trust, norms and networks; it was found that an individual's networks is the most significant during various stages of the entrepreneurial process and it is also the most significant predictor to the entrepreneurial process (AFANDI; KERMANI; MAMMADOV, 2017). As for the entrepreneurial process within existing firms, strategic human resource management facilitates introduction of new products, especially in uncertain environments (WEI, 2013). As to new companies, the entrepreneurs' implementation intention also impacts on the entrepreneurial process (Van Gelderen et al., 2017), as well as motivation and perception of business opportunities (GARCÍA-RODRÍGUEZ et al., 2017).

In order to differ among different approaches, views and aspects related to entrepreneurial process models, Moroz and Hindle (2012), proposed four taxonomy classifications. The first one, stage model, refers to tasks and phases usually sequentially and linearly arranged. Such model implies that there is no overlap between activities (MOROZ; HINDLE, 2012). The second classification is called static framework, and does not take into

considerations tasks order, but its processes try to identify causal links to the entrepreneurial process (MOROZ; HINDLE, 2012). Process dynamics, the third classification, refers to models that are built upon qualitative methods. Therefore, such processes are explained in terms of how and why they happen. These processes are also influenced by their contexts, temporal characteristics, researchers' interpretation and oriented towards change (MOROZ; HINDLE, 2012). Finally, the fourth classification is called quantification sequences and refers to the approaches that takes into consideration the historical sequence of the process.

In order to summarize the current section, Framework 2 shows each author's contribution to the entrepreneurial process. In fact, it is possible to notice that there are gaps in the literature regarding the entrepreneurial process (ZAPKAU; CHRISTIAN; KABST, 2017).

Framework 2 – Entrepreneurial process summary

(to be continued)

Author	Year	Contribution to the entrepreneurial process
Schumpeter	1934	Identified five types of opportunities to be explored.
Wilken	1979	The first author to propose the entrepreneurial process and its phases.
Gartner	1985	Recognized that the process is not linear.
Moore	1986	The entrepreneurial process is subject to personal, organisational, innovative and environmental characteristics at each stage.
Gartner	1988	The entrepreneurial process was understood as the set of entrepreneurs' behaviours.
Morris	1988	Seven creation possibilities arise from the entrepreneurial process: wealth, company, innovation, change, employment, value and growth.
Shane and Venkataraman	2000	The stages of the entrepreneurial process are: discovery, evaluation and exploration of opportunities.
Schlemm and Duclós	2003	Added organisation and arrangement of resources steps to the entrepreneurial process.
Shane	2003	Environment, individual attributes, psychological factors, demographic factors, resource assembly, organisational design and strategy are variables that affect the process.
Brockner, Higgins and Low	2004	The result of the non-linear process should be success.
Cardon et al.	2005	Compared the entrepreneurial process to the parents and children metaphor.
Reynolds et al.	2005	Considers three phases to be performed by the entrepreneur: conception, company's birth and persistence.
Eckhardt, Shane and Delmar	2006	One of the sub processes concerns how resources will be gathered to fund the enterprise, which is subdivided into two stages: selection by founders and selection by the investors.
Grilo and Thurik	2006	The entrepreneurial process is affected by different engagement levels according to each step of the process.

(conclusion)

Alvarez and Barney	2007	Two theories influence research on the entrepreneurial process: discovery theory and creation theory.
DeTIENNE	2010	Added the exit phase to the entrepreneurial process.
Van Der Zwan, Thurik and Grilo	2010	The entrepreneurial process is based on motivations and barriers encountered by entrepreneurs.
Hitt et al.	2011	Results in the development of new products or services.
Moroz and Hindle	2012	Proposed four taxonomy classifications for the entrepreneurial process.
Nordqvist et al.	2013	Claimed that successions in family businesses can be considered entrepreneurial processes.
Wei	2013	Associated strategic human resource management, entrepreneurially-oriented firm, and uncertain environments.
McCann and Vroom	2015	The nascent stage of the entrepreneurial process is characterized by ongoing significant changes in entrepreneurs' beliefs.
Afandi, Kermani and Mammadov	2017	Declared that the individual's networks influence stages of the entrepreneurial process and it is also the most significant predictor to the entrepreneurial process.
Van Gelderen et al.	2017	Implementation intentions mediate the effects of goal intentions on taking entrepreneurial action.
Di Toma and Montanari	2017	Related private equity buyout governance to sustainable organisational capabilities in entrepreneurial transition.
García-Rodríguez et al.	2017	Perception of business opportunities is associated with motivation, which influences entrepreneurial intention.
Galkina and Lundgren-Henriksson	2017	Coopetition is an entrepreneurial process that involves coping with uncertainty, risk-taking behaviour, exploring and exploiting opportunities, and developing innovative solutions.
Zapkau, Christian and Kabst	2017	The authors show that prior findings on entrepreneurial process are ambiguous and theoretical shortcomings exist.

Source: author's own (2018).

2.3 INNOVATION

Innovation studies originated with Schumpeter (1934) in his work entitled "The Theory of Economic Development: An Inquiry into Profits, Capital Credit, Interest, and Business Cycle" in which he declares innovation an agent of creative destruction, resulting in economic imbalance. The proposition consisted of processes that resulted in the economic system's rupture and promoted creative destruction by inserting new products for both consumption and production goods, new production methods, new market creation, discovery and use of a new raw materials or components source, as well as using new market structures that generate innovation. Therefore, small improvements are not enough, but rather a break in the way things are done in organisations (SCHUMPETER, 1961).

According to Olea (2008), Schmookler (1966) in his work entitled Invention and

economic growth, continued Schumpeter's studies, as he proposed that market pressure and technological impulses are innovation sources. Whereas Haustein (1980) associates innovation with change, that is, the organisation's ability to generate products, machines, and organisational solutions both for its own use and for the external market. As well as, Robbins (1998) who also associates innovation with change, although he warns that innovation must be a specialized change, that is, not every change is an innovation. Likewise, Pavon and Goodman (1981) believe that innovation is the process of transforming an idea into new or better products, processes, services or management and planning techniques. Similarly, Freeman (1982) associates innovation with novelty, dividing them into four categories: product, process, system or device.

The Oslo Manual defines innovation as the introduction of a new product, process, marketing method or organisational change, classifying innovations as new to the market or to the world, with radical or disruptive innovations indicating significant change in market and economic activity of a company (OECD, 2005). Innovation objectives regarding its economic aspect include products substitution or products line increment; developing products and processes that contribute to the environment through harm reduction; increasing or maintaining market share, as well as opening new markets not exploited by other companies; production costs reduction or making production methods more flexible; and improving product quality or working conditions as well (OECD, 2005).

Regarding motivation to innovate, Prahalad and Krishnan (2008) argue that innovation has become responsible for creating consumer expectations based on their behaviour. In the same way, innovation is responsible for meeting market's demands. Therefore, companies that can anticipate such demands will be announcing their own success, since innovative organisations show superior growth when compared to non-innovative companies. Likewise, Bessant and Tidd (2009) define innovation as the relationship between opportunities and the advantages provided by them, so innovation is characterized by constant change through ideas' generation, selection and implementation. For this purpose, Crossan and Apaydin (2010) add that innovation can be the production or adoption, assimilation and exploitation of an idea that generates renewal or significant improvements.

Similarly, "innovation is an idea, practice, or object perceived as new by an individual or group of individuals" (ROGERS 2003, p. 67), with the perception of novelty by the individual as sufficient condition to classify the idea, practice or object as innovative (ROGERS, 2003). In Brazil, technological innovation is acknowledged in Law No. 11,196, of November 21, 2005, that characterizes innovation as new products or new manufacturing

processes, as well as products and processes that have added new functionalities or characteristics that result in incremental improvements, and consequently present an effective quality or productivity gain, resulting in greater market competitiveness (BRASIL; ORTEGA, 2007).

As for the innovative opportunities sources, Drucker (1986) cites: the unexpected; the incongruity; process needs; change in the industrial sector or in market structure; demographic change; changes in perception; or new knowledge appearance. Therefore, innovation activities can appear in the form of: knowledge acquisition and generation for the company: research and experimental development, acquisition of technology incorporated or not, acquisition of know-how not incorporated; other preparations for production: instrumentation and industrial engineering, industrial design, capital acquisitions, production start; marketing of new or improved products (OECD, 2005). In contrast, Birkinshaw, Hamel and Mol (2008) include to the types of innovation, management innovation that is the invention and implementation of a management practice, process, structure, or technique that is new to the state of the art and is intended to further organisational goals.

On the other hand, Dosi (1984) believes that innovation can also be characterized by the imitation of new products, whereas Van De Ven (1986) associates innovation with ideas that are driven by groups of people, who are responsible for developing and deploying ideas in organisations. Therefore, innovation results in changes that can lead to improvements in organisational performance (DRUCKER, 1986). In order for such improvements be sustainable Schot And Geels (2008) argue that technological niches must be created. In contrast, Rosenbusch, Brinckmann and Bausch (2011) argue that the age of the firm, the type of innovation, and the cultural context affect the impact of innovation on firm performance.

Once more, innovation is defined as the process that results in new products, processes and systems, which is essential for companies to be competitive (LAWSON; SAMSON, 2001). In order for this process be possible, Porter (2004) states that innovation depends on management and innovation support strategy that includes employees' endorsement as well. While Porter (2004) considers that innovation appear in new or improved products, processes or marketing, Oslo Manual defines innovation as:

> The implementation of a new or significantly improved product (good or service), a process, a new marketing method, a new organisational method in business practices, workplace organisation or external relations (OECD, 2005, p. 55).

Therefore, Gatignon et al. (2002) deal with innovation's place by distinguishing it between central or peripheral. Hence, different innovation types are defined as new generation

or architecture, as well as innovation characteristics are: incremental, that is, represents improvement and skills strengthening; or radical, which represents innovations that rupture with everything that exists in the market and destroy current skills. As for innovation characteristics, Prajogo and Ahmed (2006) add that innovative companies develop and implement products that are radically or incrementally innovative in a given period of time. Thereupon, Gatignon et al. (2002) conclude that complexity is directly related to the time need from developing to launching an innovation in a product, service or process.

As a result, the novelty level can be expressed in terms of users' knowledge, persuasion or decision to adopt an innovation, whereas its adoption depends on their knowledge and attitudes (ROGERS, 2003), since there are new principles applied to innovation: the uniqueness of each individual's needs, relationships complexity, and access to resources (PRAHALAD; KRISHNAN, 2008). Accordingly, the uniqueness of each individual's needs must be met through flexibility, quality, cost, experience and collaborative networks, whereas relationships complexity is characterized by clients' interface and scalability; and finally, access to resources and high-quality and low-cost learning that must feature speed, scalability and innovation arbitrage.

Hence, the perceived attributes associated to innovations influence their diffusion speed (ROGERS, 2003) are:

a) relative advantage: comparison between the proposed innovation and the one it is replacing; hence, it can be measured in economic terms, social prestige, convenience, and satisfaction. Thus, the greater the relative advantage, the faster the diffusion of such innovation;
b) compatibility: compares the proposed innovation compatibility to the values, culture, past experiences, and users' needs. Once again, the greater the compatibility the higher diffusion speed;
c) complexity: it is related to the difficulty of using an innovation, that is, the more difficult its use, the slower its diffusion;
d) testability: if the proposed innovation can be tested, the greater its diffusion chances;
e) observability: the greater the results visibility of an innovation, the greater its diffusion chances.

As to innovation indicators, Bessant and Tidd (2009) have identified some that can be used to measure innovative performance such as patents, scientific papers, new products, customer satisfaction surveys, product cost, market share, quality performance, revenue,

increased profitability, added value, number of new ideas, failure rate, over-development time, budget cost, time to launch the product or service, man-hours per completed innovation and lead time. Likewise, the Oslo Manual describes recommendations for data collection on innovation, based on concepts and studies that served as a reference for the manual creation (OECD, 2005). Thus, respondents to innovation questionnaires should be managing directors in small units, and for large units they should be the directors of technology and innovation.

As proposed by OECD (2005), the questionnaire or interview should have questions addressed to technology acquisition, especially regarding its origin, whether national or international. It must also be questioned whether the company has sold technology and for which markets (international or national). Therefore, it is advisable to investigate and subdivide the technology in:

> Patents, non-patented inventions, licenses, know-how, trademark registration, services with technological content, use of consultancy services, acquisition / transfer of technology through the purchase / sale of a company, through the purchase / sale of equipment, qualified transfer, etc. (OECD, 2005, p.90).

As to improve innovation measures, Holgersson and Kekezi (2017) proposed an innovation index based upon a four-dimensional space of orthogonal axes: size, accessibility, firm performance, and agglomeration. Therefore, their index offers a new way of defining and analyzing innovation and should have a wide range of important applications in a world where innovation is receiving a great deal of recognition (HOLGERSSON; KEKEZI, 2017).

Factors that hinder or hamper innovation activities are divided into three categories: economic, company, and other reasons. Economic factors are related to risks, costs, financing problems and return on investment. Scarcity factors are related to: human resources, technology and market information; specialized external services, cooperation opportunities, cost control and innovation potential. Other reasons include infrastructure, opportunity and lack of need to innovate (OECD, 2005). As to overcome such factors, innovating firms often depend on the efforts of other innovators in its environments (ADNER; KAPOOR, 2010).

Thus, Oslo Manual (2005) recognizes certain aspects related to innovation, such as: uncertainty is associated with innovation; the need for investments to make it happen; the use of innovation benefits not only the organisation that developed the innovation but also all those who have appropriated it; use of new or combined knowledge; and the innovation goal as the competitive advantage it provides (OECD, 2005).

In order to overcome barriers to innovation, open innovation academics suggest that establishing relationships with external organisation and individuals may improve internal

innovation performance (CHESBROUGH, 2006; CHIARONI; CHIESA; FRATTINI, 2010). For this purpose, companies may engage in inbound open innovation process, that is, sourcing and acquiring; and outbound open innovation process, that is, reveling and selling (DAHLANDER; GANN, 2010).

Moreover, open innovation may involve venturing, outward intellectual property licensing, employee involvement, customer involvement, external networking, external participation, outsourcing R&D and inward intellectual property licensing (VAN DE VRANDE et al., 2009). Therefore, companies that share R & D suppliers with competitors may have some advantages and disadvantages from such process, especially in countries that offer weak intellectual property rights protection (MARTÍNEZ-NOYA; GARCÍA-CANAL, 2018). In fact, open innovation may be related to innovation management as well (HUIZINGH; KRE, 2011).

Even though this master dissertation has no intention to map the body of knowledge about innovation, such as the work published by Cancino et al. (2018), Framework 3 presents a summary of innovation researches addressed in this master dissertation. Finally, a bibliometric search was performed on Scopus database, as shown on Appendix H.

Framework 3 – Innovation summary

(to be continued)

Authors	Year	Contribution
Schumpeter	1934	Innovation is a creative destruction agent.
Schmookler	1961	Market pressure and technological impulses are sources of innovation.
Haustein	1980	Innovation is associated with change.
Pavon and Goodman	1981	Innovation is a process of transformation.
Freeman	1982	Innovation can be divided into four categories: product, process, system or device.
Dosi	1984	Innovation can be characterized by the imitation of new products.
Drucker	1986	Innovation results in changes that can lead to improvements in organisational performance.
Van De Ven	1986	Innovation happens through ideas that are driven by groups of people.
Robbins	1998	Associates innovation with specialized change.
Lawson and Samson	2001	Innovation it is essential for companies to be competitive.
Gatignon et al.	2002	Classified innovation in either incremental or disruptive.
Rogers	2003	Introduced research on diffusion of innovation.
Porter	2004	Innovation support a company’s strategy.
OECD	2005	Guides data collection and interpretation on innovation.
Prajogo and Ahmed	2006	Innovative companies develop and implement innovative products.

(conclusion)

Chesbrough	2006	Created the term open innovation.
Prahalad and Krishnan	2008	Proposed new innovation principles based on the uniqueness of each individual's needs; relations complexity and access to resources.
Birkinshaw, Hamel and Mol	2008	Related management innovation to further organisational goals.
Schot and Geels	2008	Suggested that sustainable innovation journeys can be facilitated by creating technological niches.
Bessant and Tidd	2009	Summarized innovation knowledge in a pedagogical book.
Van De Vrande et al.	2009	Claimed that small and medium enterprises pursue open innovation primarily for market-related.
Crossan and Apaydin	2010	Considered innovation as the production or adoption, assimilation and exploitation of an idea that generates renewal or significant improvements.
Dahlander and Gann	2010	There are two inbound processes and two outbound processes.
Adner and Kapoor	2010	Considered innovation ecosystems to influence the success of an innovating firm.
Huizingh and Kre	2011	Related open innovation and innovation management.
Rosenbusch, Brinckmann and Bausch	2011	Age of the firm, the type of innovation, and the cultural context affect the impact of innovation on firm performance.
Holgersson and Kekezi	2017	Propose an innovation index that comprises size, accessibility, firm performance, and agglomeration.
Cancino et al.	2018	Mapped gaps in the innovation research field.
Martínez-Noya and García-Canal	2018	Sharing R & D suppliers with competitors may have advantages and disadvantages, especially in countries offering weak intellectual property rights protection.

Source: author's own (2018).

2.4 INNOVATIVE PROCESS

In order to understand how innovation happens, it is necessary to understand its process stages, since there are seven key management activities related to it: motivating, resourcing, goal setting/refining, consolidating, coordinating, controlling, and leveraging (AARIKKA-STENROOS et al., 2017). Therefore, the five generations of the innovative process according to Rothwell (1994) are presented, as well as characteristics, purpose, and results of the process. Finally, this section introduces the diffusion of innovation as proposed by Rogers (2003).

Therefore, the innovative process is made up by activities necessary to transform into reality what emerged as an idea (BELL; PAVITT, 1995). In addition, Dosi (1982) claims that innovation is a process that happens through the search, discovery, experimentation and

adoption of new products, new processes and new organisational forms. On the other hand, innovation starts from the analysis of market opportunities that can generate changes and consequently innovations, in other words, innovation is what allows the entrepreneur to invest in new technologies, resulting in new products, service processes and new ways of managing the entire organisation (DRUCKER, 1986).

As to the innovative process, four characteristics can be related: uncertainty related to techno economic problems; dependence on new technological opportunities; formalization of R&D activities in industries; and learning through informal activities (DOSI, 1982). The process complexity and abstraction allow us to affirm that it has to be a common base throughout the organisation, so it requires innovation to be managed to reach the organisation's initial objectives (TIDD; BESSANT; PAVITT, 2005). Moreover, these complexities associated with innovation processes were further labeled: evolutionary, relational, temporal, and cultural (GARUD; TUERTSCHER; VAN DE VEN, 2013).

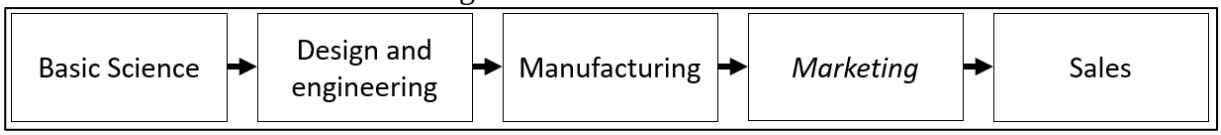
The innovative process pillars are economic forces, technological knowledge and specific demands (MOWERY; ROSENBERG, 1989). As a result, the innovative process is not only related to the creation of innovation, but also to the renewal within the organisation, in order to reanimate it in what it offers, creates and distributes to the market (TIDD; BESSANT; PAVITT, 2008). Moreover, the complexity of this process results in uncertainty, which can be reduced, although, it cannot be eliminated (NELSON; WINTER, 1982). Besides, stakeholders and partnerships also develop the conditions for the implementation of technical and non-technical changes at the company and sectoral levels during the innovative process (FREIRE, 2018).

Therefore, Leeuwis And Aarts (2011) claim that innovation is a collective process that involves the contextual re-ordering of relations in multiple social networks. As a matter of fact, organisation, internal processes, roles, and tools are the four categories that encourage a company to have a strategic sustainability perspective towards product innovation and achieve success (HALLSTEDT; THOMPSON; LINDAHL, 2013). Moreover, when customers take part in the innovative process, it is more successful when trying to produce novel and relevant knowledge. Besides, customers provide more relevant knowledge at lower costs (MAHR; LIEVENS; BLAZEVIC, 2014).

In order to understand different approaches taken by companies, Rothwell (1994) considers five generations of innovative process, each constituted of own characteristics that differ it from others generations. The first generation, shown in Figure 5, comprises the period from mid-1950s to mid-1960s, with the end of World War II being the enabler of technology-

based industries and the renewal of existing firms (Rothwell, 1994). Therefore, there was employment and consumption increase, so that society began to accept and demand innovations based on science and technology, characterizing the first generation as pushed by technology (Rothwell, 1994).

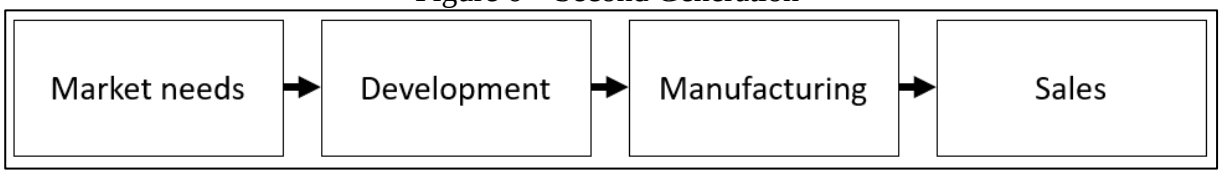
Figure 5 – First Generation



Source: adapted from Rothwell (1994, p.8).

The second generation, represented in Figure 6, occurred from the mid-1960s and early 1970s, and it was a consequence of growth rate decreasing at the same time that productive capacity was increasing considerably, hence, boosting competitiveness (ROTHWELL, 1994). Therefore, it was necessary to generate market pulled innovations, even though companies could risk stagnating long R & D programs, that is, they would risk to generate just incremental innovations (ROTHWELL, 1994).

Figure 6 – Second Generation



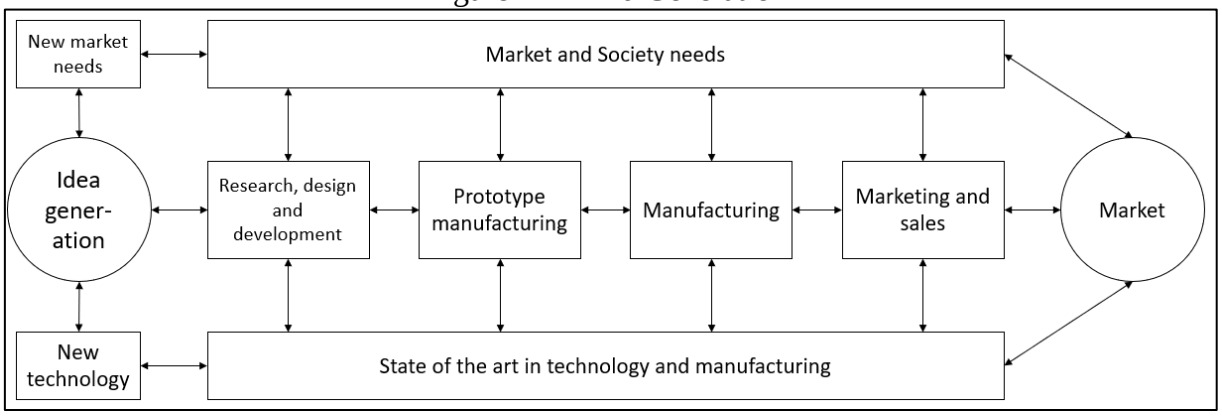
Source: adapted from Rothwell (1994, p. 9).

The third generation represented in Figure 7 represents the period comprised from the early 1970s to the mid-1980s, characterized by two oil crises, inflation, and market saturation (ROTHWELL, 1994). Hence, companies chose to focus their strategies on cost control and reduction, so the successful innovative process was the one presenting the fewest flaws (ROTHWELL, 1994). Thus, the interactive model is divided into two groups: project execution factors and corporate factors; with success and failure attributed to both factors, and higher success rates attributed to key individuals with an entrepreneurial profile as well (ROTHWELL, 1994).

The fourth generation of the innovative process, from the early 1980s to the early 1990s, featured economic recovery, emergence of IT-based manufacturing, and the growth of strategic alliances between firms (ROTHWELL, 1994). In addition, Japanese firms posed a threat to Western companies, by combining sales and quality-oriented procedures based on the Just in

Time (JIT) system (ROTHWELL, 1994). As a result, two main innovative features of Japanese companies were parallel integration and development, hence, rising integrated innovative processes (ROTHWELL, 1994).

Figure 7 – Third Generation



Source: adapted from Rothwell (1994, p. 10).

The fifth generation is characterized by companies attempt to implement a complex set of strategies, marked by technology, rapid innovation cycle, integration strategies, flexibility and adaptability regarding organisation, manufacturing and products, as well as quality and performance (ROTHWELL, 1994). At the same time, market growth stagnated turning innovation into a competitive factor, which is characterized by a trade-off between time to innovate and cost to innovate (ROTHWELL, 1994). Finally, Rothwell (1994) listed 24 factors that support the speed and efficiency of fifth generation innovation, considering lean innovation, according to Framework 4.

Framework 4 – Factors that benefit fifth generation innovation

(to be continued)

Factor	Benefits for innovation
Explicit strategy based on time.	Innovation speed as strategy.
Support and commitment by top management.	New products higher development speed.
Mobilize commitment and resources.	Prevent resistance to change.
Indirect development activities efficiency.	Cost and development time reduction.
Adoption of horizontal management style with increased decision making at lower levels.	Increases efficiency of indirect development activities.
Empowering product and project leaders.	Increases success and innovation speed.
High quality product specification.	Time and cost reduction when developing new products.
Use of integrated teams during development and prototyping.	Increases efficiency and development speed in addition to ensuring effectiveness in manufacturing.

(conclusion)

Commitment to quality control.	Ensures increased efficiency in product development and reduces cycle times as well.
Incremental development strategy.	New technologies are incorporated earlier into products.
Adopt transport strategy.	Transporting technology from a product to a new product speeds up development.
Combining new and old product design.	It refers to the creation of new product types based on current ones, reducing development costs and speed, thus ensuring quick market entry.
Design flexibility.	It creates a family of products that ensures economies of scale and scope.
Economy in technology.	Apply the same technology to as many products as possible, hence, reducing innovation costs.
Close relationships with primary suppliers.	Reduces costs and increases development speed of new products.
Updated components database.	Facilitates initial design and decreases overall cycle time.
Involve leading users in development activities.	Increases development speed and reduces costs.
Access external knowledge.	Significant factor for successful innovation as it speeds up product development.
Use of computers for efficient communication and data sharing.	Efficient information flow contributes to efficient new products development.
Computer-aided design systems use in the production process.	Reduces lead times and tests number.
Rapid prototyping techniques use.	Reduces new product development time and cost.
Use of modeling and simulation.	It increases the overall development efficiency.
Create technology demonstrators as an input to the simulation.	Improves modeling in early development stages.
Use of specialized systems to aid design.	Reduces development time.

Source: Rothwell (1994).

In contrast, small firms make creative use of existing resources and scope innovations to be affordable with available resources. Hence, they use external resources whenever and wherever these become available (BERENDS et al., 2014). In order to finish the process, small firms prioritize existing business over product innovation projects and work their steps toward tangible outcomes. They also tend to rely on their own customer knowledge rather than early market research (BERENDS et al., 2014).

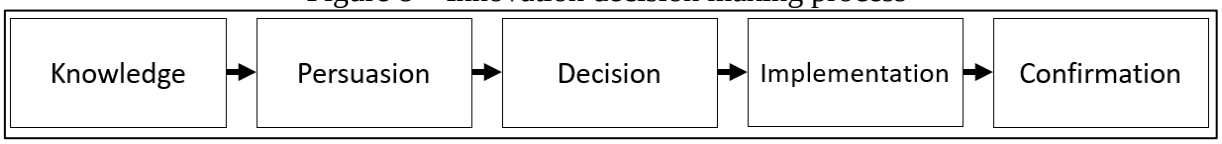
Different from the generations proposed by Rothwell (1994), diffusion involves a new

idea’s communication that carries certain uncertainty degree associated along with the novelty degree. Therefore, the degree of uncertainty is related to the number of alternatives and the probability of each of these alternatives prevailing over the others, hence, it assumes foresight, structure and information lack. For this purpose, information is a mean by which uncertainty can be reduced, and technological innovations incorporate information, thus reducing uncertainty (ROGERS, 2003).

As a result, "diffusion is the process in which an innovation is communicated through certain channels through time between members of a social system. It is a special type of communication, in which messages have new ideas (ROGERS, 2003, p.33). Hence, diffusion may be spontaneous or planned, the latter being called dissemination. Therefore, the diffusion process is composed of four elements: innovation, communication channels, time, and social system (ROGERS, 2003). To this end, communication channels refer to the medium through which communication takes place and may be through mass media channels or interpersonal channels. However, when two individuals do not share the same values, education or social system, innovation communication is hampered by differences between them. Likewise, the time element is directly related to the diffusion process, the innovation and the innovation adoption rate (ROGERS, 2003).

The innovation decision process is the one that happens from the knowledge of an innovation to the confirmation of this decision, as shown in Figure 8. The knowledge stage happens when the decision maker, individual or organisation, knows a new innovation and like the way it works. In the first step, the information acquired can help reducing innovation uncertainty, as one gains knowledge of what innovation is and how it works, usually through the media. Finally, persuasion is related to the favorable or unfavorable attitude towards innovation, and it seeks to evaluate what the innovator can receive as benefits of the innovation diffusion. The decision phase is related to the activities carried out that result in accepting or rejecting the innovation and can be reversed in the confirmation phase (ROGERS, 2003).

Figure 8 – Innovation decision making process



Source: Rogers (2003).

The decision may be optional (one member independent of other members' opinions), collective (decision by consensus) and authoritarian (when some members with power, status,

or technical expertise make the decision). The implementation marks the beginning of the innovation use, followed by the confirmation stage, which is the search for the innovation reaffirmation, and the previous decision can be modified according to the feedback received. Innovations can be accepted or rejected by an individual in the social system, or by the system as a whole (ROGERS, 2003).

The fourth component is the social system, which can be defined as the set of related units that seek to solve the same problem, being structured in order to achieve stability and regularity. It is endowed with communication structure that facilitates or prevents the innovation diffusion innovation, and norms that influence behaviour patterns (ROGERS, 2003). As to summarize main concepts and ideas towards innovative process, authors' contributions are shown in Framework 5.

Framework 5 – Innovative process summary

(to be continued)

AUTHOR	YEAR	CONTRIBUTION
Nelson and Winter	1982	The process results in uncertainty.
Dosi	1982	Innovation is a process that happens through the search, discovery, experimentation and adoption of new products, new processes and new organisational forms.
Drucker	1986	Innovation starts from the analysis of market.
Mowery and Rosenberg	1989	The innovative process pillars are economic forces, technological knowledge and specific demands.
Rothwell	1994	Differentiated between five generations of innovative process.
Bell and Pavitt	1995	It is made up by activities necessary to transform ideas into reality.
Rogers	2003	In-depth studied the process by which innovations are spread to the market, creating the diffusion of innovation theory.
Tidd, Bessant and Pavitt	2005	Innovation helps the organisation achieve its initial objectives.
Tidd; Bessant; Pavitt	2008	It is also to the renewal within the organisation.
Leeuwis and Aarts	2011	Innovation is a collective process that involves the contextual re-ordering of relations.
Hallstedt, Thompson and Lindahl	2013	Identified four categories of elements that make a company successful: organisation, internal processes, roles, and tools.
Garud, Tuertscher and Van De Ven	2013	Identified four different kinds of complexities associated with innovation processes: evolutionary, relational, temporal, and cultural complexities.

(conclusion)

Mahr, Lievens and Blazevic	2014	Customer cocreation is a major source for firms' competitive advantage.
Berends et al.	2014	Small firms take a number of measures in order to optimize the use of resources when innovating.
Aarikka-Stenroos et al.	2017	The authors study the innovation process as to turn the diversity of an innovation network into an opportunity rather than an obstacle.
Freire	2018	Stakeholders and partnerships help to implement changes at the company and sectoral levels.

Source: author's own (2018).

2.5 TECNOLOGY

Although the terms innovation and technology are used as synonyms, technology refers to a project for instrumental action that reduces the uncertainty in cause-effect relationships involved in obtaining the desired result. It is the combination of human understanding of natural laws and phenomena that fulfill our needs and desires or that perform certain functions (LI-HUA, 2009), in short, technology is the idea of things that are created or human-made (ANDERSON; ANDERSON, 2011). Therefore, technology consists of two components (ROGERS, 2003):

a) a hardware aspect, consisting of a tool that incorporates technology as a material or physical object;
b) a software aspect, consisting of information base for the tool.

As proposed by Carroll (2017), technology is either: something that is always inherently intelligent; a function that only intelligent beings have the ability to comprehend; or something devised designed or discovered that serves a particular purpose. As a result. technology is responsible for change that results in valuable entrepreneurship, since it allows new things production and new ventures construction (BARON; SHANE, 2007).

Therefore, technology constitutes a source of competitive advantage, being fundamental to the innovation event (FLEURY; FLEURY, 1995; MAÑAS, 1999). In fact, technology requires skills, theoretical and practical knowledge that can be used in the development of products and services or processes of production and logistics (BURGELMAN; CHRISTENSEN; WHEELWRIGHT, 2009). Accordingly, as proposed by Schumpeter (1961) technology is crucial to stimulate and activate the innovative process.

Technology is also considered a system created by humans that uses knowledge and organisation to produce objects and techniques for the attainment of specific goals (VOLTI,

2009). Its acceptance depends upon perceived usefulness, attitude towards technology use, technology self-efficacy (TEO, 2009). Therefore, service technologies can be adopted based on a five-step process, and takes into consideration the industry, patents and technology perspectives (GEUM; KIM; LEE, 2017). However, business models developed as to license technologies may be unpredictable once they reach the market (GAMBARDELLA; MCGAHAN, 2010).

Moreover, technology is associated with cultural evolution, technological progress and instrumental behaviour, that is, it is a problem solver, generated from existing or new knowledge in a combined form that generates innovations, so it influences society, since it is incorporated by culture (LOWER, 1987). Technology also involves procedures, methods, experiments, equipment and other physical utilities for its creation (DOSI, 1982; DOSI, 1984). However, in order to technology be appreciated, governance commitments have to be made towards science and technology (STIRLING, 2008).

Since technology refers to knowledge creation or even new products, one can notice the relation between innovation and technology. When combined, they are responsible for knowledge use and diffusion, which generate both social and economic gains (AUDRETSCH, 2002). Therefore, technology can be generally considered as a process of creating products, services, or knowledge regardless of which machines or equipment are used (RODRIGUES, 1984; HALL, 1984). Thus, technology can also be the set of organized information (FLEURY, 1990).

In addition to being a source of competitive advantage and innovation, technology leverages entrepreneurship through the creation of new businesses. Therefore, technology can be considered as knowledge or as the techniques available at a given time (NIETO, 2004). Addressing the theme of this work and the conceptions about the technology theme, it becomes necessary to understand its relation with entrepreneurship and innovation as discussed in the next subsections. Hence, Framework 6 summarizes concepts and studies about technology.

Framework 6 – Technology summary

(to be continued)

Author	Year	Contribution
Schumpeter	1961	Technology is crucial to stimulate and activate the innovative process.
Dosi	1984	Technology involves procedures, methods, experiments, and equipment and other physical utilities for its creation.
Rodrigues	1984	Technology is a process of creating products, services, or knowledge.

(conclusion)

Lower	1987	Technology is associated with cultural evolution, technological progress and instrumental behaviour.
Fleury and Fleury	1995	Technology constitutes a source of competitive advantage.
Audretsch	2002	Technology is responsible for knowledge use and diffusion.
Rogers	2003	Consists of a hardware aspect and a software aspect.
Nieto	2004	Technology can be considered as knowledge or techniques available.
Baron and Shane	2007	Technology results in valuable entrepreneurship.
Stirling	2008	Greater appreciation is required as to facilitating the opening up of governance commitments on science and technology.
Burgelman, Christensen and Wheelwright	2009	Technology requires skills, theoretical and practical knowledge.
Volti	2009	Technology is a system created by humans for the attainment of specific goals.
Teo	2009	Studies factors that improve technology acceptance.
Li-Hua	2009	Technology represents the combination of human understanding of natural laws and human needs.
Gambardella and Mcgahan	2010	Claimed that the innovation of business model designed for licensing technologies will have unpredictable consequences for industry structure and organisational capabilities.
Anderson and Anderson	2011	Technology is the idea of things that are created or human-made.
Carroll	2017	Technology is either: something that is always inherently intelligent; a function that only intelligent beings have the ability to comprehend; or something devised designed or discovered that serves a particular purpose.
Geum, Kim and Lee	2017	Service technologies by adopting a five-step process that embraces three viewpoints on the notion of service technology: the industry, patent, and technology perspectives.

Source: author's own (2018).

2.6 TECHNOLOGY INNOVATION

By combining the concepts of technology and innovation, one can notice the existence of concepts and discussions regarding technological innovation, since innovation products can be either technology-based or technology-facilitated. In fact, technology is both the main input and the outcome of the process of technological innovation. For this reason, care must be taken not to confuse the terms technology, innovation and technological innovation (NIETO, 2004; BURGELMAN; CHRISTENSEN; WHEELWRIGHT, 2009).

In order to avoid confusion between terms, the Oslo Manual (OECD, 2005) considers

as technological innovation one that involves scientific, technological, organisational, financial and commercial activities that results in products or processes new to the market or with significant technological improvements, classifying it as TPP innovation. Technological innovations can also be considered products that undergo technical, functional or aesthetic changes (MAÑAS, 1999; ROCHA; DUFLOTH, 2009).

The term technological innovation can also comprehend systematic and coordinated actions for the acquisition and application of knowledge that results in new products or processes (ROCHA; DUFLOTH, 2009). The abandonment of the current way of doing something is also comprehended in the technology innovation definition. Thus, all changes and adaptations that generate gain for the organisation can be considered technological innovations (SNELL, 2006). Therefore, it is understood that technology innovation process is a learning process that generates skills and knowledge flow (NIETO, 2004).

Research and experimental development as well as machinery acquisition are considered TPP innovation. The other cases can be considered as innovation activity according its motivating factors. Oslo manual suggests that machinery purchase deals with TPP innovation activity only in cases where the personnel involved need training, thus it is not diffusion of machines already used. The same reason should be used to acquire software and its updates. Process technological innovation is considered even when the main activities of a company are not applied, but also when it is used in auxiliary activities (OECD, 2005).

Research regarding technological innovation approaches its acceptance, results, effects, and so on. As a matter of fact, internet-based technologies were highlighted by Koellinger (2008), who claims that Internet-based technologies are an important enabler of innovation, but in such cases, it was found that innovative activity is not necessarily associated with higher profitability.

As to open innovation, Ceccagnoli et al. (2010) claimed that firms with relatively more cospecialized complementary assets or relatively strong internal R & D productivity have a lower propensity to source a technology from outside the firm. Moreover, technology innovation has proven to be the determinant in decreasing resource use and environmental effects from electricity production (YU et al., 2011). Once again, technology innovation has proven to mostly benefit companies that invest in customer demands (PRIEM; LI; CARR, 2012). Besides, it also causes economic growth (TANG; TAN, 2013).

Most recent studies show that technology innovation network can be described in five stages, from its embryonic stage to the mitigation transformation stage. In fact, for each stage there are different optimization paths as well as diverse optimal states (LIDAN, 2017). On the

other hand, Zhu (2017) proposes that implementing innovative mechanisms improve the competitiveness of financial technologies as well. Finally, Zhang et al. (2018) propose that technology innovation is a motivating force for sustainable development, whereas government support has negative effects in technology innovation. Therefore, Framework 7 summarizes researches about technology innovation.

Framework 7 – Technological innovation summary

Author	Year	Contribution
Mañas	1999	Technological innovations can also be considered products that undergo technical, functional or aesthetic changes
Nieto	2004	Technology innovation process is a learning process.
OECD	2005	Technological innovation involves scientific, technological, organisational, financial and commercial activities.
Snell	2006	Technology innovations are all changes and adaptations that generate gain for the organisation.
Koellinger	2008	Internet-based technologies are an important enabler of innovation.
Rocha and Dufloth	2009	Technological innovation comprehends systematic and coordinated actions for the acquisition and application of knowledge.
Ceccagnoli et al.	2010	Firms with more cospecialized complementary assets or stronger internal R&D productivity have a lower propensity to source a technology from outside the firm.
Yu et al.	2011	Technology innovation is proven to be the determinant in decreasing resource use and environmental effects from electricity production.
Priem, Li and Carr	2012	Successful innovations can be consumer driven rather than resource or technology driven.
Tang and Tan	2013	Technology innovation cause economic growth.
Lidan	2017	Technology innovation network can be described with five stages: embryonic immature stage, slow growing stage, fast growing stage, mature and stable stage and mitigation transformation stage.
Zhu	2017	When rapid financial and technological innovation mechanism is established, the financial products manufacturers can gain higher profits.
Zhang et al.	2018	Innovation investment is a determinant of technology innovation, whereas government support has negative effects on technology innovation.

Source: author's own (2018).

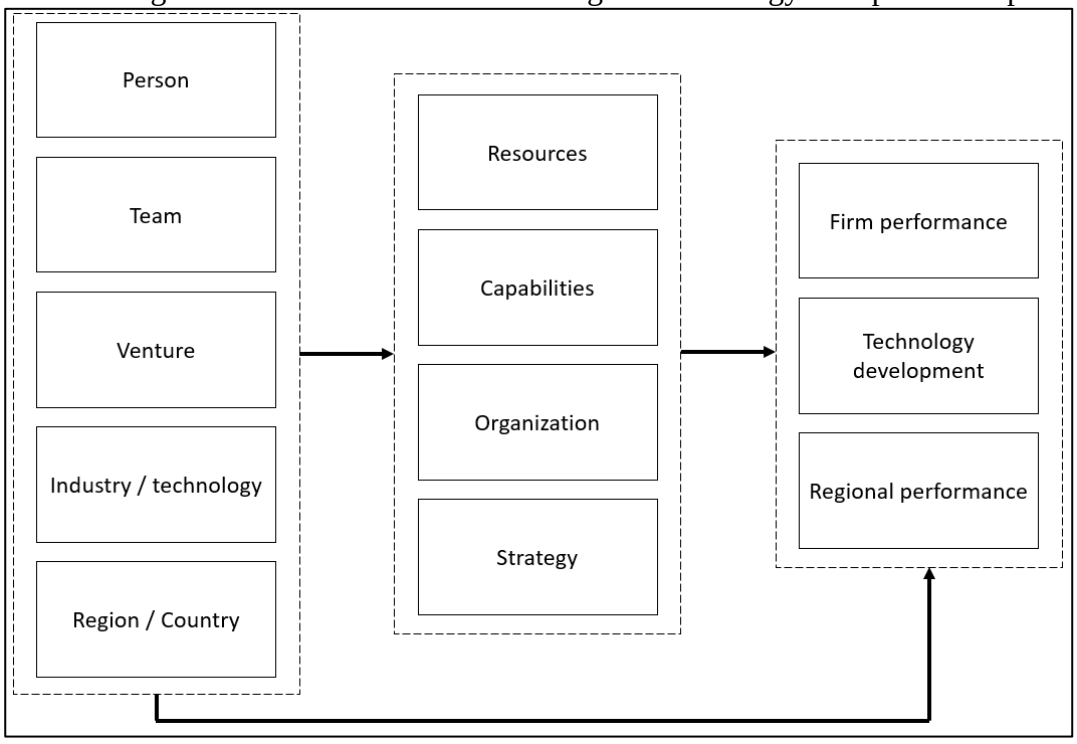
2.7 TECHNOLOGY ENTREPRENEURSHIP

Technology entrepreneurship refers to new combinations of resources and individual skills that enable the process of innovation, intended to create profit for markets that need

technological solutions (BURGELMAN, CHRISTENSEN, WHEELWRIGHT, 2009, BESSANT; TIDD, 2009). Technology entrepreneurship can also be considered as the factor that makes it possible to transform opportunities into technological resources and applications (KIRZNER, 1997; VENKATARAMAN, SARAVASVATHY, 2001). Therefore, it can be considered as the bridge between technological development, business creation, and market exploration (PETTI; ZHANG, 2011), overcoming the barrier between technological invention and successful products (ELIA; MARGHERITA; PETTI, 2016). However, consensus was sought on the definition of technology entrepreneurship (BAILETTI, 2012).

According to Borges and Filion (2010), research on technology entrepreneurship began in the 1960s through the works of Roberts (1968, 1969) and Cooper (1970, 1971). Currently, technology entrepreneurship is based on entrepreneurship, technology management and innovation, hence, its field of study investigates all the questions related to the success in the formation, exploration and renewal of products, services and processes in companies oriented by technology (SPIEGEL; MARXT, 2011). Moreover, technology entrepreneurs face different challenges such as technological uncertainty, higher capital requirements and a larger number of required capabilities. As a result, the study of technology entrepreneurship is multidisciplinary (RATINHO; HARRIS; WALSH, 2015). Therefore, Figure 9 summarized the technology entrepreneurship field.

Figure 9 – Framework for structuring the technology entrepreneurship field



Source: Harms and Walsh (2015).

Table 1 – Authors on technological entrepreneurship

Author	Articles
S.T. Walsh	9
J.Y. Park	6
E.M.A. Maine	4
G.D. Bruton	3
E. Garnsey	3
R. Harms	3
A.O. Laplume	3
S. Pathak	3
H. Qian	3
H.K. Steensma	3
A.J. Wang	3
E. Xavier-Oliveira	3

Source: author's own (2017).

Figure 10 – Articles per year on technological entrepreneurship

Source: author's own (2017).

In order to demonstrate different perspectives on technology entrepreneurship definition, a search was carried out in the Scopus database. The filters used were: the term "technology entrepreneurship" present in the title, abstract, or keywords of scientific articles. As a result, 123 articles were found, of which 111 were open file. Table 1 shows 12 authors who have at least three publications on the topic of technology entrepreneurship. Steven T. Walsh presented 9 articles on the subject, is affiliated to the University of Twente (Dutch

Institute for Knowledge Intensive Entrepreneurship), and his overall H-index is 23.

Figure 10 shows the evolution through time on the number of articles on the subject. It should be noted that in 2017 three articles were published until the time of this research that happened in February 2017. Finally, from all available articles that matched the criteria indicated previously, the articles that presented a definition on technology entrepreneurship explicitly are shown in Framework 8.

Framework 8 – Technology entrepreneurship definitions

(to be continued)

Authors	Year	Definition
Ndonzuau, Pirnay and Surlemont	2002	It is mainly characterized by the generation of new EBTs by entrepreneurs with previous experiences in R&D activities, whether in large companies or in academic environments.
Garud and Karnøe	2003	Macroprocess that happens from the effort of several actors.
Hemphill	2005	It involves the process of identifying potential technologies that can generate business opportunities by gatherings resources to make real-time decisions. It can be based on either revolutionary technologies or breakthroughs, being able to create a new market or use an existing one.
Liu et al.	2005	The ways in which entrepreneurs draw resources and structures to explore emerging technological opportunities. It explores the relationship between entrepreneurship and technology innovation, so it examines how entrepreneurs explore organisational resources and technological systems through strategies as to pursuit opportunities.
Caryannis et al.	2006	It has as its main inductors the creativity promotion, capacity for invention expansion and innovation process acceleration through knowledge diffusion.
Hsu	2008	It is distinguished from other forms of entrepreneurial entry by being innovation-based, and it requires commercial and technical knowledge.
Doganova and Eyquem-Renault	2009	It is knowledge intensive, therefore difficult to be understood by investors, clients or partners.
Fleming, Yang and Golden	2010	Application of science and technology to solve social problems.
Fan, Qi and Gao	2010	It is based on high-level technology applied in the transformation of inventions and innovations, by allocating resources in a unique way.
Spiegel and Marxt	2011	It is the process that involves opportunities recognition, creation and exploitation, as well as gathering resources around a technology solution.
Savetpanuvong, Tanlamai and Lursinsap	2011	It brings more economic value to society and the environment than incremental innovations that only sustain business.

(continuation)

Clarysse, Bruneel and Wright	2011	It is defined as companies which develop and commercialize new product/services based on proprietary technology or skills on which the founder or the different founders declared that they wanted to grow.
Rasmussen and Sørheim	2012	It gains high costs foreign investments, especially in the first financings.
Beckman et al.	2012	It focuses on the creation and discovery of unexplored opportunities, with such discoveries being driven by innovations in science and engineering. It concerns technical innovations and emerging markets that can be occupied.
Bailetti	2012	It is an investment in a project that assembles and deploys specialized individuals and heterogeneous assets that are intricately related to advances in scientific and technological knowledge for the purpose of creating and capturing value for a firm.
Pathak, Xavier-Oliveira and Laplume	2013	Propensity to create potentially new and technological products or services and it is essential for emerging economies.
Ajagbe et al.	2013	It is a form of business leadership based on the recognition of technology-intensive business opportunities that require resources such as talent and money, rapid growth management using decision-making skills. It is also an attractive business opportunity consisting of high-value proposition with technical products that can be protected by intellectual property and sustain competitive advantage, great market potential, and a business model.
Van Burg and Van Oorschot	2013	It is an important guide to economic growth, in which entrepreneurs must maintain links with the owners of any technologies they are expected to bring to market.
Qian	2013	It is the constant search for new knowledge with market potential.
Hülsbeck and Pickavé	2014	It does not depend on the creation of regional and technological knowledge between university and company.
Militaru and Niculescu	2014	It is the process by which novelties are created and new opportunities are explored, with technology and intellectual capital becoming increasingly the driving force for wealth creation
Qian and Haynes	2014	It generates impact on businesses through high growth, with sales and employability increasing as well. Technology entrepreneurship generates technological innovations that expand the frontiers of knowledge and increase the performance of other businesses, which are important for the growth of the entire long-term chain.
Brem and Borchardt	2014	It is the setting up of new enterprises by individuals or corporations to exploit technological innovations. It involves identifying high-potential and technology-intensive.
Colovic and Lamotte	2015	It differentiates from entrepreneurship by focusing on new opportunities through innovation in science and engineering.

(continuation)

Agogué, Lundqvist and Middleton	2015	It deals with understanding how to select and deviate from large technological arrangements, being more dependent on technology compared to entrepreneurship in general. It is also associated with deviation or pattern-breaking behaviours compared to general technological innovations.
Harms and Walsh	2015	It is considered the creative destruction announcer, and dynamic capitalism controller, thus it can contribute with solutions to world problems. However, it deals with a greater degree of technological uncertainty, greater capital needs, therefore it needs to consider specific industrial structures in entrepreneurial activities.
Sung, Joo and Park	2015	It is a vehicle that sends research output to companies, institutions and universities. Provides new products and creates new markets to activate the regional economy through technological innovations.
Sanjaya, Soekesi and Sitohang	2015	It focuses on two skills: entrepreneurship and technology, and their combination creates the integration of innovation and business that create technological capacity and entrepreneurial spirit. It brings prosperity to individuals, organisations, and nations.
Jaksić, Jovanović and Petković	2015	It unites science and business efforts in discovering new technologies or improving existing technologies in companies with the purpose of improving people's quality of life and meeting new needs.
Funk and Luo	2015	It creates opportunities for new entrants as some technological discontinuities are associated with creative destruction.
Ferreira et al.	2016	It happens through technology transfer within and between organisations, as well as the dynamics behind the processes.
Abou-Warda	2016	It is the operation of small businesses belonging to engineers or scientists. It finds problems or applications for a particular technology. It launches new ventures, introducing new applications or exploiting opportunities based on scientific and technological knowledge. It regards working with people who produce technological change.
Khefacha and Belkacem	2016	It is a relatively new field of study that has received attention from both the business field and technology; It provides better opportunities and enables effective optimization of resources to ensure high profit margins; It is the combination of two words from two subjects: technology from innovation and entrepreneurship from business. It is the union of specialized individuals and assets that are intrinsically related to scientific advances and technological knowledge for the purpose of creating and capturing value for the company.
Chavez et al.	2016	It emphasizes the entrepreneurial team’s technological and managerial skills;It builds and sustains basic technological competence and managerial and technological capabilities as well;It focuses on the efficiency of specific technology management practices.

(conclusion)

Malen and Marcus	2017	It deals with the discovery, evaluation and exploitation of goods and services that incorporate new technologies.
Chaston	2017	Technological entrepreneurship is an activity involving the exploitation of a new or existing technology which disrupts existing market conventions or leads to the emergence of totally new conventions.

Source: author's own (2017).

As a result of the different approaches that define technology entrepreneurship, one can see the need to understand how it happens. Therefore, next section describes studies that approach the technology entrepreneurial process.

2.8 TECHNOLOGY ENTREPRENEURIAL PROCESS

The technology entrepreneurial process can be considered unique since its opportunities are technology-based and come from advances in science and engineering (BECKMAN et al., 2012) and its process are innovation-based (HSU, 2008). As results, one should expect technology intensive firms (BECKMAN et al., 2012).

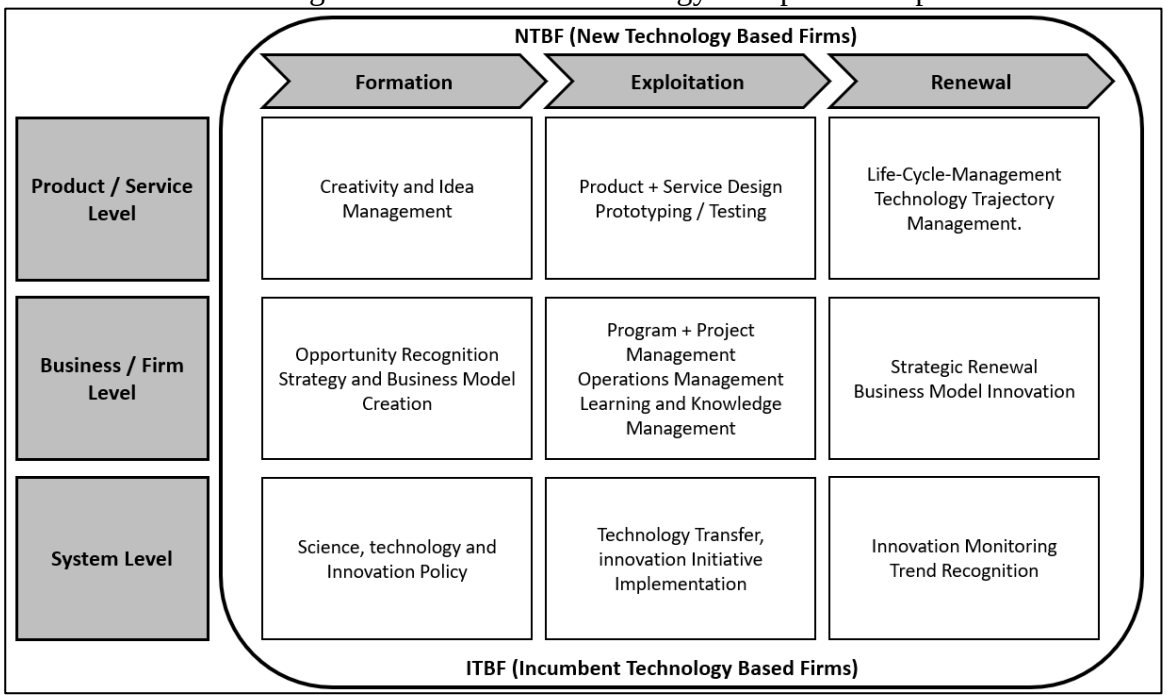
Similar to the entrepreneurial process, the technology entrepreneurial process involves recognition and identification, discovery, creation, and exploitation of opportunities arising from technological development (PETTI, 2009). Moreover, technology entrepreneurship can be understood as the process by which technology is implemented in the market, delivering new products, services or applications capable of satisfying the existing or potential market needs (ELIA; MARGHERITA; PETTI, 2016).

Technology entrepreneurship is a process that develops from the efforts of many agents and their knowledge to form new technologies characterized by having many interrelated faces because it is not only about discovery and speculation, since it also involves creation (GARUD, KARNOE, 2003). Hence, the technology entrepreneurship process at its organisational level approaches technology-based opportunities in order to meet the needs of the market (GANS; STERN, 2003), according to the company's organisational structure (COVIN; SLEVIN, 1991) its international attitude (HITT et al., 1997), as well as the steps necessary to transform technology into new business creation (SHANE; VENKATARAMAN, 2003; PETTI, 2009).

Three levels of technological entrepreneurship are recognized according to Spiegel and Marxt (2011), each composed of three phases as shown in Figure 11. The product or service, company or business and system levels are evaluated in the training, exploration and renewal

phases (SPIEGEL; MARXT, 2011). The training phase corresponds to the process beginning, while the exploration phase represents growth and the renewal phase will allow continuity at all levels (SPIEGEL; MARXT, 2011). The level of company or business deals with issues such as market opportunities recognition and business model creation during the training phase. In the exploration phase, issues such as operations management, projects, outsourcing, organisational learning and knowledge management arise. The renewal phase deals with the renewal strategy and business model's innovation, which are essential for the company continuity (SPIEGEL, MARXT, 2011).

Figure 11 – Levels of technology entrepreneurship



Source: SPIEGEL; MARXT, p. 1625 (2011).

On the other hand, Christensen, Olesen and Kjær (2005) analyzed the concept of Open Innovation from the perspective of technological entrepreneurs. The authors analyzed its characteristics and changes that take place from the embryonic phase to the mature phase and concluded that the embryonic companies outsource R & D activities, whereas in their mature phase they seek to protect technologies developed so that they are not imitated.

Yu, Stough, and Nijkamp (2009) investigated the government policies role in developing high technology research. The authors examined the last two decades of science parks and business incubators in China. Although both foster technological entrepreneurship, two characteristics differ from China in other countries: target according to government strategy and influence of local officials without stakeholders' participation.

2.9 THEORETICAL FRAMEWORK

In order to fulfill this master dissertation objectives, Framework 9 summarizes the mais concepts used during the research.

Framework 9 – Theoretical framework

Theoretical approach	Source
Entrepreneurship is the pursuit of opportunity regardless of other factors.	Stevenson, Roberts and Grousbeck (1985)
Entrepreneurs have the ability to recognize and exploit opportunities.	Audretsch (2012)
The stages of the entrepreneurial process are: discovery, evaluation and exploration of opportunities.	Shane and Venkataraman (2000)
The entrepreneurial process is based on motivations and barriers encountered by entrepreneurs	Van Der Zwan, Thurik and Grilo (2010)
Classified innovation in either incremental or disruptive.	Gatignon et al. (2002)
Innovative companies develop and implement innovative products.	Prajogo and Ahmed (2006)
Companies attempt to implement a complex set of strategies, marked by technology, rapid innovation cycle, integration strategies, flexibility and adaptability regarding organisation, manufacturing and products, as well as quality and performance.	Rothwell (1994)
It is the combination of human understanding of natural laws and phenomena that fulfill our needs and desires or that perform certain functions.	Li-Hua (2009)
Research, experimental development, acquisition, machinery and software purchase are considered Technological innovations.	OECD (2005)
It involves the process of identifying potential technologies that can generate business opportunities by gatherings resources to make real-time decisions. It can be based on either revolutionary technologies or breakthroughs, being able to create a new market or use an existing one.	Hemphill (2005)
It is distinguished from other forms of entrepreneurial entry by being innovation-based, and it requires commercial and technical knowledge.	Hsu (2008)

Source: author's own (2018).

3 RESEARCH METHOD

This master dissertation is an applied research, with qualitative approach, exploratory and descriptive objectives. Qualitative research appropriates methods and theories, participants' perspectives and their diversity, researcher and researcher reflexivity, variety of approaches and methods (FLICK, 2004). The exploratory study intends to provide greater familiarity with the proposed research theme, while the descriptive objective focuses on the analysis and description of existing phenomena, so it is possible to combine both objectives to explore and describe phenomena (STRYDOM, 2013). Therefore, this chapter presents the methodological procedures applied in order to answer the research question. For this purpose, the procedures regarding data collecting and analysis are described in the following sections.

3.1 DATA COLLECTION

The sampling strategy aims to define the extent to be analyzed, or depth of the subject studied. Thus, convenience sampling was used for this research (FLICK, 2004), once the entity chosen to participate in this study was indicated by the research advisor, and the companies surveyed were indicated by the entity’s president. Data collection in qualitative research can be done through open-ended interview, direct observation and written documents (PATTON, 1987). For this study, data was collected through semi-structured interviews that are characterized by open questions as to guide the interview, with the interviewer responsible for adding questions to the previous script, in cases in they are necessary (FLICK, 2004).

The script used was adapted from the questionnaires used by Severo (2014) and Gaio (2007), as shown in Annexes A and B respectively, so the first script was used to characterize the company and issues related to innovation, while the second one was used to address the issues regarding technology entrepreneurship. The questionnaire applied is found in Appendix I. All interviews were recorded, since electronic devices are common for both the interviewee and the interviewer, it allows the documentation of the data to be naturalistic, since the conversation follows naturally (FLICK, 2004).

3.2 DATA ANALYSIS

After data collection, the data were prepared by means of the data transcription, that is, the change in the medium, which should be done carefully, since the mere transcription does

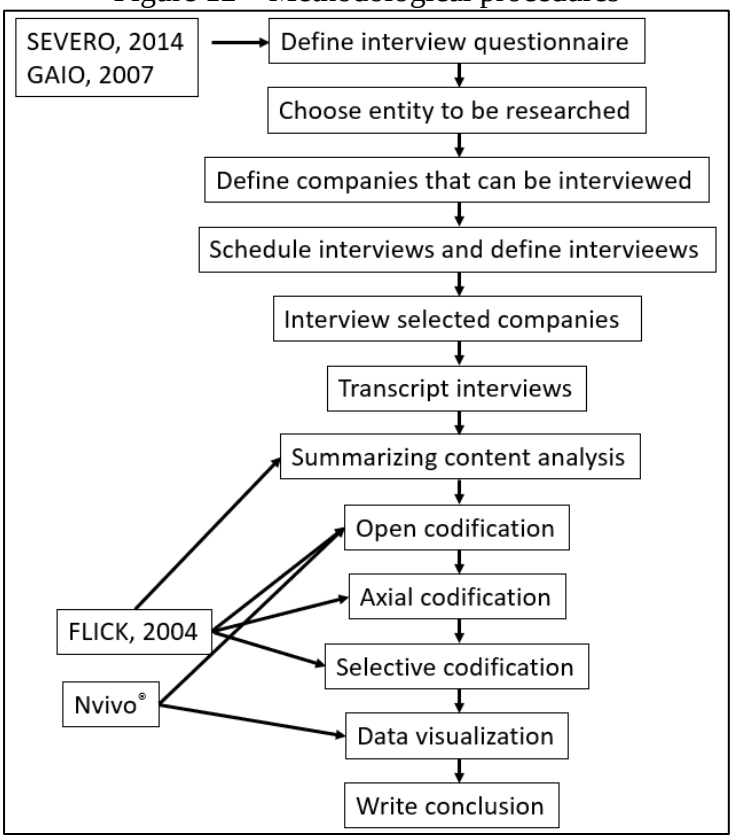
not reflect the context of the interview situation (GIBBS, 2009). Data transcription is necessary in the cases where data is in audio formats due to interview recording and its accuracy must be such as to allow the researcher to extract the analysis unit, but not so exact that it requires more hours than necessary for data interpretation (FLICK, 2004; GIBBS, 2009). Accordingly, most of the qualitative data is in the form of text, either directly or as a result of audio transcription of interviews, since it facilitates the organisation and analysis of the data (GIBBS, 2009). Participants confidentiality was guaranteed by using capital letters instead of the interviewees' names (GIBBS, 2009).

After transcription, data analysis and interpretation can be done by ordering and codifying the collected material, or by performing text sequential analysis as to reconstruct the text structure (FLICK, 2004). Previously to the coding, content analysis was done by the following steps: material definition, interviews selection, data collection situation (how the material was produced, who participated in the production, who was present in the interview situation, where the documents that will be analyzed, etc.), materials formal characterization (how it was documented, how it was edited), and finally, definition of the analytical technique (FLICK, 2004).

Theoretical coding chosen for this research is composed of open codification, as well as axial and selective coding, which represent different ways of treating the collected material. In this way, the codes can be related to each other and to the chosen background theory (FLICK, 2004). Open coding results in a set of codes generated from the text, afterwards the highlighted codes are related during axial coding, in order to fit the paradigm's model. Finally, selective coding describes the case history from the codifications performed in the previous processes (FLICK, 2004). Also, for analytical techniques, summarizing content analysis was used, for such technique the material collected is paraphrased and reduced in order to generalize and give greater abstraction to the material collected (FLICK, 2004).

The use of specific computers and software in the analysis of qualitative data through annotations, data storage, content analysis, content display, graphic mapping and report writing has the advantages of speed, qualitative research quality increase, data management, and ease of data representation (FLICK, 2004). The coding separates the text in small sections and can be done with the help of specific software for this. (GIBBS, 2009). Therefore, software Microsoft Word and Nvivo® were used in order to data preparation, analysis and presentation. Figure 12 depicts the methodological procedures and choices for this research.

Figure 12 – Methodological procedures



Source: author's own (2018).

4 RESULTS

Chapter four presents the results obtained by following the methodological procedures shown in Figure 12. Hence, the current chapter characterizes de chosen entity, companies that were part of the study, as well as the interviews. Afterwards, summarizing content analysis is presented. Next, content analysis by open, axial and selective codification is shown. Conclusions drawn are presented in chapter five.

4.1 SIMPLÁS

According to the methodology procedures exposed in chapter three, the first step after defining the interview questionnaire was choosing an entity open to be part of this research. This research's advisor suggested SIMPLÁS (Sindicato das Indústrias de Material Plástico do Nordeste Gaúcho – Plastic Materials Industry Union of Rio Grande do Sul Northeast). After, a meeting was schedule with SIMPLÁS' president, in order to present this research objectives and discuss what companies should be part of the study.

SIMPLÁS' president agreed to the research and indicated some companies that could volunteer for this research and asked for an e-mail containing the research's objectives and how the companies were expected to contribute. After having the information requested, SIMPLÁS' president send an e-mail for the selected companies. From eight companies suggested by SIMPLÁS' president, five of them were actually interviewed. As a matter of fact, the companies that did not participate in this research was due either to schedule conflicts or communication issues.

SIMPLÁS was founded in 1989 by entrepreneurs representing 23 companies that aimed to create an entity to represent their interests, as well as integration within plastic transformation companies. From its foundation up to nowadays, SIMPLÁS is located at the Caxias do Sul's Industry and Commerce Chamber (CIC – Câmara de Indústria e Comércio de Caxias do Sul) (HERÉDIA, 2014).

Currently, SIMPLÁS represents 436 transformation companies that generates more than 10 thousand direct jobs in Rio Grande do Sul Northeast (Caxias do Sul, Coronel Pilar, Farroupilha, Flores da Cunha, Garibaldi, Nova Pádua, São Marcos e Vale Real), thus it is considered the greatest concentration of plastic transformation industry in Brazil. Likewise, its annual gross revenue is believed to be around three billion in Brazilian currency. SIMPLÁS

believes that innovation may improve its companies' competitiveness to overcome its international competitors (HERÉDIA, 2014).

4.2 COMPANIES CHARACTERIZATION

After SIMPLÁS' president sent the e-mail asking for help, all the companies were contacted in attempt to schedule a formal interview. Contact was made either by phone or e-mail, in which occasions the research was explained once again and it was asked to schedule the interview with the appropriate person to answer the questionnaire. Subsections 4.2.1 to 4.2.5 present information regarding each company. Table 2 summarizes interviews details.

Table 2 – Interview details

Company	Interviewee position	Interview duration	Date of the interview	Number of pages
A	Business partner	1:08:07	November 22nd, 2017	18
B	Business partner	00:56:36	November 6th, 2017	18
C	Business partner	00:57:42	November 28th, 2017	14
D	Marketing supervisor	00:56:16	November 30th, 2017	13
E	Manager of tooling development	1:03:09	December 12th, 2017	14

Source: author's own (2018).

4.2.1 Company A

Company A is 24 years old, and it was founded by two brothers and a cousin. During its two first years of existence, Company A worked for other companies by injecting their plastic products, such as rear-view mirrors for cars, parts for kitchen stoves, and so on. After two years of existence, company A had an opportunity to start producing its own products, due to one of its customers bankruptcy. In order to pay its debts, the customer in question, gave to Company A the tools to produce what would become company A's first product: a set of coffee mugs.

Therefore, Company A embraced such opportunity and grew in size, from 75 m^2 to 350 m^2. Company A claims that such success was due to planning, management and innovation design that since that time were crucial to Company A's development. Nowadays, Company

A's Caxias do Sul Site area is 10,000 m^2. Its products are kitchen utilities, that are distributed mainly to Brazilian retailers, however its international commerce represents about 5% of its gross income.

The person that was interviewed in company A is the commercial and administrative director, who is one of two partners that own the company. The other partner is the industrial director. Besides the two business partners, the company management structure is formed by a commercial manager, a human resources manager, a financial manager and a team of commercial coordinators.

Currently, 200 employees work in the company that has two sites, one in Caxias do Sul, where the interview was conduct, and another in São Paulo. Caxias do Sul factory manufactures 90% of its products and 10% are imported items that are added to manufactured products. São Paulo unit was acquired in 2013, which increased Company A's products portfolio, so the company started distributing porcelain, ceramic and glass products to the entire country. São Paulo's site deals with imported items that are distributed in Brazil and employs 30 people, since Caxias do Sul and São Paulo sites represent different brands. Company A's clientele are usually gift store chains for its most valuable products, market chains, department store chains, and pharmacy chains for its common products. Company A has won design awards and participates in design events all over the world.

Finally, Company A carries social actions towards needy children education. Therefore, Company A directly helps in two social projects that take place in Caxias do Sul: Mão Amiga and Criança Feliz projects. These two projects are part of institutional acts that Company A takes and help more than 250 children and 120 families.

4.2.2 Company B

Company B since its foundation has had experience in plastic injection, vaccum forming, fiberglass, technical projects, tooling services, as well as tools tryouts, so its main customers are: manufactures of means of transportation for both goods and people; automotive market; cooling equipment; agro business; packaging; etc. Company B is proud of being ISO 9001 certificated since March 2012, since Company B believes it delivers a trustworthy image. So, Company B's vision is to become reference in plastic solutions in South and Southeast Brazil up to 2010.

Company B's injection moulding machines have latch capacity for: 450, 470, 600, 720, 1080 e 1800 tons, and its vaccum forming machines are capable of processing parts that are up

14 mm thick. The fiberglass products are produced mainly by two processes: spray up and RTM (Resin Transfer Molding). Therefore, Company B counts on qualified personnel for each of its manufacturing processes. Moreover, Company B is equipped with a tooling manufacturing department able to provide several services.

Company B was founded in January 2011 due to problems regarding the partners' former business. It started manufacturing plastic components by plastic injection, and later by vacuum forming. Then, some customers asked for fiberglass components, so the company started producing them as well. Company B's only site is located in Caxias do Sul, and its constructed area is about 7,000 m² in a 30,000 m² land. Company B was founded and it is owned by four partners. One of the partners was the person interviewed, who is the administrative director. The company works 24 hours a day and employs 113 people in three shifts.

Currently, company B has flexible manufacturing, therefore it can choose the process that will be used, that is, either plastic injection or vacuum forming based on the component's demand. Company B has a diversified clientele, such as automotive, construction, furniture and air conditioning industries. The mudguard is Company's B only product that goes straight to the final user, all the other products are send to other factories. Company B exports some products, especially to South America and it represents about 5% of its gross income.

4.2.3 Company C

Company C defines itself as the manufacturer of water filters and purifies, as well as other equipments that improve water quality. So, according to Company C's website, their mission is "To manufacture equipment with quality and efficiency, that guarantee our customer's satisfaction". Moreover, Company C is based on some principles, such as: respect and ethics; commitment to quality; to motivate positive results; and carefully treat the company's image. Company C's only site is located in Caxias do Sul. The company was founded in 2008, after Company's C owner left his former company partnership, but its products were brought to market only in 2011 due to new market regulation issues. Company C was founded over the belief that the entire population should have access to pure and quality water.

Currently, Company C is certified according to the ISO 9001 rules, besides Brazilian certifications ABNT NBR 16098:2012 that regulate water purifiers manufacturing. Therefore, Company C's products are characterized and differentiated by: greater filtration capacity; maximum efficiency in water dichlorination; greater durability; manufactured to support

greater water flow; low acquisition cost; low cost to replace parts; guarantee of technical assistance; and factory warranty in case of manufacturing defects.

Therefore, Company C counts on the experience of one of its founding partners which has worked in the business field since 1994. The partner in question developed a new technology for water filters manufacturing called Melt Blown. Company C also own patents on The company is formed by two partners. The person interviewed is responsible for administrative areas such as human resources, finances and commercial department. There are 84 employees working in three shifts, since company B's area is not big enough to keep manufacturing in one shift only.

Company C's products are designed for industrial and residential use. Company C is starting to pursue international clients, but up to the time of the interview, no supplying contracts were granted yet. The company's budget for R&D is defined at the beginning of the year through strategic planning meetings, and usually aim product and process improvements.

4.2.4 Company D

Company D was founded in August 6th, 1949 and since its beginning it assembles buses. The company was founded by eight partners and 15 employees worked there by that time. Company D was one of the first companies in Brazil to manufacture bus bodies. Currently, Company D is one of the biggest bus bodies manufacturer. Company D started exporting its products in 1961, with its first international customer being from Uruguay. In the 1970s, Company D becomes the first brazilian company to sell bus technology, and it also started receiving awards as to recognize its innovative actions.

As to continue its innovative tradition, Company D launches the first brazilian double-decker bus in the 1990s. In the same decade, Company D builds a unit specialized in minibuses. In early 2000s, Company D reached the 200,000 buses manufactured, and it also continues its internationalization process by joint-venture with an Indian company. Currently, company D continues to receive awards that recognizes the company as an innovative company.

Company D's vision is dedicated to have relevant business everywhere the company acts and in accordance to a solid economic and socio-environmental image. Therefore, Company D's values are related to ethics, to respect and value people, to be commited to its community and environment, partnerships, customer satisfaction, and finally, economic and financial solidity.

Brazilian sites are located in Ana Rech and Planalto regions of Caxias do Sul, Espírito

Santo, and Rio de Janeiro. International sites owned by company D are located in Argentina, Colombia, Mexico, South Africa and China. International sites partially owned by company D are located in United States of America, Egypt, India, and Australia. Therefore, Brazilian sites' capital is national, whereas international sites' capital is partially Brazilian. The interview was conducted at company D's main site in Caxias do Sul, in Ana Rech region. The person interviewed in company D is a marketing supervisor, who has worked at the company for 18 years, and he spent the past 4 years in the marketing department. Ana Rech's site employs around 5,000 people. Its international business account for 30% to 40% of its total gross income.

Company D's net income in 2017 fourth quarter was 843,6 millions in Brazilian currency for all companies in the group. In fact, net income for Brazilian companies that belong to the group has increased 39.6% in 2017, accumulating 310.5 millions in Brazilian currency, when compared to 2016. Market share has reached 53.1% in 2017 last quarter. As to manufacturing. In 2017, 9,804 buses were manufactured for the internal market and 4,889 buses were manufactured to external market.

4.2.5 Company E

Company E was founded in 1984 in Caxias do Sul and it is specialized in developing and manufacturing moulds and technical parts. By the time the company was founded, it was nestled in a 400 m² area, and it was devoted to testing other companies moulds. By 1988, Company E started developing its own tools. Later, in 1990 company E moved in to its current location, where it had 1,200 m² of constructed area. In 1997, its second site, located in Sapucaia do Sul, started working.

Since company E is aware of its need to meet customers' demands and requirements, company E got its ISO 9002 certification in 1998. In 2000, Caxias do Sul site increased its constructed area to 5,500m². In order to keep competitive, in 2005 all sites started implementing lean manufacturing practices. As a sign of company growth, in 2007 the São Paulo site started working, and further in 2011, the Joinville site started its operations. Finally, in 2015 the Pernambuco site started operating.

Company E main vision is to become a reference in plastic moulding and propelling technological and social development, therefore Company E believes it must drive excellent organizational development and maximize its active financial profitability. Finally, Company E principles and values include: customers as main focus of the companies' activities; employees development aligned to the company's vision and values; constant research towards

technology, quality and innovation; profit as to keep sustainably growing; shareholders that are aware of business' risks; ethics towards applicable laws, social responsibility and environment preservatiobs; finally, suppliers are considered business partners.

Company E has strict quality policies, since its main products consist of technical parts. Therefore, its quality policies include meeting customers requirements through process effectiveness and continuous improvement, so Company E also counts on a management system. Some of Company E measures as to meet customers' requirements include having cutting edge laboratories, process and procedures as to prevent and treat failures, clients audits, and international certifications.

Therefore, company E has its main site in Caxias do Sul, and other four sites in Sapucaia do Sul, Joinville, São Paulo and Pernambuco, which altogether employ 648 people. Caxias do Sul site employs about 280 people. Company E mostly produces components to automotive industries, and it is starting its own products line, however, none has been released to the market up to the interview. Company E's social capital is entirely national since it is limited company. Company E rarely exports products, so it is not representative for company E's gross income. Company E decides its investments on R&D according to its clientele needs, and the company financial situation. The person interviewed is the manager for tooling development, and he has worked at the company since 1997.

4.3 SUMMARIZING CONTENT ANALYSIS

This section introduces the first part of the interviews' analysis. It was used summarizing content analysis in order to find similarities and differences in the technology entrepreneurial process in each company and compare it to the literature as well.

When the interviewees were asked about opportunities that were identified, company A reported that their first own product resulted from a customer that went bankrupt and had no money to pay its debts, so the customer gave some tools away as to pay its debts. Then, company A started producing its customer product as its own, and had great acceptance in the market, so company A decided to star its own line of products. On the other hand, companies B, C and E arouse from partnerships that were terminated, so companies B and C basically continued doing the same products as their former company but intending to innovate their products and improve their process. Company E started testing tools for another company, and later started producing its own plastic injection tools and injecting plastic components as well. Finally, company D was founded due to market needs.

Companies B, C and E can be either considered entrepreneurial spin-offs, that is, employees that leave companies and decide to pursue opportunities in the same market their former company pursue (MUENDLER; RAUCH; TOCOIAN, 2012) or corporate spin-offs, also called spin-outs, that are formed when companies split their business in other companies (CHESBROUGH, 2002). On the other hand, the entrepreneurial process that lead to the creation of companies A and D happened through the entrepreneurial process that involves discovering and exploring a market opportunity (SHANE; VENKATARAMAN, 2000; SCHLEMM; DUCLÓS, 2003; SHANE, 2003).

Regarding technological opportunities, company A does not pursue technological opportunities that may result in new process or products, instead it looks for international market trends for its line of products. The interviewee claimed that company A's products are not dictated by technological advances, but for fashion trends such as colors and shapes. Its products design sometimes represents innovations. These results are in accordance to what is proposed by Moon, Miller and Kim (2013), since they claim that product design importance has increased due to customer demand for varied products, with innovatively designed products being more comfortable for customers.

On the other hand, company B seeks for innovation and technological opportunities usually when dealing with customers products, that is, it usually proposes new processes for a current component. Such opportunity seeking may be considered part of an open innovation process (VAN DE VRANDE et al., 2009). Even though, company B does not have a formalized process to look for technological opportunities, it usually analyzes such opportunities as to evaluate infrastructure, investment and financial needs, which are usually greater than other market opportunities (HARMS; WALSH, 2015), and may also hinder the innovative process as well (OECD, 2005).

When dealing with technological opportunities, company C evaluates financial viability prior to launch a new product in the market or implement a new process in their company, one of the criteria being to reject anything with a payback longer than four months. Moreover, company C evaluates if they have manufacturing abilities, physical structure, equipment, and whether there is demand for a new line of products. Company C's criteria is also based on the product life cycle, since company C claims its products life cycle is too short for great investments and risk is too high as well. As Hemphill (2005) proposes, it involves the process of identifying potential technologies that can generate business opportunities by gatherings resources to make real-time decisions. It can be based on either revolutionary technologies or breakthroughs, being able to create a new market or use an existing one.

As for company D, technological opportunities are obtained on a daily basis by current suppliers, magazines on the field, Google alerts about its competitors, e-mail newsletters and customer need. Once a technological opportunity is identified, it is directed to the innovation department, which then, continues the process. The second step involves building a prototype, that is discussed internally about its pros and cons, and evaluate whether such opportunity should be pursued. Finally, a partner customer is invited to step in and help during final tests by providing thoughts on what is good and what should be improved.

For each technological opportunity, a business plan is proposed as well as its expected target price and profit margin. Since this process is not always linear, market response and time to market to each innovation depends on the innovation price and customer line of work. In order to best understand customer needs, company D assess what line of products may incorporate such innovations in order to make it a good fit for potential customers. The technology entrepreneurial process as carried by company D is made up of discovery, evaluation and exploitation of and services that incorporate new technologies (MALEN; MARCUS, 2017).

Technological opportunities are usually brought by company E's customers that need something new. Then, company E asses the financial resources needed, and customers' demand for such innovation. Company E's interviewee claims that implementing new plastic injection processes are only worthy when a certain monthly demand is needed, since its products are extremely cheap when compared to their development process. Therefore, company E has to improve its internal processes in order to keep them profitable. Company E's interviewee affirmed that plastic products that demand high technology are all brought from Europe since they are bought in small quantities.

The technology entrepreneurial process in company E also involves constant new technological opportunities assessments. Twice a month, technological opportunities are discussed in company E in specific meetings, when a multifunctional team asses demand and investments needed in order to continue the technology entrepreneurial process or terminate it. Customers that are more open to innovation usually participate in the process of pursuing technological opportunities. Technology entrepreneurial process, as conducted by company E, represents the constant search for new knowledge with market potential (QIAN, 2013), since it deals with understanding how to select and deviate from large technological arrangements (AGOGUÉ; LUNDQVIST; MIDDLETON, 2015).

In order to pursue technological opportunities, companies may seek for external help, especially when considering that technology entrepreneurship is a macroprocess that happens

from the effort of several actors (GARUD; KARNØE, 2003). Accordingly, company A sometimes seeks outside help to design the tools necessary to inject its products, as well as some products' designs that are done by outside offices in order to finalize the products' projects and start manufacturing. Company B also has counted on external help, especially because its business partners always belonged or participated in social circles regarding industry in Caxias do Sul, therefore they never experienced any trouble when seeking help, customers or suppliers in the region. The same way, company C's partners had all necessary contacts in the market to start their business, since one of them had already worked in the same field of business. Company's C previous contacts helped them to develop a line of products that would be better accepted by the market.

The same way, when company D decides to pursue a technological opportunity that it does not have the internal expertise, it starts pursuing partnerships with specialized institutes. Company D has no trouble when looking for partners, however, company D knows what partners may not be responsive, thus, company D targets them during initial stages. On the other hand, company E has its customers involved over the entire technological process, since customers are usually responsible for exploring the technology opportunity, testing and finally, buying technological outcomes. Actions taken by Companies D and E may be considered open innovation activities (VAN DE VRANDE et al., 2009).

Even though companies pursue technological opportunities, when it was asked about how easy it is to copy their strategy the answers diverged. Company A's interviewee believes that company A's strategy may be copied by its competitors, however he also believes that its competitors may have difficulties to implement its commercial strategy, since it requires personnel training and it takes time until the commercial representatives team is ready to act on the market. Strategy deployment through all levels is also another condition that is difficult to be copied by company A's competitors.

Likewise, company B affirms that its strategy may be copied by its competitors, since technological improvements, such as machines and equipment in general are available on the market for all companies. Therefore, company B's interviewee affirms that company B's source of advantage is based on the people, so they implement strategies as to keep their strategic personnel motivated to continue working for them.

On the other hand, company C believes that its strategy is difficult to be copied by other competitors, since others merely copy company C's products and sell them as second line products, while others are not specialized in filters. As a consequence, company C intend to become the greatest Brazilian company of filters in 2018. Company C's answer may differ from

companies A and B because it was based on a technological innovation, since company C developed and commercialize new products based on proprietary technology or skills on and the founders declare how they want to grow (CLARYSSE; BRUNEEL; WRIGHT, 2011).

Likewise, companies A and B, company D's interviewee also believes that its competitors may copy its strategy and innovations, but company D takes credits for being the company that releases them, hence, company D has a good reputation on the market as a pioneer. Such claim is similar to what is proposed by Ajagbe et al. (2013), which claims that technology entrepreneurship is a form of business leadership based on the recognition of technology-intensive business opportunities consisting of high-value proposition with technical products that can be protected by intellectual property and sustain competitive advantage, great market potential, and a business model.

Concerning product innovations, company A does not release innovative products, since it follows international market trends, however, sometimes company A introduces a new component (new to Brazilian market) in its current products that result in new market needs, guaranteeing strategic advantage for some products. Main advantages due to innovative components that are aggregated in current products are specially concerning financial advantages that result in greater profitability (BESSANT; TIDD, 2009; KHEFACHA; BELKACEM, 2016).

Accordingly, company B claimed it did not introduce any innovations, but its clients required developments in order to change some products' raw material that reduced costs and made it possible to introduce new products to the market. However, significant improvements accomplished by new materials are considered product innovation (OECD, 2005). Company B's decision to not develop its own products is based on the retailers' informal market. Taking into consideration that informal markets are characterized by economic activity that occurs outside of formal regulations, they are usually guided by informal norms, values, and understandings (SUTTER et al, 2017), company B prefers to supply straight to other manufacturers in order to avoid unclear transactions. This issue resulted in lessons that were internalized by the partners and made them avoid to pursue their own products.

As time passed by, company B started understanding that manufacturing only its customers components could represent a threat for its business. Therefore, company B is starting to design its own products, even though it admits that its commercial department is a weakness that may hurt its business. Such difficulty may become a barrier, since technological entrepreneurship requires commercial and technical knowledge (HSU, 2008). Such situation is the opposite to what happens in company C, which introduces new design products to the

market every year. Company C's business partner developed technology to produce water filters in 1994, in the company he worked at that time. Therefore, company C is able to introduce new products to the market and can be claimed an innovative company, since it develops and implement products that are radically or incrementally innovative in a given period of time (PRAJOGO; AHMED, 2006).

Company D seeks innovations that will improve final user comfort, because such actions may improve Company D's customers perception through final users' perceptions. As to product innovation, company D's interviewee believes the company has released disruptive innovations since company D has been awarded and represents a pioneer in the market. In fact, company D displays, in its main site, a concept bus where all innovations are displayed, so customers can understand their utility. Incremental product innovations are usually results from relationship with customers that introduce the need for some modification, such as raw material change. As proposed by Lawson and Samson (2001), company D's innovative process results in new products, processes and systems that make company D competitive.

As for process innovations, company A claims that there is not a routine towards process innovation, however it was disclosed during the interview that a person was hired in order to improve manufacturing processes. Company A expects that innovations may be introduced to its process in order to accommodate Industry 4.0 trends, which is claimed to be the next industry generation (LEE; BAGHERI; KAO, 2015). Accordingly, company B's interviewee declared that it's the company focus for 2018. The interviewee is currently enrolled in a manufacturing engineering master course, so he intends to implement the technological novelty theme of his dissertation into the company process. This change is intended to improve product structure, programming process, and reduce products cost as well. Such attitude is considered technology entrepreneurship that is driven by innovations in science and engineering (BECKMAN et al., 2012; COLOVIC; LAMOTTE, 2015).

Company B also claims that process innovations are done in a daily basis, since they represent continuous improvement that can be proposed by any employee. However, company B has not defined a specific budget for such innovations. Likewise, incremental process innovations are done in a regular basis, since company C is always looking for opportunities to improve its process. So, company C seeks to decrease manufacturing time, which leads to manufacturing cost reduction. In order to do so, company C specifies a monthly budget for process improvement, and it controls the benefits through manufacturing efficiency. The same is true for company D, that applies incremental innovations to its manufacturing processes, since the industrial manager endorses lean manufacturing practices in the factory floor,

however, such incremental innovations are not traced as its direct impact on company D's finance. Initiatives taken by companies B, C and D are examples of continuous improvement lead by lean manufacturing practices that support new process innovations to thrive (BORGES LOPES; FREITAS; SOUSA, 2015). On the other hand, company E is currently investing in automating its tooling department, so it can reduce its manufacturing costs, therefore, focusing on the efficiency of specific technology management practices (CHAVEZ et al., 2016).

Interviewees were asked about mistakes and lessons learned over the entire entrepreneurial process. Mistakes by company A were made due to lack of expertise regarding final user's product use. However, for the last five years the interviewee has no memory of such problems happening. Company A's past errors resulted in money loss, since the tools need to produce products that did not work out in the market had to be discarded. Likewise, company B's interviewee declared that he did not regret pursuing the first entrepreneurial opportunity, but he admitted that they could have done a better planning as to avoid internal problems. They would also invest their capital in a different way, since they learned that their vacuum process is more profitable than their plastic injection process.

Accordingly, company C's interviewee believes that their greatest accomplish was to never give up the business, whereas its greatest mistake was to not be prepared to grow about seven times in only five years, since it caused great stress for company C's partners. Moreover, Company C was not able to supply all of its customers, due to capacity lack. Company C learned that they should not take into account financial forecasts for Brazilian markets, since they usually turn out different from its preview. Errors made by company D are usually regarding understanding market needs. So, when they happen company D evaluates again the products according to market responses, and then changes what needs to be improved.

After performing summarizing content analysis, codification aided by Nvivo® was performed in order to compare results of both analysis. Section 4.3.2 summarizes results achieved by Nvivo®.

4.4 OPEN CODIFICATION

The first part of the coding process was the open codification of the five interviews, which results are shown in Table 3. First column refers to the name given to the category; second column refers to the number of interviews that had at least one part of the text codified in the corresponding category; third column refers to how many times parts of text were codified according to the corresponding category. The categories are shown in descending

order.

Table 3 – Open codification

Category name	Sources	References
Competitive Strategy	5	84
Customers	5	80
Technical assessment	5	65
Product Research	5	64
Investment needs	5	63
Technological opportunity	5	61
Company characterization	4	56
Product Differentiation	5	54
Focus on new products	5	48
Process development	4	48
Process improvement	5	44
Entrepreneurial opportunity	5	42
Equipment investment	5	42
External Support	5	39
Product Distribution	3	38
Competitive differential	5	37
New to market	5	36
Product incremental innovation	5	36
Management structure	5	33
Product development internal structure	5	33
Uncertainty	5	33
Company growth	5	32
Employees	5	31
Learning	5	31
Market recognition	4	31
Competitors	5	30
Profit	4	25
Risk	4	23
Personnel qualification	5	18
Mistakes	5	15
Focus change	4	13
Challenge	3	11
Product Exportation	5	10
Lack of technological differentiation	4	8
Market regulation	3	7
Product Importation	2	6
Social Issues	3	6
Safety	2	4
Competitors copying products	2	3
Environmental assessment	2	2

Source: author's own (2018).

Competitive strategy was the most referenced category, since according to the

interviewees to pursue a technological opportunity that may turn out as an innovation, is part of the company's strategy. Indeed, strategy is one of the variables that affect the entrepreneurial process (SHANE, 2003). Any decisions are also made according to the company strategy, since innovation depends on company's strategy and management (PORTER, 2004).

Customers were pointed as the ones that request the companies to improve their products, as well as trying other materials or processes, and they may work also as partners in order to develop or test new products or processes as well, which may represent a major source for firms' competitive advantage (MAHR; LIEVENS; BLAZEVIC, 2014). Such involvement may be part of open innovation efforts (VAN DE VRANDE ET AL., 2009).

Technical assessment is performed anytime a new machine, tool or technology appears on the market, and it is part of the exploitation phase at the product/process level (SPIEGEL; MARXT, 2011). According to the interviews, most of the time, technological entrepreneurial process would end on this stage, since the relationship between cost and benefit would not seem positive to the company.

Since innovation is responsible for meeting market demands (PRAHALAD; KRISHNAN, 2008), product research is performed in order to understand market needs and has its importance related to the fact that lack of market information is one of the factors that may hinder or hamper innovation (OECD, 2005). On the other hand, BERENDS et al. (2014) suggests that founders' knowledge about customers and market probing may be more used by small firms than early market research.

Investments are required in order to pursue any technological opportunity. Companies assess whether a technology opportunity investment is worthy pursuing according to its return on investment. Accordingly, Oslo Manual (2005) claims that one of the barriers to innovation is return on investment, at the same time, it recognizes that without investment, innovation is not possible to be accomplished (OSLO, 2005). Likewise, equipment investment is needed in order to continue the technology entrepreneurial process.

Mean technological opportunities are usually brought by customers and suppliers, however, company D has other sources of technological opportunities, which includes competitors' information. As revealed by companies' representatives, technological opportunities are usually pursued as a way to keep up with competitors (VAN DE VRANDE et al., 2009). Likewise, dependence on technological opportunities are long recognize as one of the variables that interfere in the innovation process as well (DOSI, 1982).

The category company characterization was used any time the interviewees were describing company characteristics or talking about the companies' trajectory. Historical

context is part of the entrepreneurial process (TIDD; BESSANT; PAVITT, 2008). Likewise, entrepreneurial opportunities were cited either to explain how the company started as well as to explain changes in the company focus, such as company A explained. Therefore, such entrepreneurial opportunities may lead to creation of new companies or result in company's expansion (GEM, 2016).

Even though product differentiation was a goal for most companies, companies could achieve such goal without adding technology to their products. New products may result from entrepreneurship (DRUCKER, 1986) and innovation efforts as well (HAUSTEIN, 1980; OECD, 2005). Likewise, focus on new products was also cited as a main concern to all companied interviewed, since they all revealed that will release new products to market, even though some companies did not have their own products up to the time the interview was conducted. Companies may invest or plan releasing new products to market because it represents one way of exploring market opportunities (HITT et al., 2011) that may lead to product innovation (SCHUMPETER, 1934).

During Company A's interview, process development was not cited, what may be explained by the company's lack of investment in new process up to the time of the interview. Whereas company B cited that customers' requests to replace materials made them develop new processes as to meet customers' needs. Accordingly, company D develops its processes in order to accommodate new components that are incorporated to current products, and finally, company E develops process in order to attend customers demand. Hence, process improvement was present in all companies, since they all apply lean manufacturing concepts and tools, that is, they all improve its process in a daily basis in order to reduce costs which along with other enablers may be able to results in product and process innovation (RINGEN; SCHULTE, 2017). On the other hand, company C developed its own process in order to manufacture its products, therefore, characterizing the introduction of a new process (FREEMAN, 1982; LAWSON; SAMSOM, 2001; OECD, 2005).

All companies admitted that external support is often used when pursuing technological opportunities. In fact, company A hires companies to help developing its products, company B has ties with its suppliers in order to maintain its competitive advantage; company C required external help when starting the company, company D asks for external help to develop new products as well as to test its innovations; and finally, company E involves its customers as external help to develop and improve its process. Actually, establishing relationship with external organisations and customer participation are considered open innovation activities (VAN DE VRANDE, 2009; CHIARONI; CHIESA; FRATTINI, 2010)

Products distribution was cited by companies A, B and C since their products do not go straight to final users, but rather to clients that distribute the products to the market. According to Loomba (1996), product distribution deals with how a product should be distributed to the end consumer, so the decision about how a company is going to perform such activities is a strategic decision (NORDIN, 2005).

All companies' representatives agreed that competitive differential is a possible outcome for companies that pursue technological opportunities (OECD, 2005; BESSANT; TIDD, 2009), especially when customers are part of the technology entrepreneurial process (MAHR; LIEVENS; BLAZEVIC, 2014).

All companies put out products that are new to market, even though company A was the only one that neither incorporate technology in its products nor in its processes. When a company is the first one to introduce a product or a process in a specific market, one can say that it is innovation that is new to market (OECD, 2005). External support and new to market innovations are moderated by investment for technological and skills-related knowledge assets (TORUGSA; ARUNDEL; O'DONOHUE, 2016).

As to product incremental innovation, all companies delivered to market at least one product featuring incremental innovation, once again company A was the only one that did not produce its product by pursuing a technological opportunity. Incremental innovations result in competitive advantage, specially to small and medium-size companies. Such effect is possible since incremental innovations are easily adopted, so companies can focus on sales and marketing (BHASKARAN, 2006).

Management structure was pointed out as to depict how management works in order to pursue technological opportunities. Management abilities can be either a latent characteristic of entrepreneurs (FILION, 1991) or required to be developed when the company reaches the mature phase (MOORE, 1986). Besides the management structure, companies' representatives claimed they all have their own internal development structure, whereas it is in a department arrangement or by some specific processes that may be formal or informal, which may be compared to R&D department (DOSI, 1982; OECD, 2005).

Uncertainty was cited by all companies since entrepreneurship, whether when pursuing an entrepreneurial opportunity or a technological opportunity. Tolerance towards uncertainty is also a characteristic of entrepreneurs (FILION, 1997). On the other way, uncertainty is another factor that act as a barrier to innovation (OECD, 2005), and at the same time is an intrinsic characteristic (DOSI, 1982), that can be reduced (NELSON; WINTER, 1982). However, technology entrepreneurs face a great level of technological uncertainty (HARMS; WALSH,

2015).

Company growth is considered the ultimate goal, whether when pursuing an entrepreneurial opportunity or a technological opportunity. Accordingly, technology entrepreneurship is considered a source of continuous growth (TANG; TAN, 2013; VAN BURG; VAN OORSCHOT, 2013; YUN; PARK; MOHAN, 2016). Companies featuring high growth rates also generate more jobs (KOELLINGER, 2008; DELGADO; PORTER; STERN, 2010).

Employees are considered valuable assets and play an important role in the technological entrepreneurial process, especially when competences are properly assessed (JIAN; XIAOLIN, 2011).

Learning customer and marketing response and acting based on the previous learning was indicated as part of both the entrepreneurial process and the technological entrepreneurial process. Factors such as risk, uncertainty, status, pervasiveness, observability, disruptiveness, and centrality influence on the learning process (LINTON; WALSH, 2013).

Market recognition is also considered another outcome expected from companies' strategies. Once again, need for recognition is a characteristic present in entrepreneurs (BROCKHAUS, 1980). However, SMEs may lack market recognition, even when they are innovative (EL ASSAR; SAID, 2015).

Competitors were pointed out as one of the sources to pursue a technological opportunity by company D, whereas all companies claimed that pursuing a technological opportunity may be a way to overcome its competitors. Having advantage over competitors is expected by technology entrepreneurship (VAN DE VRANDE et al.; 2009) and innovation initiatives as well (HERÉDIA, 2014).

Even though company B did not cite profit, it is an expected result as outcome for any decisions the company may take, therefore, technological innovations are expected to deliver maximum profit for companies (YUN; PARK; MOHAN, 2016). Increasing profitability is also recognized as an innovation indicator (BESSANT; TIDD, 2009). However, innovative activity may not result in higher profitability (KOELLINGER, 2008). On the other hand, Zhu (2017) shows that the more stringent government laws and regulations are, the higher the profits of financial products manufacturers will be.

Likewise, risk is also cited as a characteristic present during all the life of the company, even though companies try to reduce it. Since risk is considered one of the economic factors that may hinder or hamper innovation (OECD, 2005), risk propensity is not significantly related to entrepreneurial performance (ZHAO; SEIBERT; LUMPKIN, 2010). However, Caliendo,

Fossen and Kritikos (2009) claim that risk do not seem to play a role in the decision process.

Personnel qualification is one of the requirements so the technology entrepreneurial process can happen, since the company may not have know-how on technologies purchased. Therefore, OECD (2005) advises that one of the categories of technology be related to qualified personnel transfer. Likewise, TPP innovation may be acknowledge when personnel involved need training (OECD, 2005).

Business mistakes represent a natural learning cost for economic development (ELIASSON; ELIASSON, 2006). Mistakes were admitted to be part of the entrepreneurial process and technology entrepreneurial process as well, but they usually result in learning. Accordingly, the literature shows that mistakes are part of the entrepreneurial process since its early stages, when investors are analyzing business proposal (MAS; HSUEH, 2017). Therefore, Barr et al. (2009), claim that graduate students that are enrolled in theory-driven approaches may learn from other companies' past mistakes. On the other hand, Quadros et al. (2004), claim that technology related mistakes are usually related to the business plan.

Focus change in the business were admitted as a way to pursue new markets and customers, likewise, Colovic and Lamotte (2015) claim that technology entrepreneurship and entrepreneurship are differentiated by their focus. Therefore, when a company can focus both in technology and entrepreneurship, it results in prosperity (SANJAYA; SOEKESI; SITOHANG, 2015).

Challenges were faced by companies during their history. Challenges relate to organisational and cultural issues as a consequence of dealing with increased external contacts (VAN DE VRANDE et al., 2009), technological uncertainty, higher capital requirements and a larger number of required capabilities (HARMS; WALSH, 2015).

Companies have exported products at least once. They claimed they intend to intensify their marketing actions in order to increase their income by exportation. One of the innovative enterprise characteristics is related to the development of products and services oriented to international markets (GEM, 2014). Accordingly, OECD (2005) claims that the technology efforts may be also categorized according to intended markets, whether international or not.

Lack of technological differentiation category refers to the companies that argued there is no new technologies in the plastic process being developed in Brazil. Therefore, Brazilian plastic companies must find out what is being developed in European and Asian markets.

Market regulations often interfere in the process of developing a new product or a new process. Likewise, GOUVEA et al. (2012) found that regulation may be limiting the benefits that may come from emerging technologies.

Product importation was admitted by two companies, company A as to improve its product and introduce in the Brazilian market a new component, and company B started its production in China before starting its own manufacturing process. According to Pak e Ku (2017), technology imports result in positive effects in the long run. Likewise, technology imports are considered important, in a regulated market, since they fill gaps in domestic technological capabilities (AGGARWAL, 2000).

Social issues were pointed out as factors that may interfere in the technology entrepreneurial process, since such conditions may affect decision making. Moreover, corruption and regulations may limit benefits obtained from new technologies (GOUVEA et al., 2012). Another issue, intellectual property may be overcome by open-innovation activities (MARTÍNEZ-NOYA; GARCÍA-CANAL, 2018).

As to the category that refers to competitors copying products, companies C and D affirmed that it may happen, however, such companies are recognized as pioneer of their lines of products.

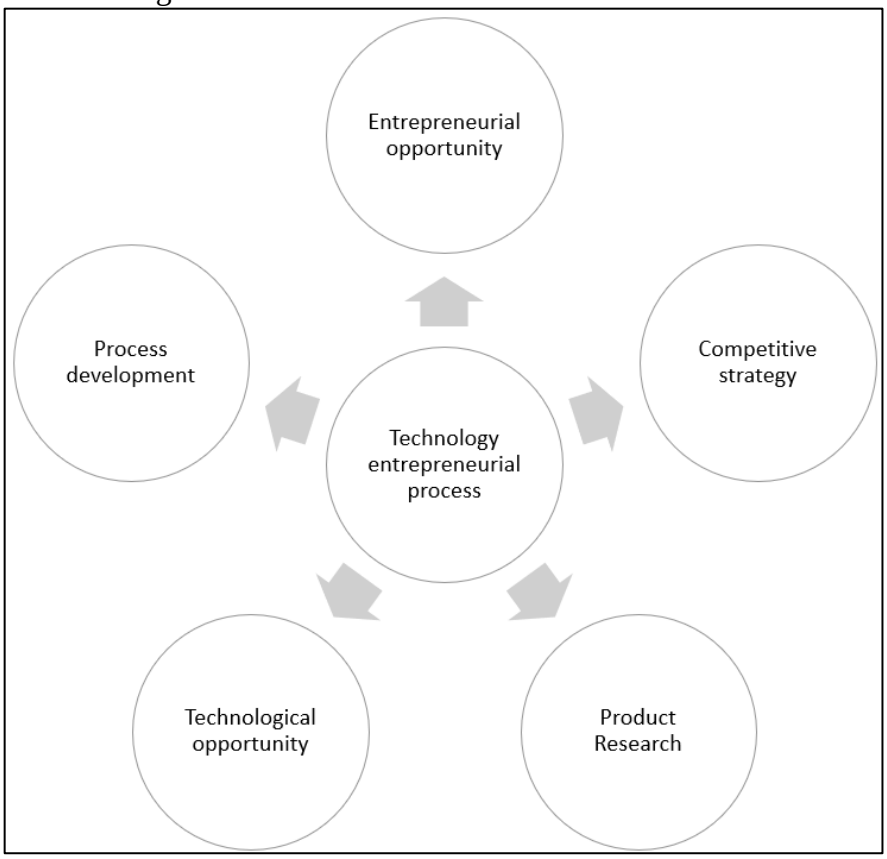
4.5 AXIAL CODIFICATION

After performing open codification and analyzing it thoroughly, axial codification results were arranged as shown on Appendix J. Later, the categories were arranged according to Figures 13, 14, 15, 16, 17 and 18. Since Nvivo® Starter edition was used to perform codification, it was not possible apply its graphical tools. The categories units and company characterization were excluded since they represent companies' characteristics and history. Therefore, it seems that technology entrepreneurial process depends on the company competitive strategy (Figure 14), its product research procedures (Figure 15), technological opportunities available on market (Figure 16), its process development procedures (Figure 17) and its entrepreneurial opportunity (Figure 18), as shown in Figure 13. Each one of these categories are influenced by a series of other subcategories. Some of these subcategories interfere in more than one factor, therefore, each subcategory and its relationships among categories and subcategories are explained as follows.

Customer is the only subcategory present in all categories, since it influences all perspectives on the technology entrepreneurial process. When it comes to competitive strategy, the companies make decisions based on how they are going to approach customers and its acceptance regarding technology. Customers are also responsible for demanding new products development, therefore they may participate during new products testing, and some key

customers provide valuable feedback when companies try to develop new products. Accordingly, technology opportunities may also arise from customers that need new technological products or processes. Entrepreneurial opportunities may originate from customers that were not supplied accordingly by its previous suppliers, so the opportunity to fill a new market wither originates a new company or contributes to company growth. These findings confirm previous literature regarding customer participation and open-innovation efforts, as well as its benefits (VAN DE VRANDE ET AL. 2009; CHIARONI; CHIESA; FRATTINI, 2010; MAHR, LIEVENS, BLAZEVIC, 2014; BERENDS ET AL. 2014).

Figure 13 – Axial codification: main codification

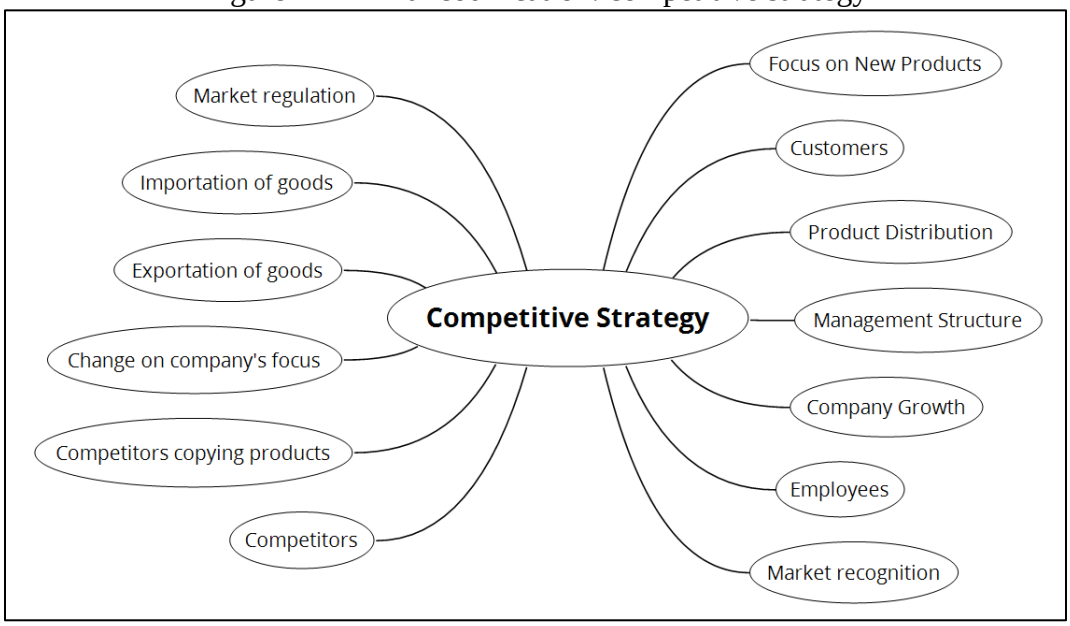


Source: author's own (2018).

Market recognition is a result related to all categories, but entrepreneurial opportunity. As to competitive strategy, market recognition was considered the result of an effective competitive strategy, so innovative organisations being those that continuously respond to market needs (MINTZBERG, 1989). Therefore, when product research results in products that match and overcome market needs, market recognition may emerge as awards, as told by some companies during the interviews. Companies that use technological opportunities and develop them in the form of new or improved products or process are also recognized in the market as

pioneers, therefore reinforcing that companies are able to use available resources that may become innovations (BERENDS et al., 2014).

Figure 14 – Axial codification: competitive strategy



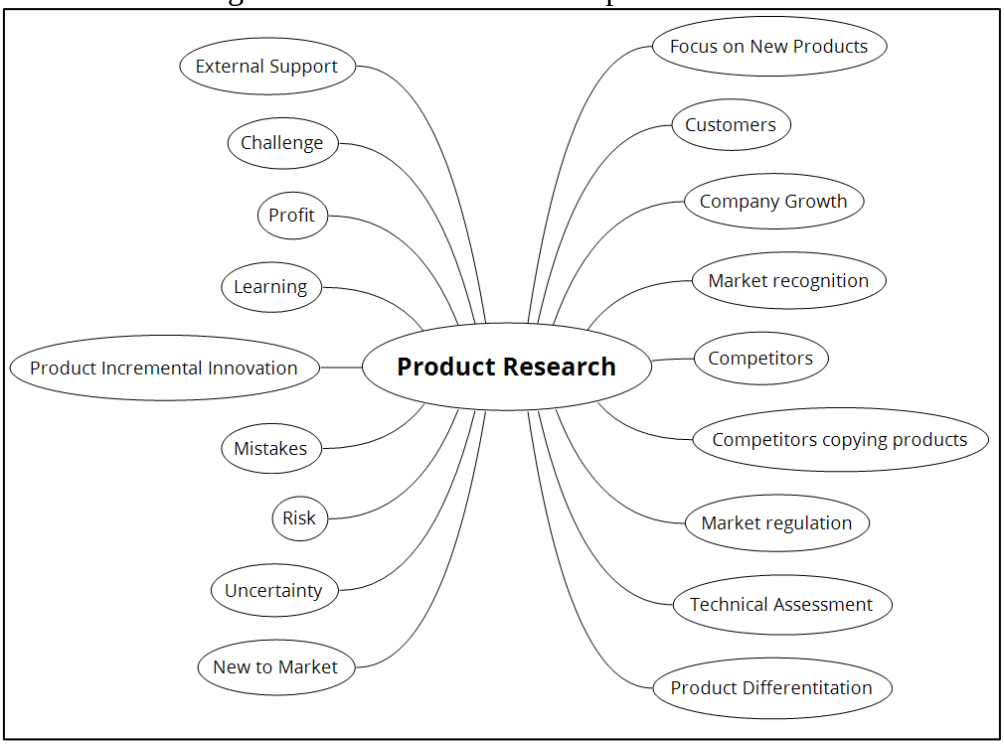
Source: author's own (2018).

The subcategory competitors are also present in four out of five categories, with process development as the only category left out, since there are no disruptive innovative processes being developed in Brazil according to the interviews. As for competitive strategy, competitors must be neutralized in expand market share. One way of doing such thing is to put out innovative products on the market by taking advantage of technological opportunities, such findings corroborate with the previous literature (VAN DE VRANDE et al., 2009). Competitors may also influence on the entrepreneurial opportunity, since parts of the market that are not fulfilled by current companies may result in new entrepreneurial opportunities. As a matter of fact, even though companies engage in technological opportunities pursuit competitors may also copy products what may affect a company's strategy and turn product research in a risk business.

Risk, profit and uncertainty are subcategories common for product research, technological opportunity, process development and entrepreneurial opportunity. According to the interviews, risk is inherent to the entrepreneurial process as well as to the technology entrepreneurial process. Product research and process development are risky due to market acceptance and innovativeness to the company. Nevertheless, profit is the companies' goal, and each of these processes are supposed to bring profit that would not be possible without the

inherent risk. As to product research, uncertainty concerns market acceptance of new products. Likewise, entrepreneurial opportunity and technological opportunities feature uncertainty, since the entrepreneur is not certain about the profit that will result from the new enterprise, or that incorporated technologies will be accepted on the market. These findings support previous literature on risk and uncertainty (NELSON; WINTER, 1982; OECD, 2005; CALIENDO; FOSSEN; KRITIKOS, 2009; GALKINA; LUNDGREN-HENRIKSSON, 2017), indeed, as claimed by Harms and Walsh (2005) technology entrepreneurship is characterized by uncertainty.

Figure 15 – Axial codification: product research



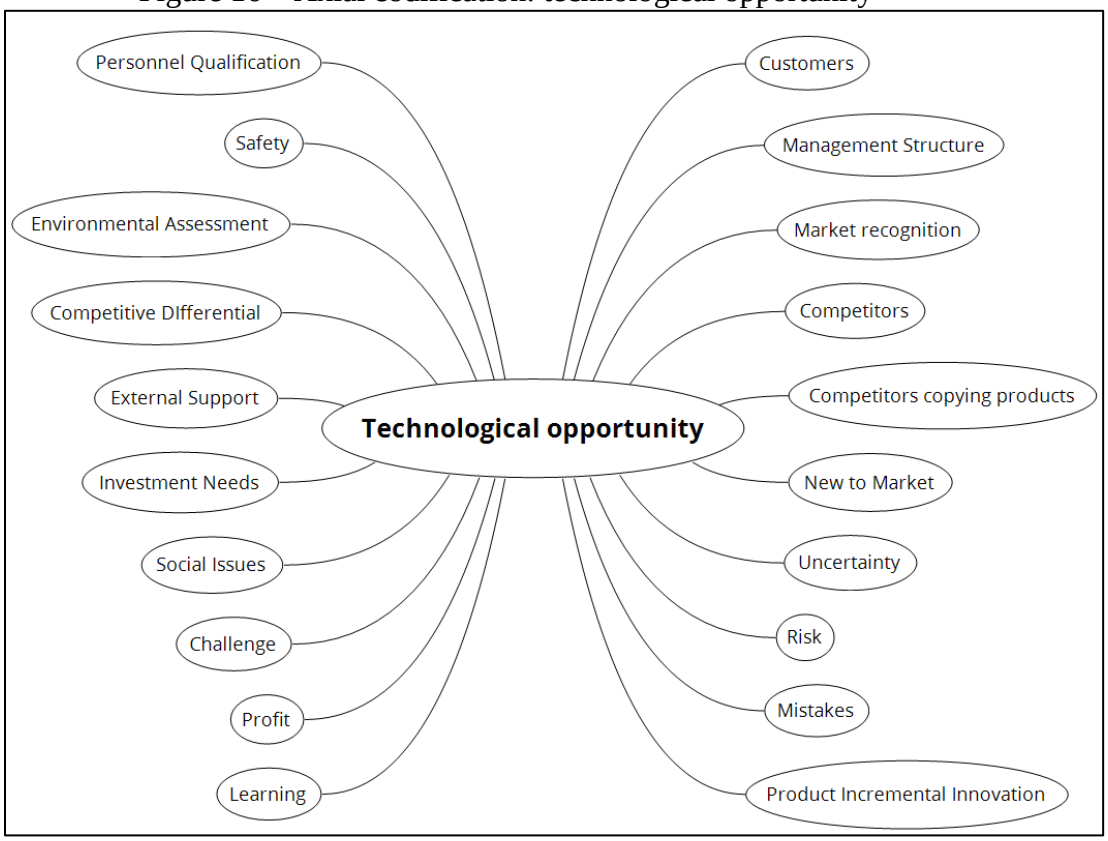
Source: author's own (2018).

Management structures affects competitive strategy, since decision making influences whether the company will pursue a technology entrepreneurial opportunity that may turn out to be a new process within the company. As to the entrepreneurial opportunity, management structure is also responsible for decision making and plays a significant role in the company development, therefore entrepreneurs as well as technology entrepreneurs must have managerial abilities (FILION, 1991). Finally, technology management is part of the technology entrepreneurial process (CHANDRA, 2018).

Subcategory product importation refers not only to whole products that were imported, but to components as well. When related to company strategy deals with products that are new to Brazilian market and may complement existing products. Likewise, product research may

indicate what components or products may be imported in order to guarantee new products to the market and may even interfere in the market price for certain products. Entrepreneurial opportunities were also pursued by initially importing products in order to sell them and gather financial resources, what may result in positive effects in the short run as opposed to what is claimed by Pak e Ku (2017).

Figure 16 – Axial codification: technological opportunity



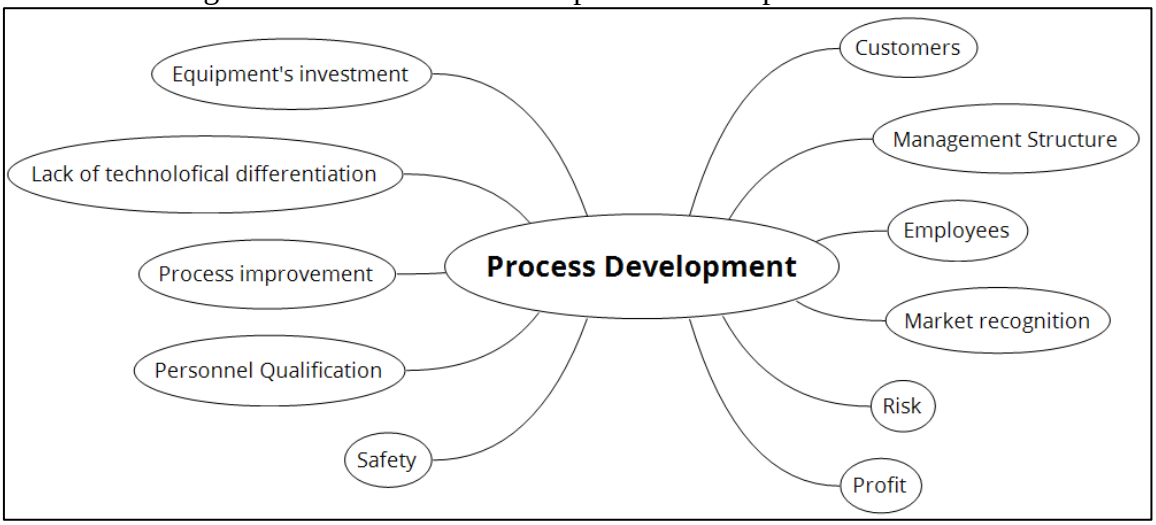
Source: author's own (2018).

Market regulations such as laws, rules, regulations, and requirements may interfere in the company's competitive strategy since it may interfere in the release of new products. Such regulations may be related to environmental, safety, inclusion, and ethical issues. Product research and time to market may also increase as well as its costs due to market regulations that were not expected. Likewise, some projects may become unfeasible due to unexpected market regulations. These findings support previous literature (GOUVEA et al., 2012).

Learning was associated to product research, technological opportunity and entrepreneurial opportunity. The interviewees claimed that mistakes are part of these processes, as well as the lessons that are internalized by the company. However, Mccann and Vroom (2015) argue that such process is more intensive in the nascent stage of the entrepreneurial

process. On the other hand, learning is part of the innovative process that may influence innovations diffusion speed (ROGERS, 2003), may happen through informal activities (DOSI, 1982) and is a main characteristic of the technology innovation process (NIETO, 2004). As for the technology entrepreneurial process, organisation learning is part of the renewal phase (SPIEGEL, MARXT, 2011).

Figure 17– Axial codification: process development



Source: author's own (2018).

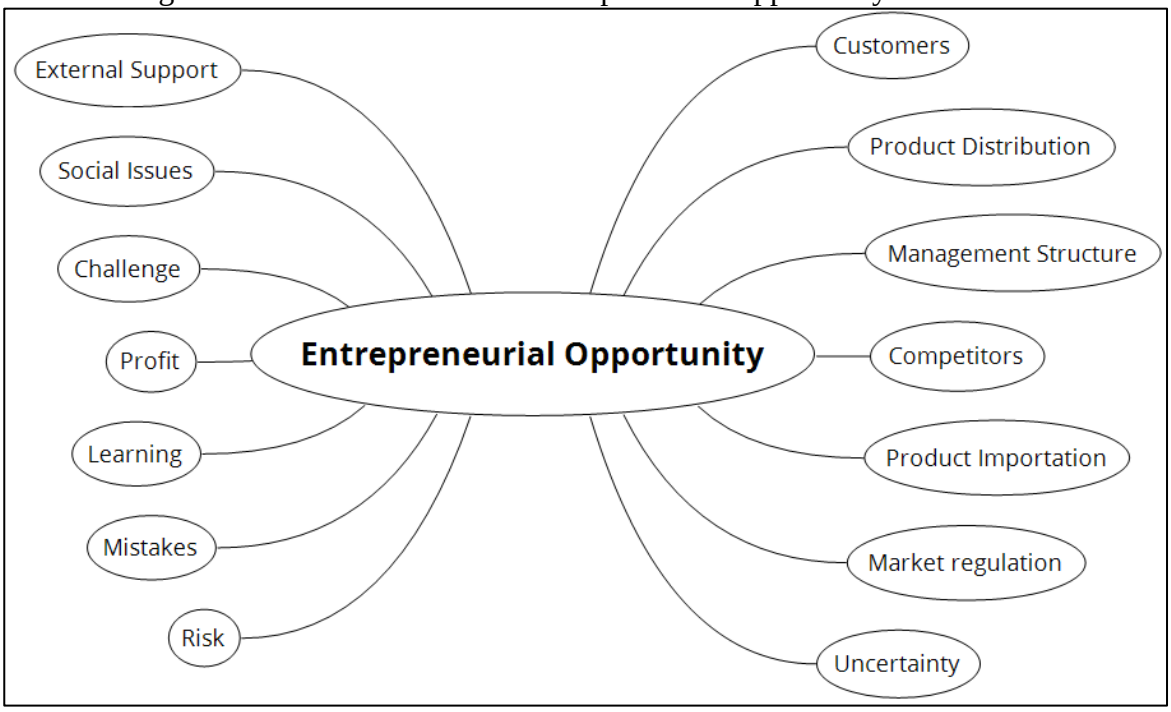
As to focus on new products, it has ties with competitive strategy and product research. When a company decides its strategy will be focused in releasing new products to the market, it must have its own internal structure. Therefore, focus on new products usually results in company growth, probably because it increases market share as well. Accordingly, increase in market share is one of the innovation indicators (OECD, 2005; BESSANT; TIDD, 2009).

Companies may not always deliver its products straight to the final user. In such conditions, they partner with retailers that will distribute their products to intended final users. This kind of partnership calls for a strategic decision since product distributers represent a chain to the final user. Company A has strong ties with some of its product distributors and accredit them its competitive advantage. These finds corroborate previous literature that indicates the importance of partnerships when pursuing technological and non-technological innovations (FREIRE, 2018), however, technology-based initiatives may be difficult to be understood by commercial partners (DOGANOVA; EYQUEM-RENAULT, 2009).

Technology opportunities may result in product incremental innovation and products new to market as well, confirming previous literature (ELIA; MARGHERITA; PETTI, 2016).

In such cases, technical assessment must be performed in order to decide on the market release of new products (SPIEGEL; MARXT, 2011), as part of the exploitation phase of technology entrepreneurial process (PETTI, 2009). Therefore, product research, pursuing technological opportunities and entrepreneurial opportunities represent a challenge to companies which may require external support in order to make them profitable, therefore being part of open-innovation initiatives (CHRISTENSEN; OLESEN; KJÆR, 2005). Product differentiation is a consequence of companies' efforts to meet market needs (GANS; STERN, 2003).

Figure 18 – Axial codification: entrepreneurial opportunity



Source: author's own (2018).

Employees were cited as essential in companies' competitive strategy and process development. Even though each company has its own way of being open to employees' participation, they all endorse employees in order to make internal manufacturing process easier and reduce their costs. Therefore, employees' participation may lead to process innovation, even though sometimes they are not properly acknowledged. These practices support the idea that innovation also depends on employees' endorsement (PORTER, 2004), as well as characterizes open innovation efforts (VAN DE VRANDE et al, 2009).

Social issues were cited by some companies as obstacles when pursuing technological and entrepreneurial opportunities. Factor such as taxes, inflation, laws, and political issues make it difficult for companies to forecast the future, therefore, long term decisions are risky and

complicated. Such issues, may hinder or hamper innovation (GOUVEA et al., 2012; MARTÍNEZ-NOYA; GARCÍA-CANAL, 2018).

As to competitive strategy, the subcategories that it does not share with the others are focus change and product exportation. Focus change happens when companies assess their current strategy and notice there is room for improvement, hence, they try to change the company focus. Likewise, product exportation is one of the ways companies decided to compete, usually by exploring Latin American market. However, the national market seems to indicate a different trend, since Brazil has exported products featuring low technology and knowledge applied to them (GEM, 2016).

Investment needs, competitive differential and environmental assessment were associated with technological opportunity only. According to the interviews, technological opportunities require investments and may bring competitive differential for the company. Sometimes, they are also responsible for reducing natural resources need, usually when products' raw materials are changed. As for investment needs, innovation depends on it (OECD, 2005), moreover, it may be a determinant of technology innovation (ZHANG et al. 2018). On the other hand, companies did not expect foreign investment as claimed by Rasmussen and Sørheim (2012). The competitive differential that may result from technology claimed by the companies' representatives is also found in the literature regarding entrepreneurial orientation (MARTENS ET AL., 2018), innovation (LAWSON; SAMSON, 2001; OECD, 2005; MAHR; LIEVENS; BLAZEVIC, 2014), technology (FLEURY; FLEURY, 1995; MAÑAS, 1999) and technology entrepreneurship (AJAGBE ET AL., 2013).

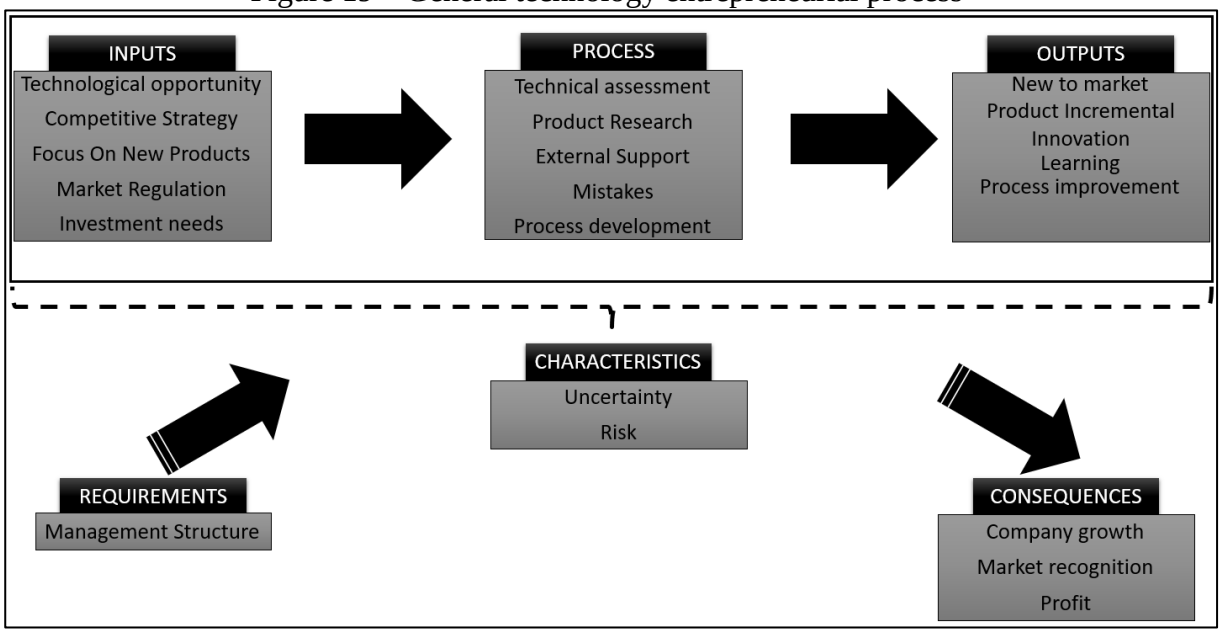
Personnel qualification may be either an input or a requirement when pursuing technological opportunities and developing new process. As company C claimed, professionals in Caxias do Sul region may not be able to assist when developing automated process that are new to the market. However, between the study's participant companies, none was identified as source of self-employment, as suggested by literature on the field (DELGADO; PORTER; STERN, 2010).

During the interviews, companies claimed that they may lack innovative processes because there is no research in Brazil that results in new processes. Therefore, equipment's investment usually results in process improvement. Companies admitted that their factories are up to date, but there is no equipment that their competitors may not have access as well.

4.6 SELECTIVE CODIFICATION

In order to answer the research question proposed on this master dissertation: *how does technology entrepreneurial process occur in SIMPLAS companies?* Therefore, selective codification was performed by using key categories and subcategories, therefore results are described hereinafter. Three scenarios were identified for technology entrepreneurial process according to each type of company, as they are depicted in Figures 20 (mature companies), 21 (technology-based companies) and 22 (embryonic companies). However, as expected these three scenarios have most factors in common, as shown in Figure 19.

Figure 19 – General technology entrepreneurial process



Source: author's own (2018).

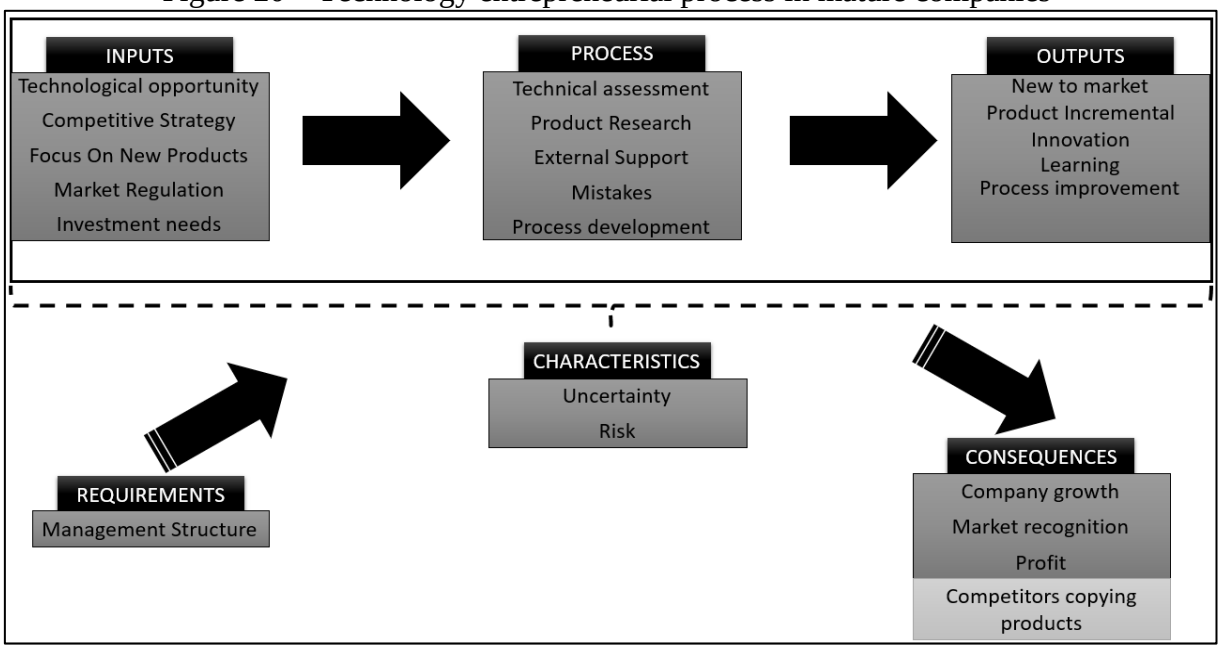
The technology entrepreneurial process requires companies to have a managerial structure that support technology opportunities pursuit, that is, if the company's managers are not willing to take the risk by pursuing technological opportunities, the process will not happen. Mean inputs to the process are technological opportunity that may be brought by a customer, supplier, or even a competitor. Competitive strategy, focus on new products and market regulation are key elements when deciding whether to pursue such opportunity as well. Investment needs may also impact the process start.

As for the process itself, it usually develops products or process in which it is necessary to technically and financially assess the opportunity. During the process, some mistakes may occur that eventually will lead to learning as shown in the output part of the process. Other outputs include products that are new to the market, products and process characterized by incremental innovations, and improved process. The whole process is characterized by

uncertainty and risk and has as its final consequences for the company that know how to pursue such process, company growth, market recognition and profit.

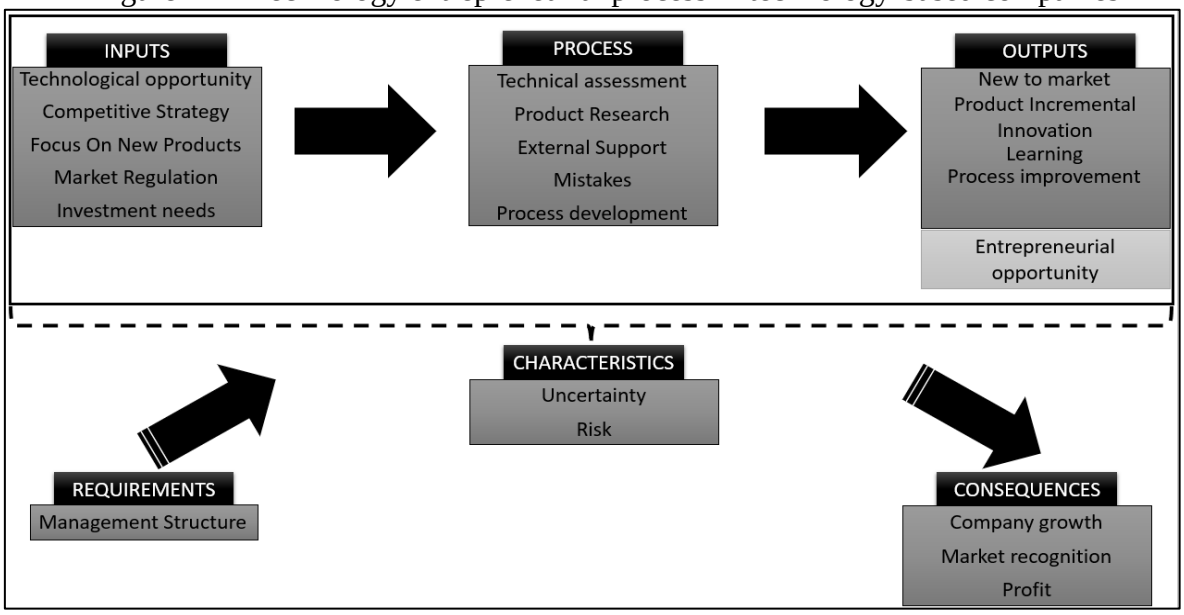
Companies that have reached a mature level, as shown in Figure 20, pursue technological opportunities in a daily basis. As a result, such companies are pioneers in the markets they act, and face competitors that may copy their technology once it is full developed and released to the market.

Figure 20 – Technology entrepreneurial process in mature companies



Source: author's own (2018).

Figure 21 – Technology entrepreneurial process in technology-based companies

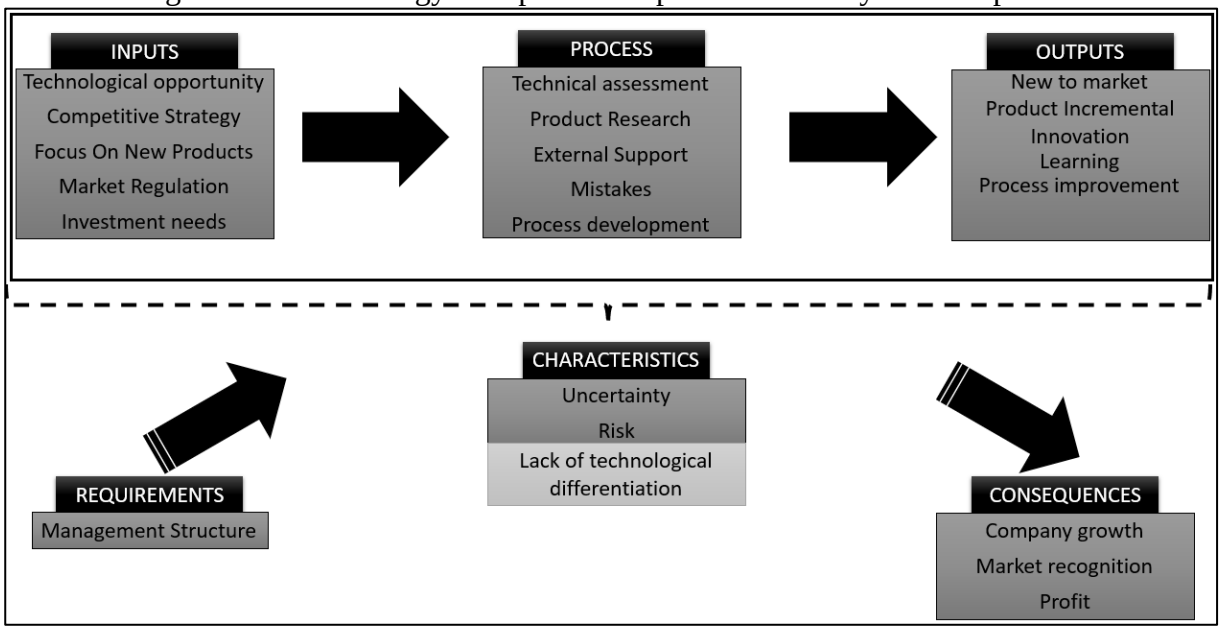


Source: author's own (2018).

On the other hand, companies that originated from technological opportunities that were fully developed by them, do not face competitors' threats of copying its products, but may face challenges when starting to pursue technological opportunities as a routine.

Finally, companies that neither started from technology opportunities nor are mature enough to have defined process in their attempt to achieve competitive advantage through pioneering, are mainly characterized by lack of technological differentiation, that is, they pursue technological opportunities, but differently from mature companies, they may lack financial resources and technological differentiation.

Figure 22 – Technology entrepreneurial process in embryonic companies

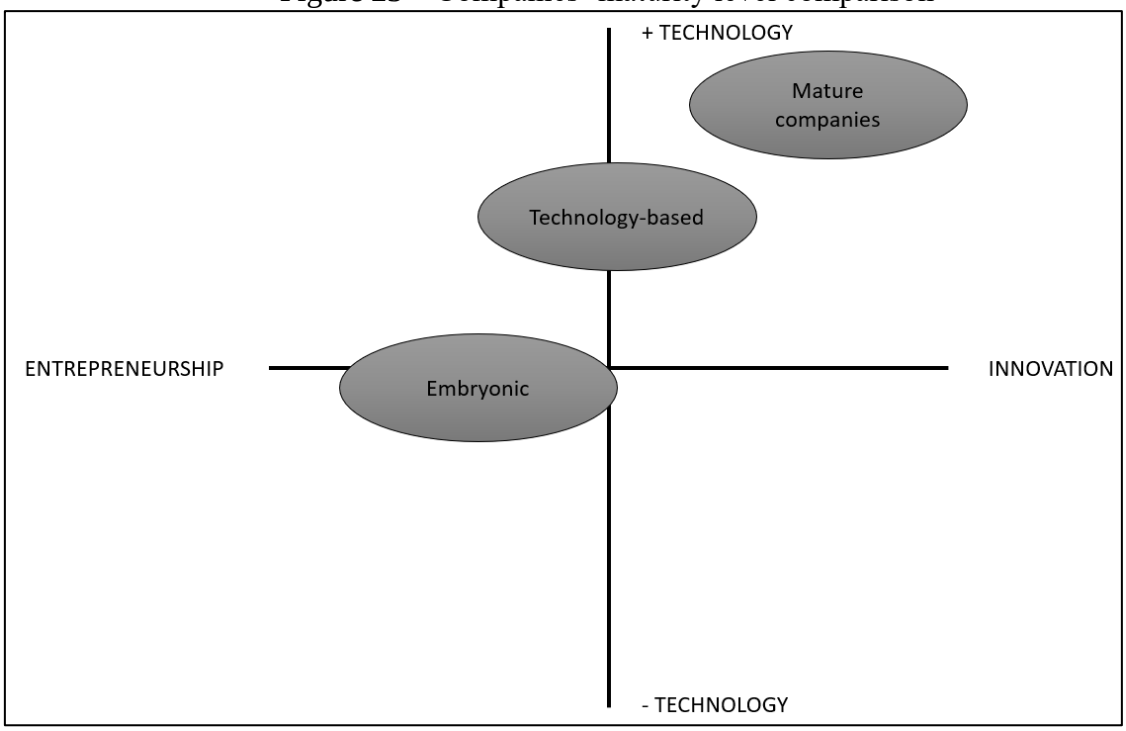


Source: author's own (2018).

Taking these three scenarios into account, it is possible to evaluate how the technology entrepreneurial process occur in companies according to its levels of technology, innovation and entrepreneurship as shown in Figure 23. Mature companies feature high levels of technology, therefore they put out more innovative products and process. Likewise, companies that arose from technology-based opportunities, present entrepreneurial and innovative characteristics, usually featuring midlevel technology use. Such companies may reach the mature level if they make the technology entrepreneurial process as part of their routine. However, if such companies stop trying to improve its products and processes, they may decrease their innovative levels, therefore they may be compared to embryonic companies. Such companies present low levels of innovation and technology; however, they attempt to find technological opportunities, but their concern and awareness regarding risk and uncertainty

may result in lack of innovation and reduce their technology opportunities pursuit.

Figure 23 – Companies' maturity level comparison



Source: author's own (2018).

5 CONCLUSIONS

This master dissertation intended to explore the technology entrepreneurial process in SIMPLÁS companies, which resulted in an answer to the research question and fulfilled the main objective, as well as the specific objectives. Therefore, this section will present conclusions regarding both academic and managerial perspectives. Finally, limitations to this research are presented, as well as suggestions for future researches.

The research was conducted in 5 companies, here named A, B, C, D and E, which are all members os SIMPLÁS. These companies agreed to be part of this study since they have their own interest in entrepreneurship and innovation related themes. Therefore, interviews were scheduled and performed according to the companies' representatives schedule. The interviews allowed to draw some conclusions, such as dividing the companies in three groups according to their technology entrepreneurship maturity level.

Company A started producing parts and components for other industries, but an unexpected event in its early history made de company change its focus from process based to product based. Among the companies that were part of this study, Company A is the one that presented the least technology entrepreneurship maturity level, what may be explained by its current focus on product design. Even though Company A acknowledges the importance of technology, the company business partners admit that they did not invest in this matter up to now. However, Company A plans to start investing soon in technology in its process as to improve them and become more competitive. As for Company A's products, the company has imported some components that are assembled in its products and made them be new for the Brazilian market. However, it is not an ongoing process. For the reasons presented, company A is considered to be at the embryonic maturity level of technology entrepreneurial process.

Company B was founded because the business partners were partners in another company and were not happy about the company's policies about innovation and process and product improvement. Therefore, Company B since its foundation is concerned about making its process and products better. As to accomplish that, Company B maintain cutting edge equipment in its shop floor and invest in its personnel as to have a team that can make Company B more competitive. However, Company B has not implemented formal processes as to pursue technological opportunities that may lead to technological products or processes, even though it may happen sometimes. So, as to define the technology entrepreneurial maturity level for company B, it is considered embryonic because of its informal processes.

As for Company C, it was founded because one of the business partners had the patent for an exclusive manufacturing process. Therefore, Company C is a company based on technology, the second technology entrepreneurial process maturity level. Since Company C entreneurial opportunity came from its technological opportunity pursuing, Company C has formal processes when it pursues technological opportunities that may lead to innovative processes or products. So, Company C may achieve the next maturity level if it continues to pursue technological opportunities.

On the other hand, Company D was identified as the only mature company analyzed on this dissertation. Company D has formal procedures as to pursue technological opportunities that eventually lead to innovative products and processes. Since Company D is recognized in its market as a pioneer of new technologies, it can easily start research with institutes and partners such as customers and suppliers that will help thoughout this process. Company D acknowledges that innovative products may be copied by its competititors, but the only way to overcome such threats is to keep innovating.

Finally, Company E is a solid company in the market it acts. So, Company E is aware of the need to introduce innovative processes and products. As to achieve it, Company E goes through an informal process in order to decide which technological opportunities it is able to pursue. However, Company E's attempts to pursue the technological entrepreneurial process may be put in risk because of the high risk and uncertainty that come along with technological opportunities. Nonetheless, Company E is sometimes able to introduce products that are new to the market. Finally, it is possible to say that Company E is at the embryonic maturity level at the technology entrepreneurial process.

The objectives regarding identifying and analyzing the technology entrepreneurial process in SIMPLÁS companies are described hereinafter. Hence, it was noticed that such process can happen in three different ways, which were arranged in different levels according to the company level: embryonic, technology-based and mature. The process in embryonic companies usually features high levels of risk and uncertainty, that along with high investment needs represent barriers and threats to the whole technology entrepreneurial process. Companies at this level, look for technological opportunities and may pursue them as long as they have some guarantee that risks can be reduced and threats may be mitigated

Since technological opportunities usually represent high investment needs to such companies, one characteristic that is exclusive to these group of companies, is lack of technological differentiation. Even though it seems contradictory to the technology entrepreneurial process, it shows that such companies are aware that they must not take

anything for granted, in other words, they are looking at technological opportunities that arise, therefore they may able to create internal procedures as they learn with their mistakes. Companies at this level are aware of the importance of being prepared to compete with new products, especially the ones that feature high levels of technology.

On the other hand, these companies have introduced lean manufacturing practices and tools, current machinery and equipment, what shows they are concerned to be, at least, as good as their competitors in terms of infrastructure. Once their infrastructure is up to date, their investments are towards technological opportunities that may result in innovative products and processes, that will ultimately guarantee competitive advantage. Technological opportunities are usually brought by customers, since they act as partners in a process that reminds open-innovation. As for innovative process, these companies are not as concerned as they are for products, once their representatives claimed that regarding plastic manufacturing process, nothing is being invented in Brazil. Europe and Japan are the countries that introduce innovative manufacturing process, therefore, companies that need the most recent technologies usually import products from these countries. Embryonic companies also claimed that there is not enough demand for the newest plastic manufacturing process, hence, investment in order to purchase such machines cannot be justified, as well as investment to develop such machines.

In the second group of companies, called technology-based, the technology entrepreneurial process starts even before the company exists. Actually, the technology entrepreneurial process results in the company itself, which leads to competitive advantage since the company's beginning, because either the company, its products or its process are new to the market and may not be easily copied by the competitors that are not expecting anything new to the market. Since such companies already started as pioneers in its field of business, they are more concerned to keep innovating than embryonic companies. These companies understand they must continue as pioneers, therefore they invest more time and money in order to pursue technological opportunities.

Finally, mature companies present full functional structures and defined procedures as to pursue any technological opportunities that may result in competitive advantage. Mature companies work closely with suppliers, customers and other institutes in order to develop products that are new to the market, and even new to all. Mature companies are aware they face risk and uncertainty every time they decide to start the process, however, such risks are assessed through the entire process, therefore they do not represent great threat as they do to other companies. The results in mature companies involve innovations and improvements, which are thoroughly analyzed in order to determine its financial results. Companies on this stage are

widely recognized as pioneers in their fields, so they introduce innovations in their products that change the way other business operate.

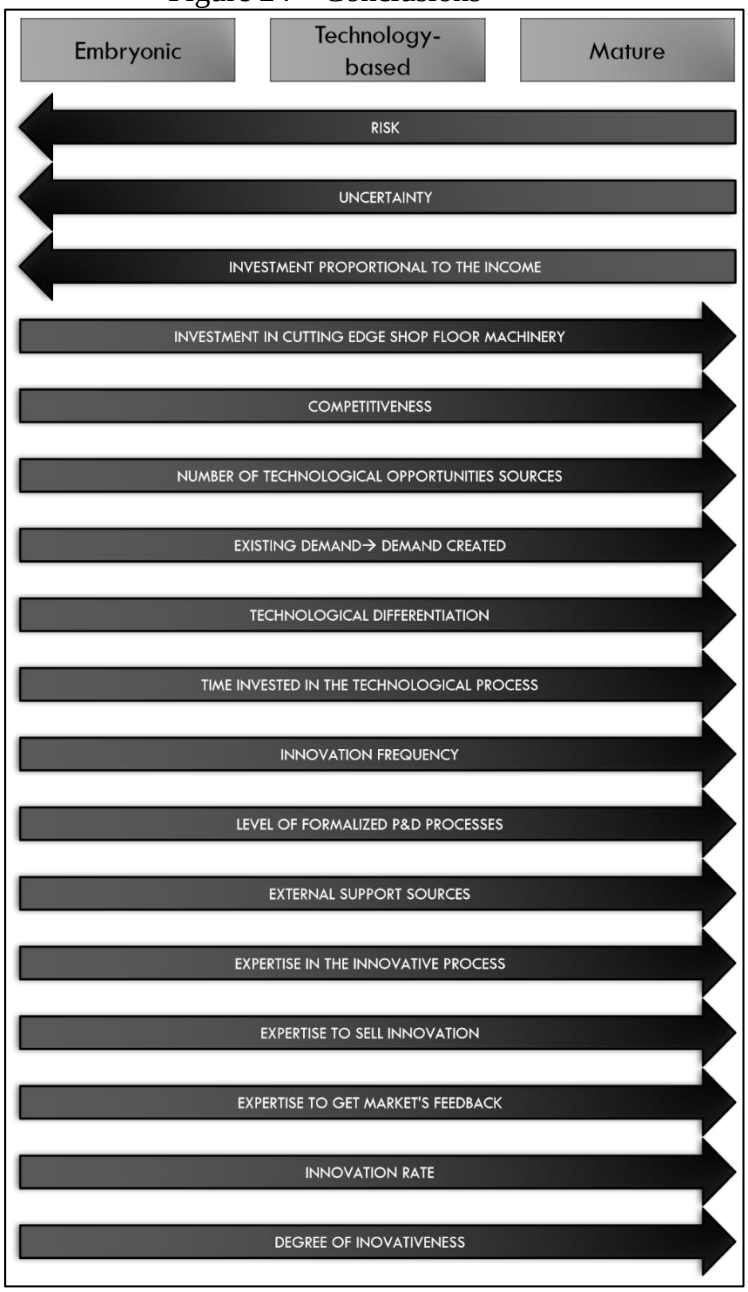
As for technological innovations objectives, it was identified that all companies presented at least one product innovation and most of them have constantly introduced process improvements in their manufacturing processes as well. As a matter of fact, even embryonic companies have introduced products that are new to the market as well as incremental product innovations. Although it is true that such innovations are not always related to technological opportunities. On the other hand, process innovations are spread in most embryonic companies and are usually incremental innovations that intend to reduce lead time and manufacturing costs. Such innovations usually result from internal management practices linked to lean manufacturing-like programs. However, during the interviews it was not possible to notice if any disruptive innovations regarding product or process in embryonic companies.

On the other hand, technology-based companies are based on innovations, such as product and process innovations. In fact, the technology-based company that was part of this study started business because of innovations developed by its owners. Therefore, technology-based companies are prone to develop more product and process innovations periodically than embryonic companies. Moreover, technology-based companies understand that innovation is a source of competitive advantage, so they constantly invest time and money in order to keep innovating. In contrast to embryonic companies, technology-based companies are technology-driven, even when improving process, so they are more inclined to introduce automation and other technological artifacts to its process and products. Finally, technology-based companies aim to grow and be recognized in their markets through its innovative products.

Product and process innovations in mature companies are carried on a daily basis, since such companies are already recognized as innovative companies in their market. Therefore, these companies periodically introduce products and processes that are either new to the market or new to all. Moreover, they have gone through the innovative process enough times to understand how to conduct it and decide whether to continue the process or not. Mature companies also have more expertise, when compared to other companies, when marketing their innovative products. Therefore, they get fast market response and are able to work on any changes while the product is being presented to the market. As for process innovation, mature companies also introduce lean manufacturing practices and manage process improvement as to reduce manufacturing costs.

In short, there seems to be a relationship between the level of the technology entrepreneurial process carried by a company and its rate of innovations delivered to the market,

Figure 24 – Conclusions



Source: authors' own (2018).

as well as the level of novelty associated with its innovations. Furthermore, companies at all levels claim that their competitive advantage is directly related to their innovation indicators. In order to it happen, companies usually engage in open-innovation efforts that may involve customers and suppliers. Besides, such process is also characterized by knowledge management that involves lessons learned. Even though not all companies have formalized procedures towards technology entrepreneurial process, they all seem to have set some informal procedures to help deciding whether to pursue a technological opportunity or not. Thus, uncertainty and

risk were constantly brought by all companies as to barriers to pursue such opportunities, especially when taking into consideration the recent political events that took place in Brazil. Therefore, Figure 24 depict the conclusion draw on this dissertation.

5.1 LIMITATIONS AND FURTHER RESEARCH

Finally, limitations to this research are based on its qualitative approach, since the number of participating companies does not allow to make generalizations over the research's findings. Also, limitations regard the fact that companies are all nestled in Caxias do Sul and belong to the same industry, that is, they are all plastic processing companies. Therefore, it must be taken into account that technology entrepreneurial process levels may differ in other regions or for different industries. Other limitations may include the researcher's perspective, since during data collecting and analysis the researcher's background might have interfered on the perception of the facts and the open codification procedures.

Based on that, recommendation for future research include applying the same research to other industries and regions in Brazil. As for methodological procedures, it is recommended to apply a quantitative approach to confirm relationships that were highlighted in the results, so some conclusions may be tested against a greater sample. Relationships to be tested include: open innovation and technology entrepreneurial procedures; technology entrepreneurial process and knowledge management; risk, uncertainty and technology entrepreneurial process; age of the firm and technology entrepreneurial process level; and, product innovation and technology entrepreneurship versus process innovation and technology entrepreneurship.

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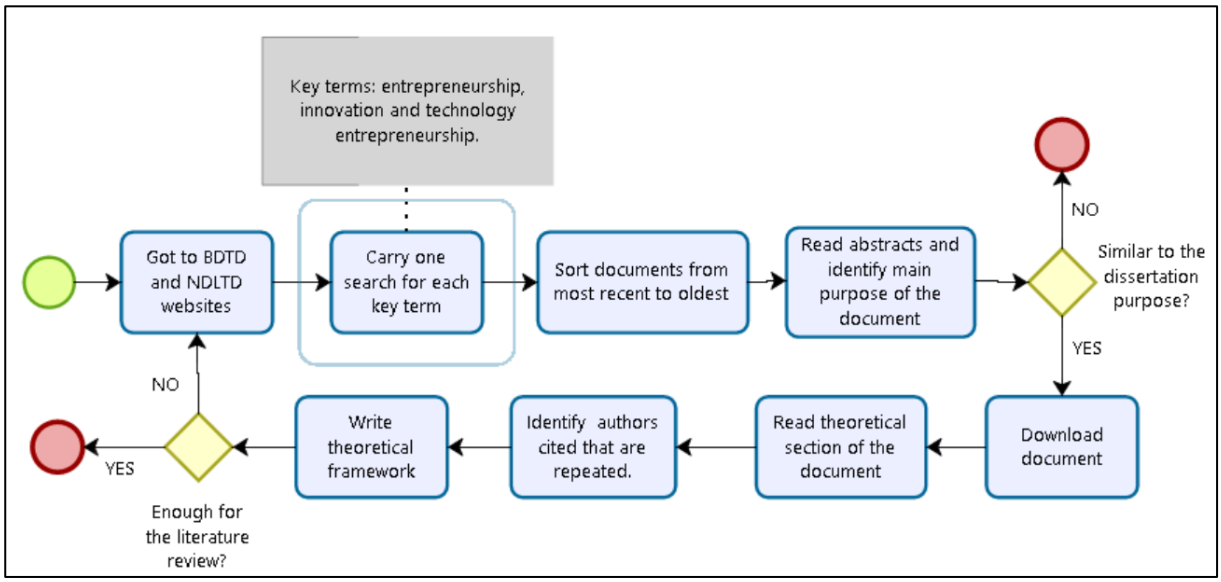
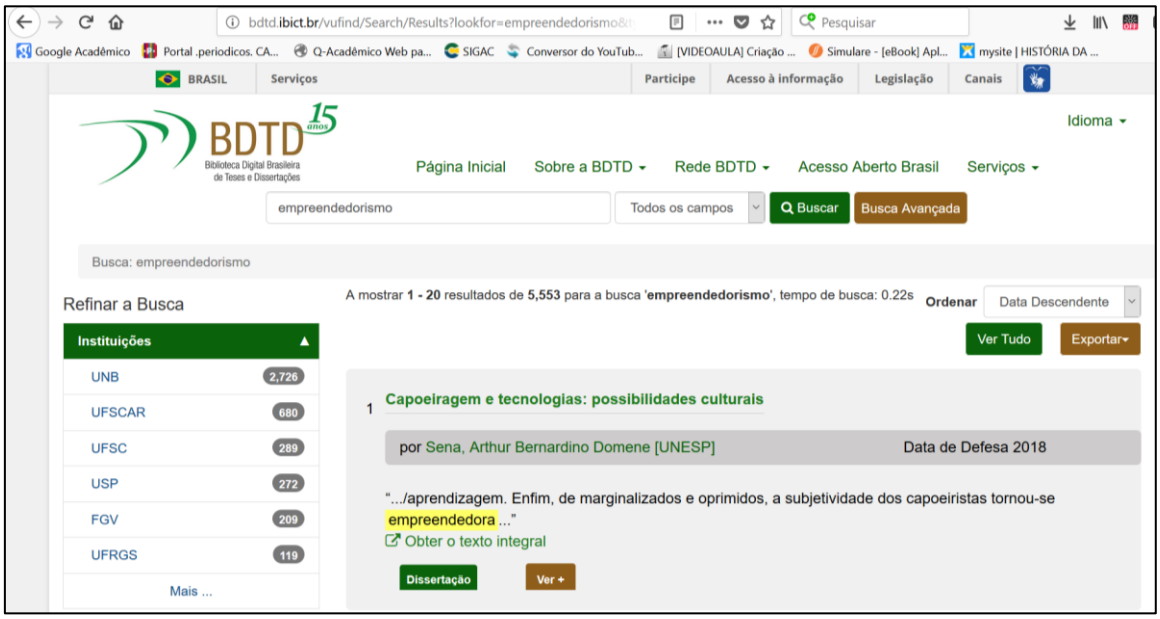
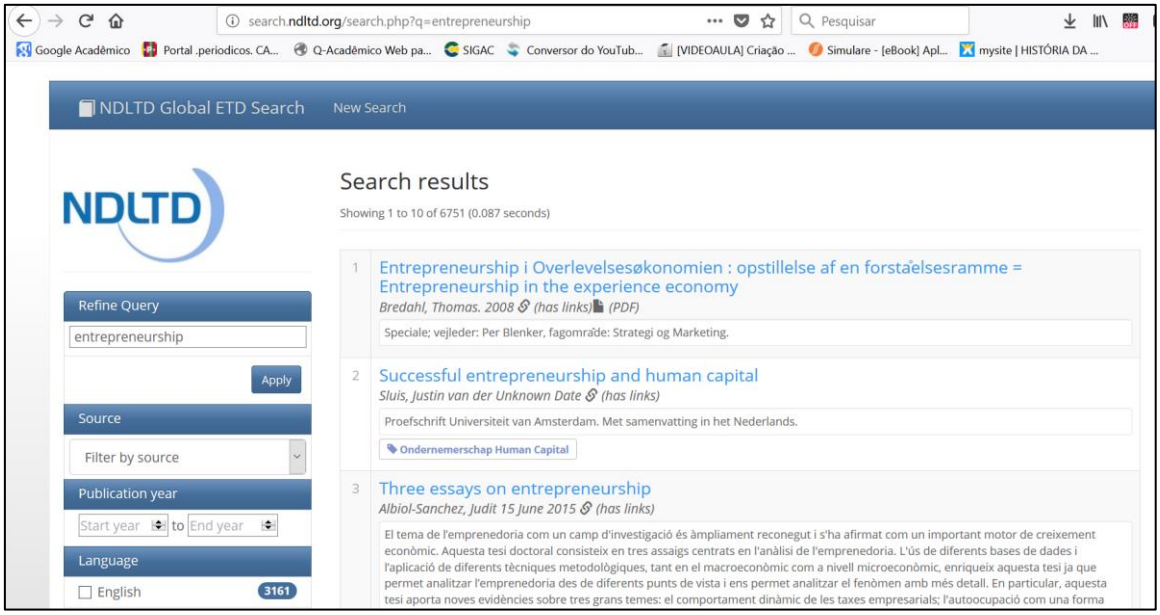
APPENDIX A – BDTD/NDLTD SEARCHING PROCESS

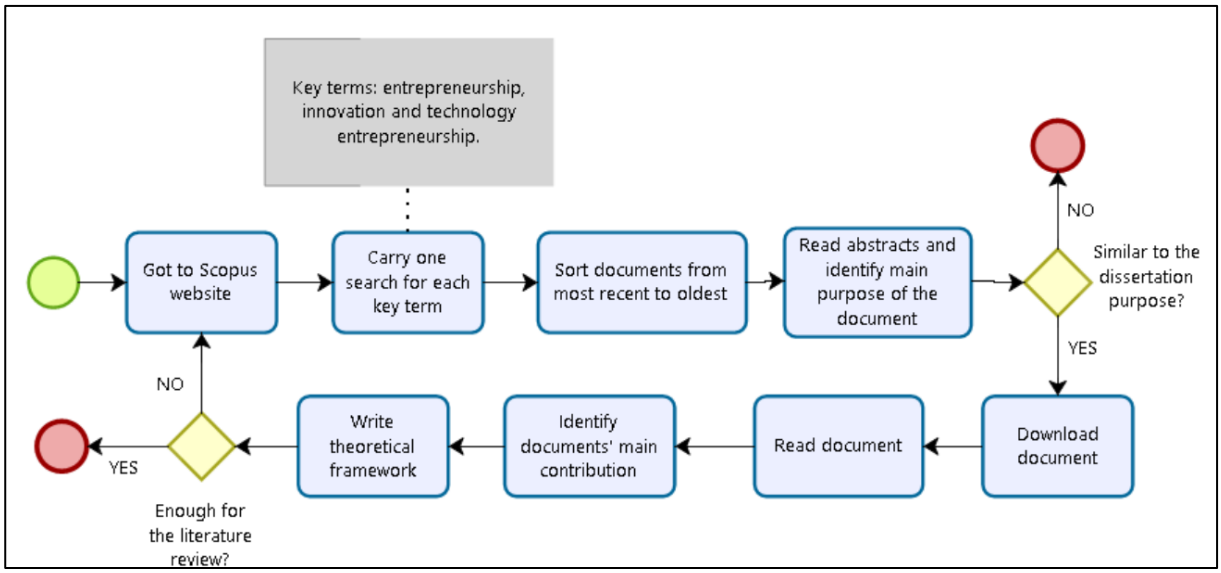


APPENDIX B – BDTD/NDLTD SCREEN SHOTS





APPENDIX C – SCOPUS SEARCH: MOST RECENT TO OLDEST



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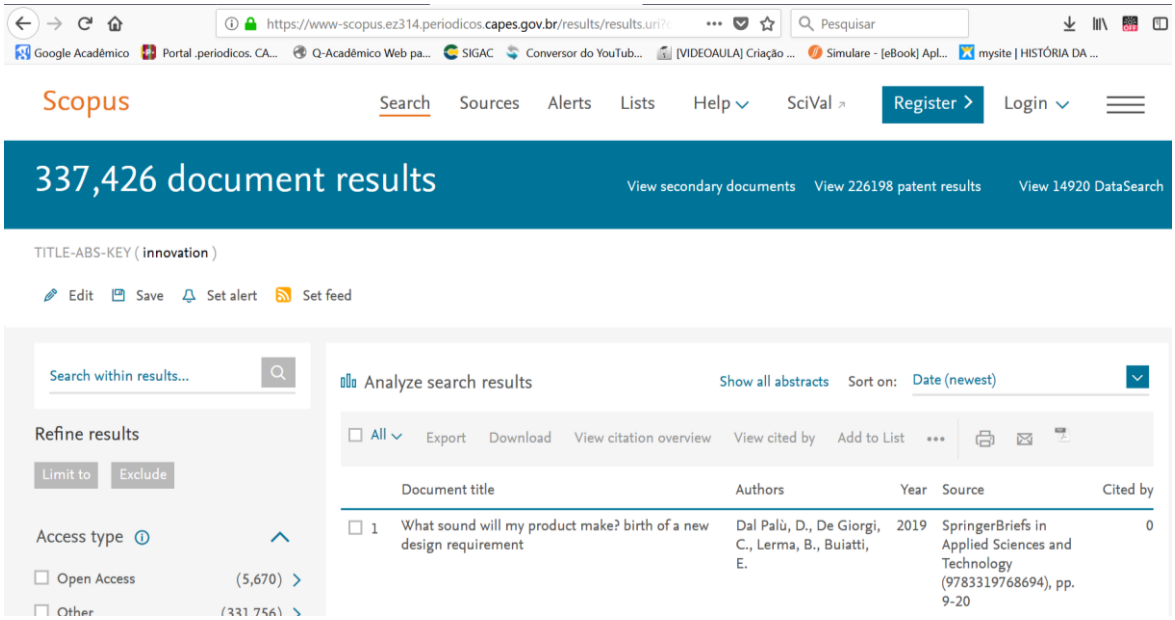

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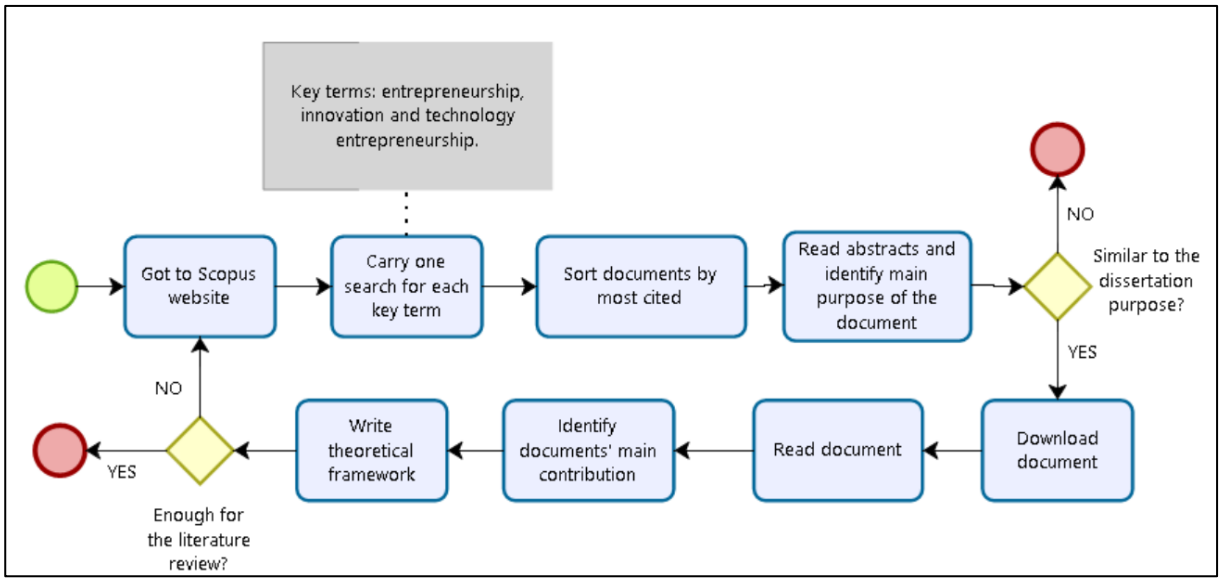
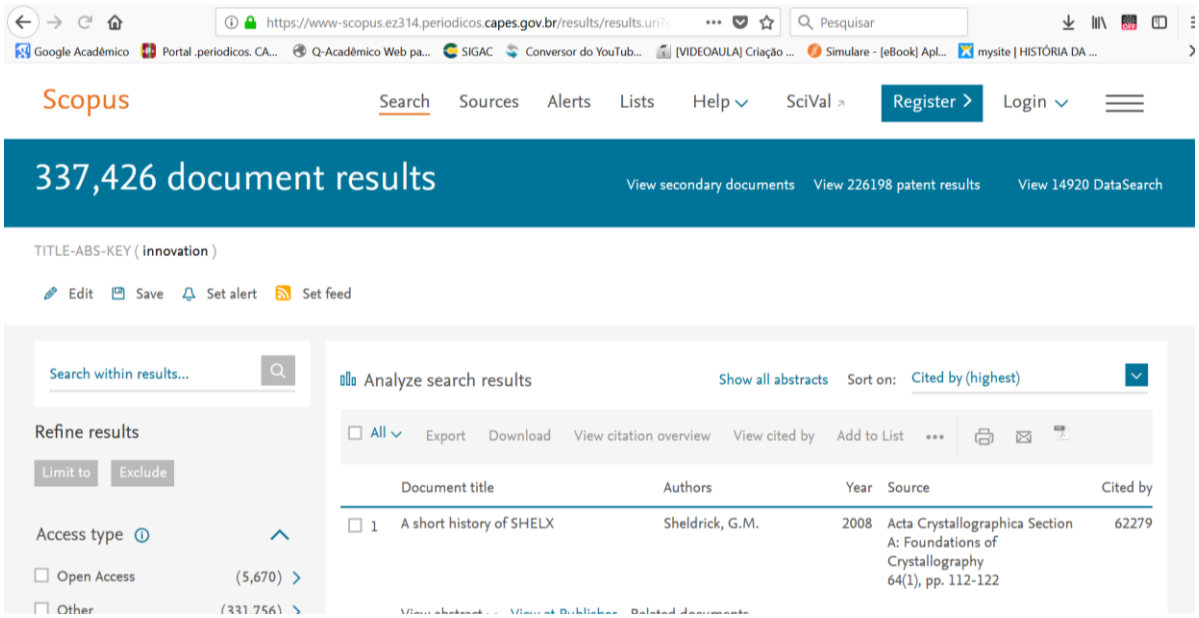
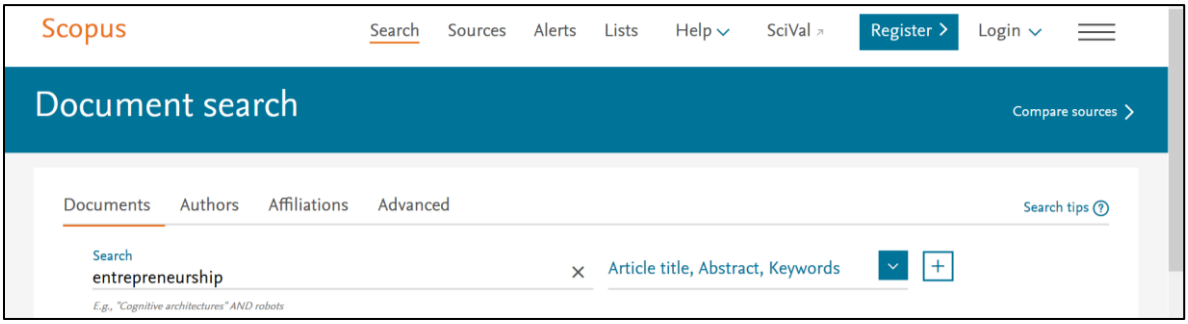
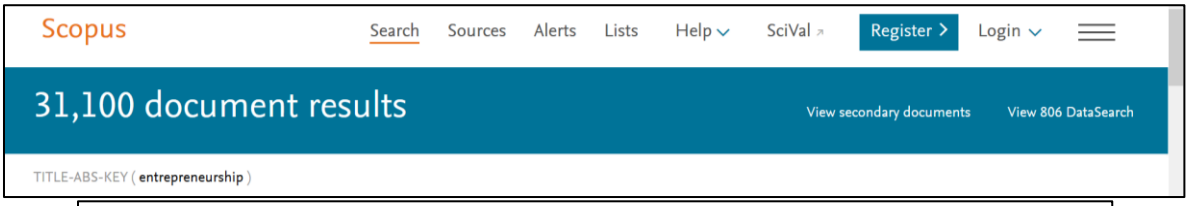


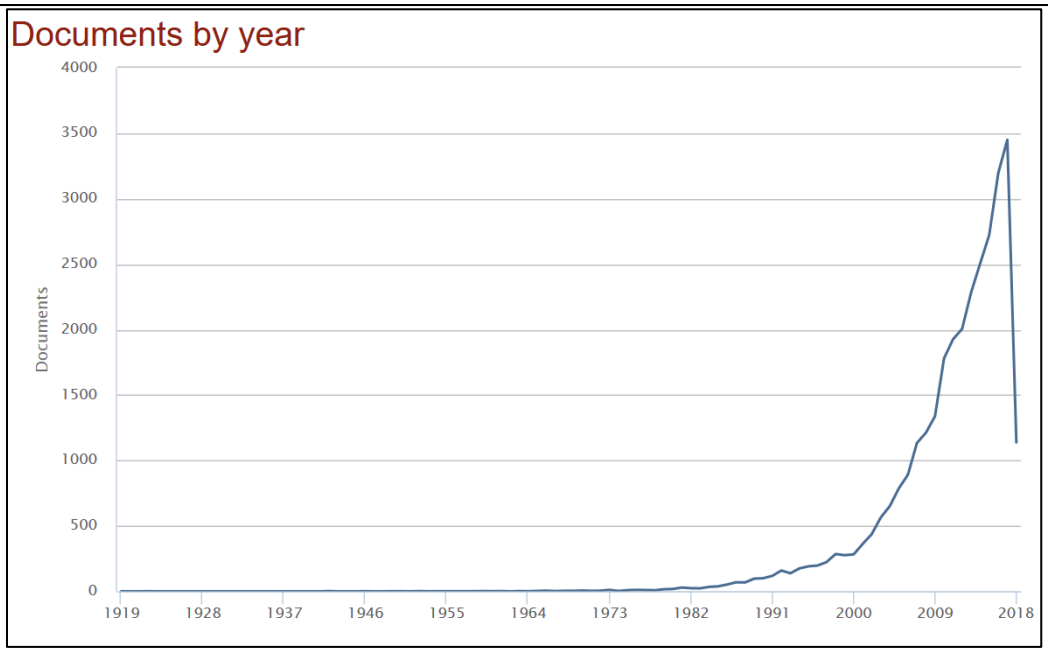
APPENDIX F – SCOPUS SEARCH SCREEN SHOT: MOST CITED

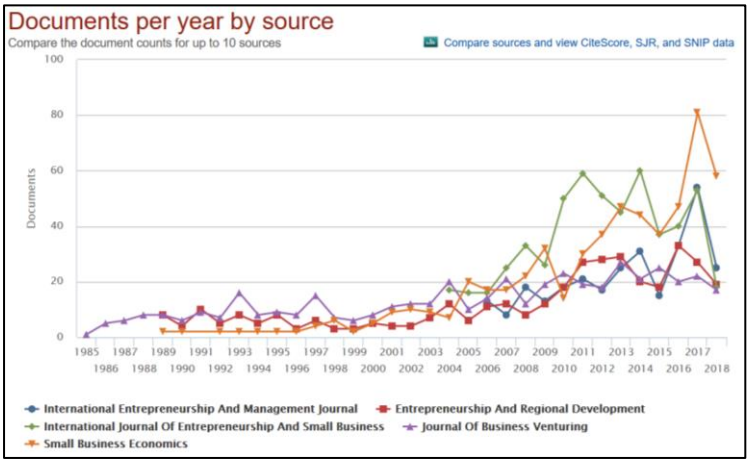


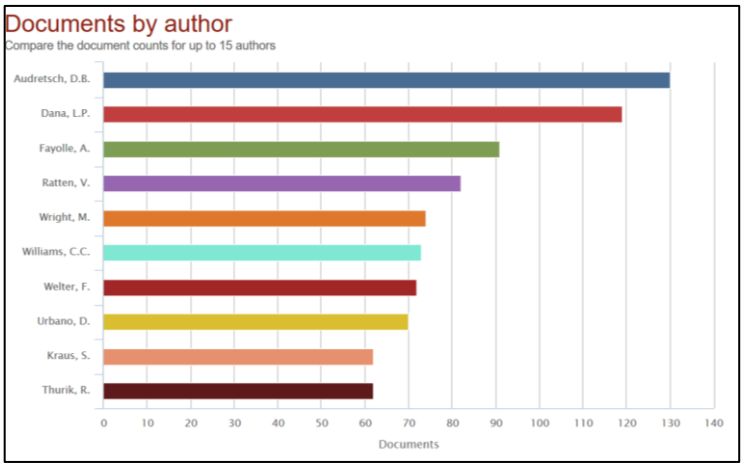
APPENDIX G – BIBLIOMETRY ON ENTREPRENEURSHIP







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Fayolle, A.
Ratten, V.
Wright, M.
Williams, C.C.
Welter, F.
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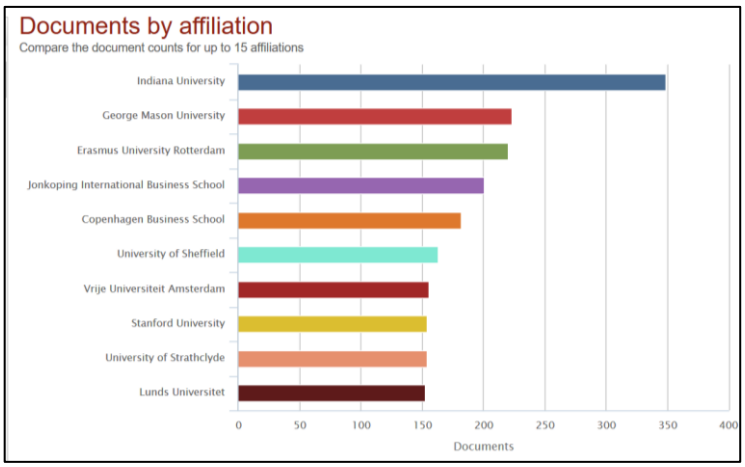
Documents by affiliation
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George Mason University
Erasmus University Rotterdam
Jonkoping International Business School
Copenhagen Business School
University of Sheffield
Vrije Universiteit Amsterdam
Stanford University
University of Strathclyde
Lunds Universitet
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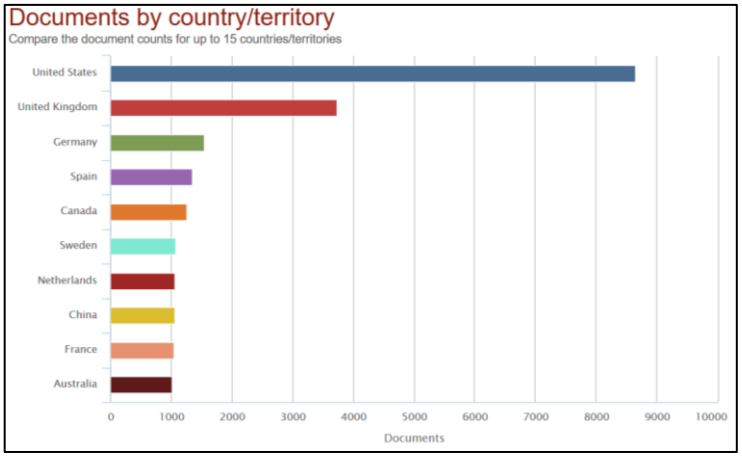
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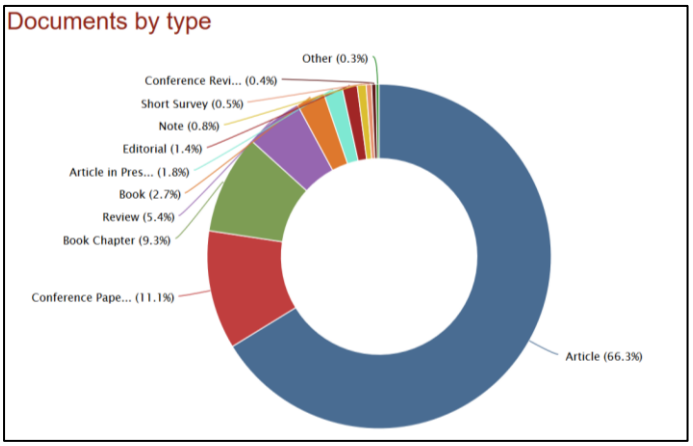
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Conference Revi... (0.4%)
Short Survey (0.5%)
Note (0.8%)
Editorial (1.4%)
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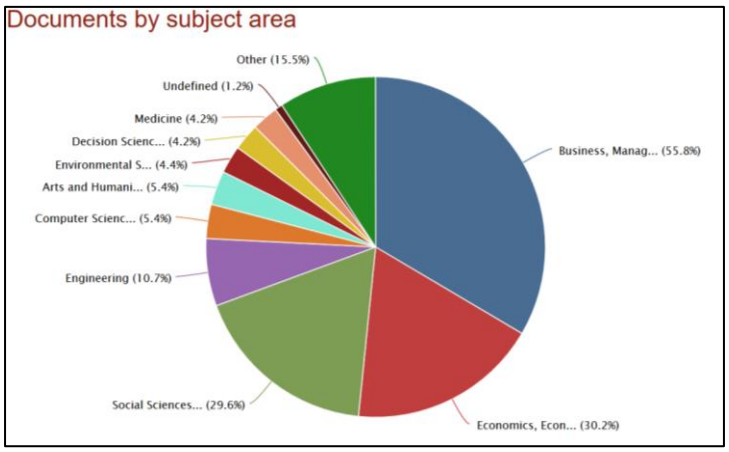
Book (2.7%)
Review (5.4%)
Book Chapter (9.3%)
Conference Pape... (11.1%)
Article (66.3%)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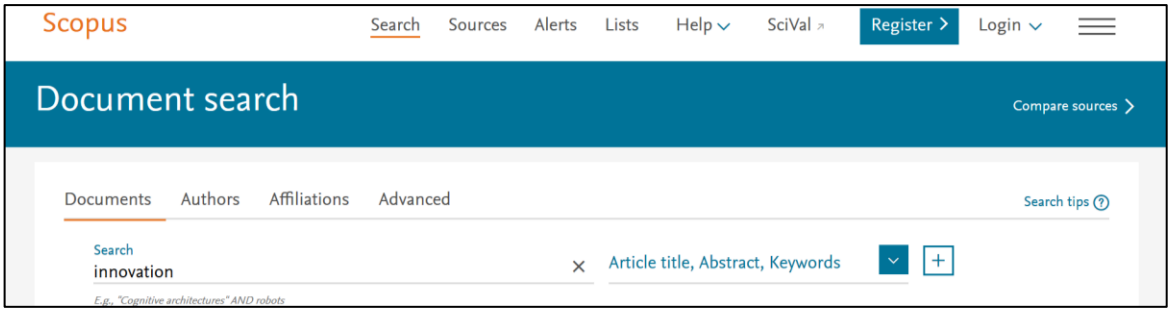
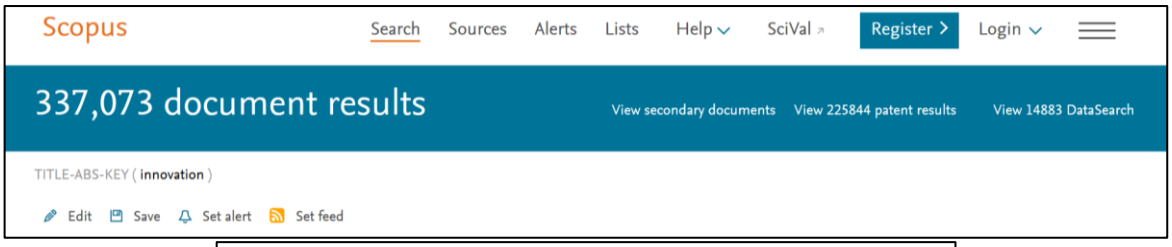
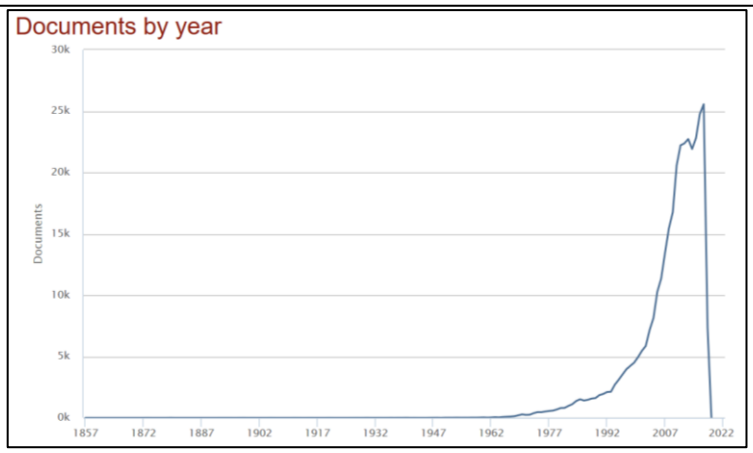
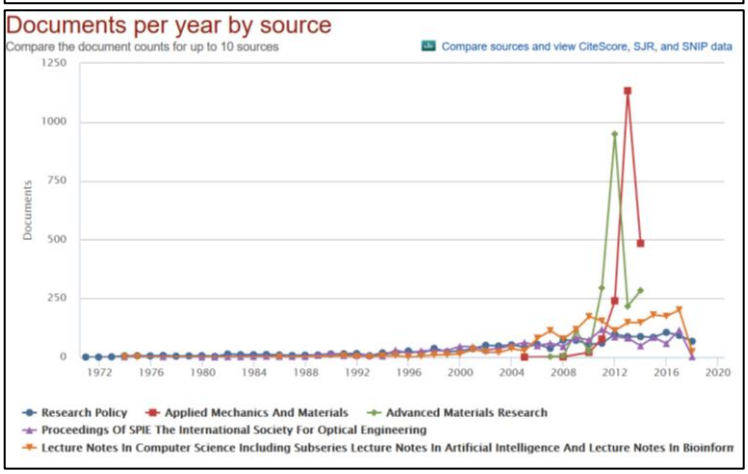
Decision Scienc... (4.2%)
Environmental S... (4.4%)
Arts and Humani... (5.4%)
Computer Scienc... (5.4%)
Engineering (10.7%)
Social Sciences... (29.6%)
Economics, Econ... (30.2%)
Business, Manag... (55.8%)

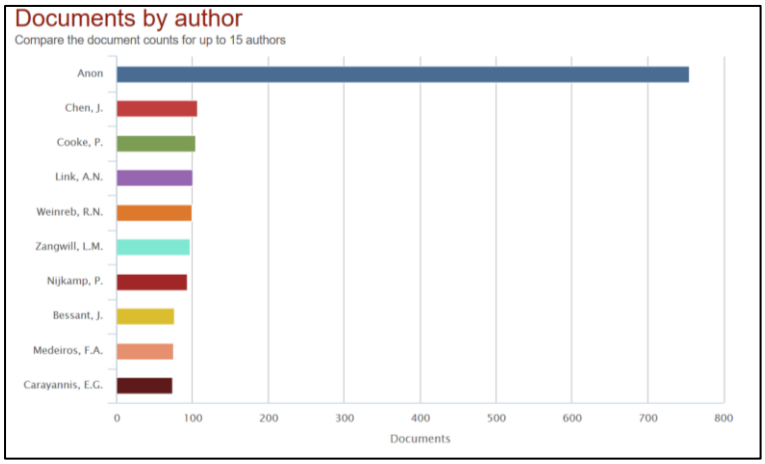
APPENDIX H – BIBLIOMETRY ON INNOVATION







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Cooke, P.
Link, A.N.
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Zangwill, L.M.
Nijkamp, P.
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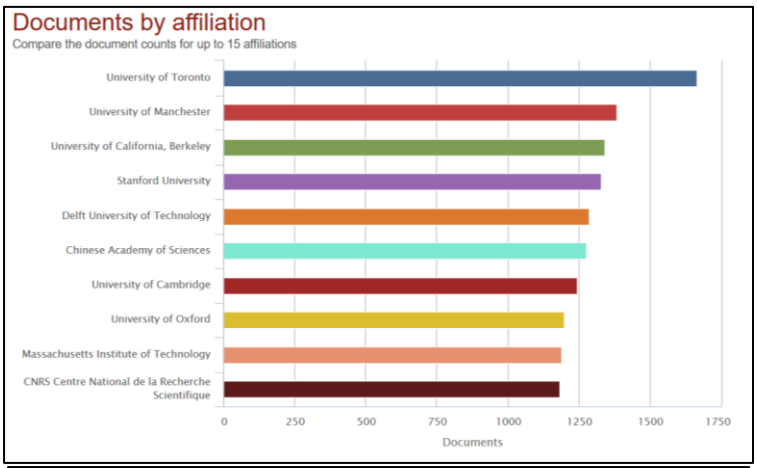
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University of Manchester
University of California, Berkeley
Stanford University
Delft University of Technology
Chinese Academy of Sciences
University of Cambridge
University of Oxford
Massachusetts Institute of Technology
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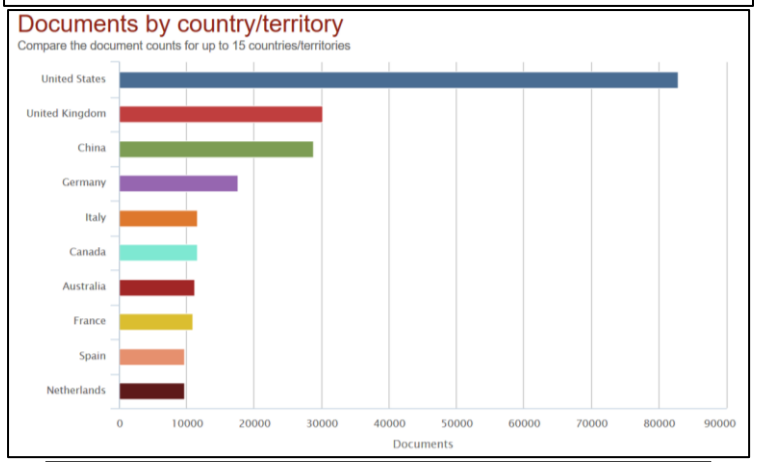
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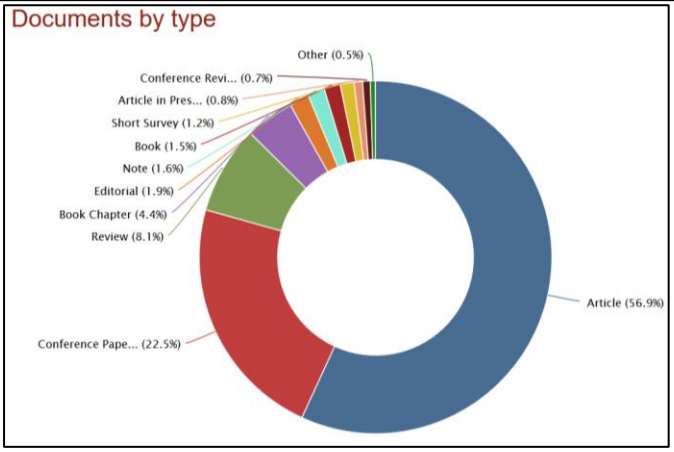
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Article in Pres... (0.8%)
Short Survey (1.2%)
Book (1.5%)
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Review (8.1%)
Article (56.9%)
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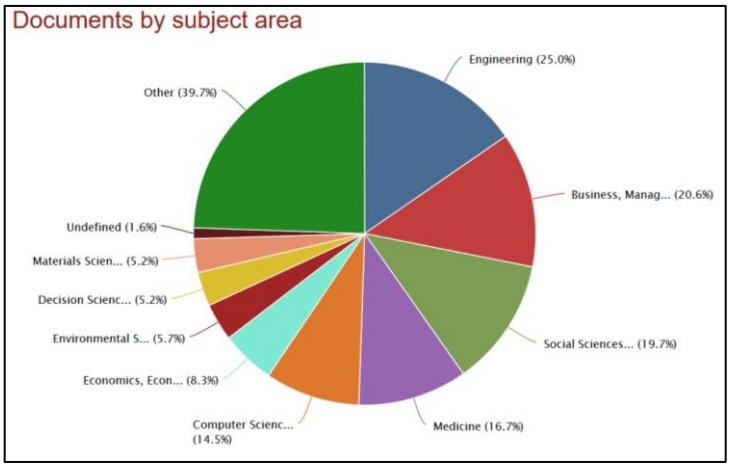
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Business, Manag... (20.6%)
Social Sciences... (19.7%)
Medicine (16.7%)
Computer Scienc... (14.5%)
Economics, Econ... (8.3%)
Environmental S... (5.7%)
Decision Scienc... (5.2%)
Materials Scien... (5.2%)
Undefined (1.6%)
Other (39.7%)

APPENDIX I – QUESTIONNAIRE

CARACTERIZAÇÃO DA EMPRESA E DO ENTREVISTADO

1) Nome da empresa:
2) Localização da empresa:
3) Atividade da empresa (principais produtos e/ou serviços):
4) A unidade da empresa é matriz ou filial?
5) Origem do capital social da empresa (nacional ou multinacional):
6) Cargo do entrevistado e tempo de atuação na empresa:
7) Quantidade de funcionários da unidade:
8) Qual o faturamento no ano de 2016 e previsão para 2017 da unidade?
9) Qual percentual de faturamento desta unidade provem de comércio internacional?
10) Qual percentual do faturamento de 2016 foi investido em desenvolvimento, pesquisa e projetos?
11) Qual percentual do valor investido em desenvolvimento é alocado para novos produtos?

GAIO, Arnaldo Pinheiro Costa. Percepções Da Passagem Da Invenção À Inovação De Empreendedores Tecnológicos De Base Universitária No Setor De Bens De Capital. 2007. Tese de Doutorado. PUC-Rio.

EMPREENDEDORISMO TECNOLÓGICO

É uma forma de liderança nos negócios baseado no reconhecimento de oportunidades de negócios intensivos em tecnologia que precisam de recursos tais como talento e dinheiro, gerenciamento rápido do crescimento usando habilidades para tomada de decisões. É uma atrativa oportunidade de negócios consistindo da proposição de grande valor com produtos técnicos que possam ser protegidos por propriedade intelectual e sustentem vantagem competitiva, grande potencial de mercado, e um modelo de negócios (AJAGBE et al., 2013).

IDENTIFICAÇÃO DA OPORTUNIDADE

1) Descreva a oportunidade identificada (que levou ao empreendimento tecnológico).
2) Você fez algum tipo de avaliação (tecnologia, equipe, mercado) antes de perseguir a oportunidade de decidir empreender?
3) Quais os principais pontos de sua avaliação sobre a oportunidade identificada e quais o fizeram tomar a decisão de empreender?
4) Existiu algum evento/situação o fez perseguir essa ideia?
5) Qual foi esse evento/situação de disparo?
6) Qual foi a estratégia da empresa para perseguir essa oportunidade?
7) Quem eram seus clientes alvo?
8) Escolhi esses clientes e conseguiria conquista-los porquê.....
9) Porque as empresas existentes não poderiam atender a essa demanda?
10) Você pensou em uma estratégia para a empresa?
11) Qual foi a estratégia inicial da empresa?
12) Como você achava que a estratégia pensada inicialmente poderia fazer a empresa crescer e gerar os retornos suficientes?
13) Você considerava sua estratégia difícil de ser copiada pelos competidores? Por que?

CAPACIDADE DE EXECUTAR

14) Você era capaz de desenvolver tecnicamente a ideia sozinho?
15) Você possui os recursos necessários?
16) Você considera que dispunha de todos os contatos e de reconhecimento necessários para lançar a empresa sozinho?
17) Quais as principais questões que deveriam ser solucionadas para o sucesso do seu empreendimento na fase inicial, para a colocação do primeiro produto no mercado? Fale sobre cada uma delas.
18) Quanto tempo levou desde a exploração da ideia até a primeira venda do produto?
19) Quanto tempo a equipe empreendedora estava voltada para P&D nessa fase?
20) Qual era a estrutura percentual da receita da empresa naquele momento?
21) Qual a sua reflexão sobre a ativação do empreendimento inovador?
22) Quais erros e acertos, ao longo do processo, você considera mais importantes?
23) Quais foram as principais lições aprendidas com eles?
24) Se você pudesse voltar no tempo, começaria esse empreendimento novamente?
25) Você faria algo de forma diferente, se tivesse a oportunidade de começar de novo?

INOVAÇÃO DE PRODUTO (BEM OU SERVIÇO)

Introdução de um produto novo ou significativamente melhorado no que diz respeito as suas características ou usos previstos dos produtos previamente produzidos pela empresa (MANUAL DE OSLO, 2005).

1) A empresa introduziu no mercado alguma inovação de produto (bem ou serviço) nos últimos 5 anos?
2) A empresa introduziu produto novo ou aperfeiçoado no mercado em que ela atua? Sem sim, quais?
3) A empresa introduziu produto novo ou aperfeiçoado no mercado mundial? Sem sim, quais?
4) A empresa introduziu produto novo, com uma nova tecnologia para o mundo? Sem sim, quais?
5) Como ocorre o processo de inovação de produto (bem ou serviço) na empresa, com a contribuição e participação de agentes internos e externos a empresa?
6) Os novos produtos (bem ou serviços) são comercializados em quais mercados (Brasil e outros países)?
7) Quais as contribuições das inovações de produtos (bem ou serviços) com relação aos aspectos financeiros (custos, aumento de receita, e outros)?

INOVAÇÃO DE PROCESSO

Processo novo ou substancialmente aprimorado envolve a introdução de tecnologia de produção nova ou significativamente aperfeiçoada, de métodos para oferta de serviços ou para manuseio e entrega de produtos novos ou substancialmente aprimorados, em atividades de suporte à produção (MANUAL DE OSLO, 2005).

1) A empresa introduziu no mercado alguma Inovação de processo nos últimos cinco anos?
2) Quais foram as inovações de processo introduzidas na empresa?
3) Das inovações de processo quais são novas para a empresa e para o mercado?

4) Das inovações de processo quais são novas para a empresa e conhecidas pelo mercado?
5) Como ocorre a inovação nos processos na empresa, considerando a contribuição e participação de agentes internos e externos a empresa?
6) Quais as contribuições das inovações de proesso com relação aos aspectos financeiros (custos, aumento de receita, e outros)?

APPENDIX J – AXIAL CODIFICATION

Technology entrepreneurial process				
Competitive Strategy	Product Research	Technological opportunity	Process development	Entrepreneurial opportunity
Focus on new products	Focus on new products	Management structure	Customers	Competitors
Customers	Customers	Customers	Management structure	Customers
Product Distribution	Company Growth	Market recognition	Employees	Product Distribution
Management structure	Market recognition	Competitors	Market recognition	Management structure
Company growth	Competitors	Competitors copying products	Risk	Product Importation
Employees	Competitors copying products	New to market	Profit	Market regulation
Market recognition	Product Importation	Uncertainty	Safety	Uncertainty
Competitors	Market regulation	Risk	Personnel qualification	Risk
Competitors copying products	Technical assessment	Mistakes	Process improvement	Mistakes
Focus change	Product Differentiation	Product incremental innovation	Lack of technological differentiation	Learning
Product Exportation	New to market	Learning	Equipment's investment	Profit
Product Importation	Uncertainty	Profit		Challenge
Market regulation	Risk	Challenge		Social Issues
	Mistakes	Social Issues		External Support
	Product incremental innovation	Investment needs		
	Product development internal structure	External Support		
	Learning	Competitive differential		
	Profit	Environmental assessment		
	Challenge	Safety		
	External Support	Personnel qualification		

ANEXX A

I) CARACTERIZAÇAO DA EMPRESA E DO ENTREVISTADO

1) Nome da empresa:

2) Localização da empresa:

3) Atividade da empresa (principais produtos e/ou serviços):

4) A unidade da empresa é Matriz ou Filial?
( ) Matriz ( ) Filial

5) Origem do capital social da empresa:
( ) Nacional ( )Multinacional

6) Cargo do entrevistado e tempo de atuação na empresa:

7) Quantidade de funcionários da Unidade:

8) Qual o faturamento no ano de 2011 e previsão para 2012 da unidade?

9) Qual percentual de faturamento desta unidade provém de comércio internacional?

10) Qual percentual do faturamento de 2011 foi investido em desenvolvimento, pesquisa, projetos?

11) Quanto (em %) do valor investido em desenvolvimento é alocado para novos produtos?

II) INOVAÇÃO DE PRODUTO (BEM OU SERVIÇO)

INOVAÇÃO DE PRODUTO (BEM OU SERVIÇO)
Introdução de um produto novo ou significativamente melhorado no que diz respeito as suas características ou usos previstos dos produtos previamente produzidos pela empresa (MANUAL DE OSLO, 2005[5]).

2) A empresa introduziu no mercado alguma **Inovação de Produto (bem ou serviço)** de 2010 até a presente data?
a) Sim
b) Não
Se "a", passar para questão 2.1.

2.1) Entre 2010 e 2011, a empresa introduziu produto novo ou aperfeiçoado no MERCADO em que ela atua? Se sim, quais?

2.2) Entre 2010 e 2011, a empresa introduziu produto novo para o MERCADO MUNDIAL? Se sim, quais?

2.3) Entre 2010 e 2011, a empresa introduziu produto novo, com uma NOVA TECNOLOGIA para o MUNDO? Se sim, quais?

2.4) Como ocorre o processo de inovação de produto (bem ou serviço) na empresa, com a contribuição e participação de agentes internos e externos à empresa?

2.5) Os novos produtos (bem ou serviços) são comercializados em quais mercados (Brasil e outros países)?

2.6) Quais as contribuições das inovações de produtos (bem ou serviços) com relação aos aspectos financeiros (custos, aumento de receita, e outros) e ambientais (emissão de resíduos, diminuição de matéria-prima e/ou energia, entre outros)?

2.7) Quais as práticas ambientais utilizadas nas inovações de produto (bem ou serviço)?

III) INOVAÇÃO DE PROCESSO

INOVAÇÃO DE PROCESSO
Processo novo ou substancialmente aprimorado envolve a introdução de tecnologia de produção nova ou significativamente aperfeiçoada, de métodos para oferta de serviços ou para manuseio e entrega de produtos novos ou substancialmente aprimorados, em atividades de suporte à produção (MANUAL DE OSLO, 2005).

3) A empresa introduziu no mercado alguma **Inovação de Processo** de 2010 até a presente data?

a) Sim

[5] MANUAL DE OSLO. **The measurement of scientific and technological activities**. 2005.

b) Não
Se "a", passar para questão 3.1.

3.1) Quais foram as inovações de Processo introduzidas na empresa?

3.2) Das inovações de processo quais são novas para a empresa e para o mercado?

3.3) Das inovações de processo quais são novas para a empresa e conhecidas pelo mercado?

3.4) Como ocorre a inovação nos processos na empresa, considerando a contribuição e participação de agentes internos e externos à empresa?

3.5) Quais as contribuições das inovações de processo com relação aos aspectos financeiros (custos, aumento de receita, e outros) e ambientais (emissão de resíduos, diminuição de matéria-prima e/ou energia, entre outros)?

3.6) Quais as práticas ambientais utilizadas nas inovações de processos?

ANEXX B

I – Identificação da Oportunidade (00:04:00)

1. Fale sobre sua experiência empreendedora anterior e como essa influenciou na sua decisão de empreender o atual negócio?
2. Descreva a oportunidade identificada (que levou ao empreendimento tecnológico)...
3. Você fez algum tipo de avaliação (tecnologia, equipe, mercado) antes de perseguir a oportunidade, de decidir empreender?

a) Sim. *Quais os principais pontos de sua avaliação sobre a oportunidade identificada e quais o fizeram tomar a decisão de empreender?*

b) Não.

4. Algum evento/situação o fez perseguir essa idéia?

a) Sim *Qual foi esse evento/situação de "disparo"?*

b) Não

III – A Estratégia da Empresa (00:05:00)

7. Quem eram seus clientes-alvo?
8. Escolhi esses clientes e conseguiria conquistá-los porque...
9. Por que as empresas existentes não poderiam atender a essa demanda?
10. Você pensou em uma estratégia para a empresa?

a) Sim. *Qual foi a estratégia inicial da empresa? Como você achava que a estratégia pensada inicialmente poderia fazer a empresa crescer e gerar os retornos suficientes? Você considerava sua estratégia difícil de ser copiada pelos competidores? Por quê?*

b) Não.

IV – Capacidade de Executar a Estratégia (00:06:00)

11. Você era capaz de desenvolver tecnicamente a idéia sozinho?

a) Sim.

b) Não.

12. Você possuía os recursos necessários?

a) Sim. *Que recursos?*

b) Não. *Quais recursos possuía e quais não possuía?*

13. Você considera que dispunha de todos os contatos (rede de relacionamento) e de reconhecimento necessários para lançar a empresa sozinho?

a) Sim.

b) Não.