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Risk analysis in introduction of new technologies by start-ups in the Brazilian market

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Abstract

Purpose – The volatile scenario of technological innovation demonstrates the need for risk control processes, in order to ensure its viability. The purpose of this paper is to propose a conceptual framework for risk management in the introduction of new technologies by start-ups, aiming to provide the guidelines for the improvement of this process.

Design/methodology/approach – The study comes up with conceptual categories related to risk management in start-ups, mainly based on the NPVR approach. The methodology included two comparative case studies: MercadoPago and GuiaBolso, which had their data collected through interviews with key managers and documents provided by the organizations. Data analysis was based on the Miles *et al.* (2014) model, whereby data were condensed; data were visualized, and conclusions developed and checked.

Findings – Among the main results, there is the proposition of a deductive-inductive matrix for the management of uncertainties and risks in start-ups, which brings elements that provide the calculation of the NPV adjusted for the risk of developing a new product (NPVR), process or service, as well as the contribution of the level of risk management maturity of the companies, setting up the Risk Management Matrix (RMM).

Practical implications – The authors propose a matrix for the management of uncertainties and risks in start-ups.

Social implications – The authors present comparative case studies of MercadoPago and GuiaBolso which help the entrepreneurs to develop their start-ups.

Originality/value – As the main contribution, this paper proposes the start-up RMM, a model for the management of uncertainties and risks in start-ups, which brings elements that provide the calculation of the NPV adjusted for the risk of developing a new product (NPVR), process or service, as well as the contribution of the level of risk management maturity of the companies.

Keywords Start-ups, Risk management, Emerging market, Enterprise risk management, New technologies, Quantitative risk analysis for start-ups

Paper type Research paper

1. Introduction

This paper deals with risk management in the launch of products, processes or services by start-ups. These risks may be associated with a number of undesirable effects, such as increased aversion to entrepreneurship and difficulty in understanding the real needs of customers.

In general, the sectors in which start-ups operate are those in which the volatility and risks are present in larger scale and with greater intensity, causing severe consequences (Hall and Hulett, 2002). According to Hall and Woodward (2010), rewards to the entrepreneurs who provide the ideas and long hard hours of work in these start-ups are zero in almost three-quarters of the outcomes. Sahlman (2010) reports that 85 percent of financial returns come from just 10 percent of investments in venture capital.

In turn, the literature on corporate risk-taking is largely underexploited and does not clarify the types of risks an entrepreneur may face and relevant mitigation strategies (Tipu, 2017; Forlani and Mullins, 2000).

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The absence of risk-taking research reinforces the notion of risk-taking as a multifaceted and complex phenomenon. The literature also indicates that most risk-taking studies are conducted in developed countries. Therefore, more studies should be carried out to explore risk patterns in entrepreneurship in emerging markets (Tipu, 2017).

Considering the emergence of start-ups in the Brazilian organizational settings main research objectives were analyze the management process of the risk of introducing products or services by start-ups operating in the Brazilian market and propose a model for risk management in the introduction of new technologies by start-ups (Risk Management Matrix (RMM)).

To achieve this purpose, two main models, the Net Present Value Risk Adjusted (NPVR) (Davis, 2002), and the prospect of Maturity Level in Enterprise Risk Management (MLERM) (Oliva, 2016) were adopted. The other concepts in the conceptual framework were developed deductively and refined from inductive data from this case study research. Our data analysis followed the qualitative data analysis model developed by Miles *et al.* (2014) which allows the condensation of data, data visualization, and the development and check of conclusions.

2. Theoretical framework

2.1 Start-ups

Start-up firms are an important component for the growth of any nation's economy as they increase competition, drive innovation and generate jobs (Archibald *et al.*, 2007). Nevertheless, research on software development activities in newly created companies has been scarce (Paternoster *et al.*, 2014).

According to Blank and Dorf (2012), start-up is a temporary organization in search of a repeatable, scalable and profitable business model. It is more than simply smaller version of large companies. It usually focuses on unmet or underserved market need as a growth and profit potential (Cusumano, 2013).

Start-ups are known for their high risks and failure rates (Giardino *et al.*, 2014). According to Ries (2011), by operating in uncertain environment, the strategy, planning and market research arguments do not apply to start-ups, because these approaches are designed for established companies.

Software start-ups are companies with no operating history, no business model and no market share to defend, but with fast growth, and focused on the production of cutting-edge technologies. These companies develop software in uncertain conditions, under a severe lack of resources. Therefore, software start-ups feature a unique combination of characteristics that pose various challenges (Blank, 2017; Paternoster *et al.*, 2014).

In a literature review, Giardino *et al.* (2014) propose that there are at least 12 inherent characteristics of a start-up, which are expressed by Table I.

Unlike established companies that are placed in a well-defined market and a well-known competition basis, start-ups work on hypotheses, which are tested with customers for the formulation of facts (Blank and Dorf, 2012). In addition, start-ups have limitations in some aspects, such as those related to resources and human capital. So any bad decisions in understanding the market can result in severe consequences, or even its end (Christensen, 2016).

2.2 Risk and uncertainty

All organizations face uncertainty and the challenge that managers face is to determine when to accept uncertainties and challenge, and define how these uncertainties can interfere with the effort to generate value to stakeholders. According to COSO (Steinberg *et al.*, 2004), uncertainties present risks and opportunities, with the potential to destroy or add value.

The uncertainty is a property of nature which resists to quantification, and, therefore, cannot be effectively reduced to probabilities and scenarios (Davis, 2002). Jalonen (2011)

Feature	Description
Lack of resources	Economical, human and physical resources are extremely limited
Highly reactive	Start-ups can quickly react to changes in the underlying market, technologies and product (compared to more established companies)
Innovation	Given the intense competitive ecosystem, start-ups need to focus and explore highly innovative segments of the market
Uncertainty	Start-ups deal with a highly uncertain ecosystem under different perspectives: market, product features, competition, people and finance
Rapidly evolving	Successful start-ups aim to develop and grow rapidly
Time pressure	The environment often forces start-ups to release (what?) fast and to work under constant pressure
Third party dependency	Due to lack of resources, to build their products, start-ups rely on external solutions, such as: External APIs, Open Source Software, outsourcing and COTS
Small team	Start-ups begin with a small numbers of individuals
One product	Company's activities gravitate only around one product/service
Low-experienced team	A good part of the development team is composed by people with less than 5 years of experience and/or often recently graduated students
New company	The company has been recently founded
Full organization	Start-ups are usually founders-centric and everyone in the company has considerable responsibilities, with no need of high management
Highly risky	The failure rate of start-ups is extremely high
Not self-sustained	Specially in the initial stages, start-ups need external funding to sustain their activities (Venture Capitalist, Angel Investments and Personal Funds)
Little working experience	The basis of an organizational culture is not initially present

Table I. Characteristics – start-ups

Source: Giardino *et al.* (2014, pp. 28-29)

has identified eight factors of innovation uncertainty, which are technological uncertainty, market uncertainty, regulatory/institutional uncertainty, social/political uncertainty, acceptance/legitimacy uncertainty, managerial uncertainty, timing uncertainty and consequence uncertainty.

Risk, in turn, is calculable and can be expressed in terms of probabilities (Nohria and Thomas, 2006). The risk is represented by the possibility that an event occurs and adversely affect the achievement of objectives (Aven, 2010; Steinberg *et al.*, 2004). According to Jorion (2009), the risks can be classified into three categories, ranging from those that are recognized and understood to those which are not recognized or understood (known knowns, known unknowns and unknown unknowns).

The division of the risks proposed by Steinberg *et al.* (2004) establishes the four categories: strategic – high-level goals; operations – effective and efficient use of resources; reporting – reliability of reporting; and compliance – compliance with applicable laws and regulations. In this study, we chose to focus on the strategic dimension of risks, which are understood as those voluntarily accepted by companies to generate superior returns.

Strategic risks cannot be managed through a rule-based controlling model. Instead, the company needs a risk management system designed to reduce the likelihood that the assumed risks materialize, improving the company's ability to manage or contain the risk events should they occur (Kaplan and Mikes, 2014). The activity of risk management itself entails the identification, estimation, evaluation, treatment and monitoring of potentially negative influences on performance (Hain, 2011).

Bhidé (2000) states that, in the specific case of start-ups, entrepreneurs have little reason to devote much effort in planning and research prior to the launch of their product. In new markets, planning can be expensive also because of the transient nature of the opportunities, because they may disappear in the interval between the beginning of the research and its end.

2.3 NPVR and MLERM frameworks

Start-ups are particularly vulnerable to risks such as technical (Will the product work? Will it scalable?); market (Is there a legitimate need? Can we charge enough to generate profits? Is the size of the opportunity sufficient to justify the investment?); competitive (How will competitors react? Will the company maintain a competitive advantage?), and execution (Does the management team have skills and experience?) (Picken, 2017a, b).

In this sense, Davis (2002) develops the conceptual framework NPVR – Net Present Value (NPV) adjusted to the Risk of developing a new product, a model which provides quantitative tools to increase the Return on Investment, increasing the likelihood of success of a product.

The NPVR provides advantages in the analysis of risk as more traditional models, such as decision trees and real options are complex and may require information not readily available at the beginning of the development process.

By focusing on some critical evaluation areas, the main development risks are exposed, and predictability of new product development is amplified. The NPVR depends on the use of experience and judgment to assess the relative risk.

However, instead of requiring a probability estimate, the scores are scaled high, medium and low. Qualitative assessments can be converted into numerical scores. In NPVR model, this is done by assigning more positive ranking (high chance of success) to the value 5 and the more negative rating (low probability of success) to the value of 1 on a scale of 1 to 5.

Using these assessments proposed by Davis (2002), decision makers can compare the Net Present Value Adjusted to Risk to the traditional NPV. This allows managers to understand which part of a proposed business NPV is at risk, focusing on key factors, making it possible for several projects to be evaluated quickly and consistently.

Davis (2002) establishes two classifications (i.e. by product category and by types of risk) necessary for the development of his methodology that contribute to determining the risks and their ratings. First, classification by product category has four items:

(1) New ventures – are the "new to the world", which represents the first of its kind and require the creation of a whole new market.

(2) New categories – are "new to the company" and include new product lines, which target an established market in which the company does not currently compete.

(3) New platforms – they are often additions to existing product lines, while the products themselves can be quite innovative. Platforms create the basis for the future derived products, providing better market knowledge and know-how of manufacturing.

(4) New products – are derived from improvements and revisions of existing products, including costs reduction.

In addition to the classification by product category, Davis (2002) defines the classification by risks: the market, technological and user's risks.

2.3.1 Market risks. The real disruptive innovation happens in environments where the final product and its value proposition, price, marketing, sales channels and, more important, its customers are, at best, assumptions (Cooper and Vlaskovits, 2013).

Thus, market risk encompasses any element of the value chain required for any new product to reach its prospects. This includes factors, such as salesforce skills, distribution channels, manufacturing capabilities and customer support. Each element must be understood and evaluated. In addition, success will be influenced by the current company presence in the target market segment (Davis, 2002).

2.3.2 Technical risks. Technical risks are related to the product and the company's development capabilities. Innovation risks must be evaluated not only in terms of the technology itself, but also in the degree to which technology is integrated into existing

processes of product development. Skills assessment should include the development team and its support for program management.

2.3.3 User risks. The user risk determines the likelihood that the company is developing a product that will be valued by the market. The user's risk assessment focuses on the degree to which the user interaction with the product attributes are known and the degree of knowledge of design and performance specifications.

After surveying 200 companies and elaborating the framework, Davis (2002) proposes categories and the most significant risks and calculated the weights related to the market, technical and user in each of the categories. They are expressed in Table II.

From the data collected by the model later presented, the NPVR is calculated, according to Davis (2002) as follows:

$$\mathrm{NPVR} = (\mathrm{aM} + \mathrm{bM} + \mathrm{cT} + \mathrm{dT} + \mathrm{eU} + \mathrm{fU})/10) \times \ \mathrm{Net\ \ Present\ \ Value}$$

In this case, a, b, c, d, e and f are the value chain, market segment, innovation, capabilities, interaction and specification assessments, respectively, and each of these items should be rated on a scale from 1 to 5. The values for the risk weighting, M (market), T (technical) and U (user) are chosen according to the product category. In this case, MercadoPago ($M = 0.4$, $T = 0.2$ and $U = 0.4$, because it is a new category – see Table II) and GuiaBolso ($M = 0.3$, $T = 0.6$ and $U = 0.1$, because it is a new derivative product, see Table II).

It is, therefore, concluded that the NPVR model provides insights into how user research can affect the success estimates of a product. Conducting user research early in the development cycle should improve the risk of interaction assessment and change the chance of success in this area, from low to high.

Besides NPVR, Oliva (2016) highlights the risks of a business can be of different nature and may have different degrees of importance for each agent. The business environment includes several organizations and macro- as well as micro-environmental forces. There are different actors in these environments, namely: customers, competitors, suppliers and distributors.

2.4 Factors conditioning the company's results

The complementary elements of RMM, presented below, were created based on a review of the literature and through the analysis of the collected data, using as the reference to codify the proposed aspects in a deductive way. These elements are in line with the business management literature which defines factors deemed critical for success in high-tech new ventures (Blank and Dorf, 2012; Chorev and Anderson, 2006; Kakati, 2003).

2.4.1 Time and resources. The main characteristics observed in the management of a start-up are uncertainties, lack of resources (economic, human and physical) and time pressure. These factors influence software development as they make all decisions related to development strategies a difficult trade-off for the company (Giardino *et al.*, 2014, 2016).

	Market risk Weight (M)	Technical risk Weight (T)	User risk Weight (U)	Total
New venture	0.45	0.1	0.45	1
New category	0.4	0.2	0.4	1
New platform	0.35	0.35	0.3	1
New derivative product	0.3	0.6	0.1	1

Source: Davis (2002)

Table II.
Distribution of risks by category

2.4.2 Product development. Regarding the development of the product, based on the literature review and the analysis of the data collected, the following items were considered relevant.

2.4.2.1 Identification of the opportunity. Before the development of new products, entrepreneurs must discover good opportunities (Wang *et al.*, 2013; Feinleib, 2012; Siegel and Renko, 2012; Oliva *et al.*, 2011; Crowne, 2002; Shane, 2000). Smith *et al.* (2009) define opportunity as a conjuncture in which it is possible to exploit a market inefficiency by offering an improved product, service or process.

According to Oliva *et al.* (2014), innovation does not occur out of context or isolated from a situation, but from sources of ideas that were already within the organization and that were tested and applied. For start-ups to identify and seize opportunities, it is necessary to manage risks and uncertainties, considering organizational context, particularities and general characteristics as well as entrepreneurial actions from this scenario. These aspects are dealt with below.

2.4.2.2 Benchmarking. Benchmarking is an important process for the development of products, services and processes, because it enables the process of acquiring external explicit and tacit knowledge (Massa and Testa, 2004). This systematic approach involves steps of planning, analysis, integration, action and maturity (Fong *et al.*, 1998).

In Brazil, the application of copycat benchmarking is observed, that occurs when a company analyses its partners and, rather than learning how the partners changed their businesses, concentrates on how to copy their current activities (Wireman, 2010).

Fundamentally, the company seeks to reduce the uncertainty of entrepreneurial start-up ventures by imitating proven business models and replicating them in other geographic regions (Tang, 2015). This shows that in the absence of innovation, copying and funding already-tested business models can work (Ekekwe, 2014).

2.4.2.3 Generation of innovation. Aulet (2015) states that innovation can be defined as: Innovation = Invention × Marketing. In other words, innovation is not the sum of invention and marketing, but a multiplication. To have innovation, a validated business model is needed. The concept of the business model is actually simple: it is the means by which a firm creates and sustains margins or growth (Euchner and Ganguly, 2014).

Innovation is a complex challenge for organizations as it relates technological elements to market dynamics. In fact, there are several variables that can impede the success of a technology. Galia and Legros (2004) suggest that the main difficulties related to innovation are: lack of information about the technology, the market, consumer and lack of qualified personnel, because breakthrough innovations transform the relationship between customers and suppliers, restructure marketplace economics, displace current products and create entirely new product categories (Goktan and Miles, 2011; Singh, 2011).

2.4.2.4 Product life cycle management. In today's global economy, competition has intensified. Product life cycles have been compressed, and product obsolescence has been occurring at a fast pace (Goktan and Miles, 2011). Over the past 50 years, product life cycles have become shorter, shrunk by about 400 percent in a wide variety of categories (Cooper, 2000).

Utterback (1997) suggests that the innovation rate occurs in its early years, which he calls the "fluid phase." In relation to that, market pioneers propose a high variety of designs, with increasing competition and high market instability. The period of fluidity gives way to a "transition phase", in which the rate of product innovation decreases and the rate of processes accelerates.

In the transitional phase, the competitiveness achieved through innovation soon returns to the starting point, i.e., it decreases. This happens due to the emergence of competitors (Tidd and Bessant, 2016). Consequently, the organization should renew itself in order to maintain its competitive advantages.

2.4.3 Communication and process management. Regarding the communication and process management, based on the literature review and the analysis of the data collected, the following items were considered relevant:

2.4.3.1 Networking. Social relationships play an important role in establishing a start-up. The entrepreneur uses his social capital to access resources, risk sharing, speeding products to market, acquire information, new skills and business relationships at each stage of the development of a business (Wang *et al.*, 2013; Pittaway *et al.*, 2004; Greve and Salaff, 2003; Hansen, 1995). Kaufmann and Schwartz (2008) suggested that start-uppers should receive formal training to develop their networking abilities.

2.4.3.2 Internal communication. Internal communication is associated with the project life cycle monitoring process, because it can ensure that the information needed by stakeholders in the company, such as delivery status for a specific release, which is available in an organized manner.

Knowledge management and internal communication are identified in current business management literature as instrumental to organizational survival and growth. They reduce the waste of incredible amounts of time and capital, two main factors that affect a start-up (Picken, 2017a; Oliva, 2014; Feinleib, 2012; Kitchen and Daly, 2002).

2.4.3.3 Activity control. The immaturity in the management of processes in start-ups may, in fact, be unavoidable, as the dynamism of start-ups makes repetition difficult. However, as time goes by, process control affects its success (Sutton, 2000).

For many small start-up software companies, implementing controls and structures to properly manage their software development activity is a major challenge. In addition, start-up companies have very limited resources and typically wish to use these resources to support product development (Coleman and Oconnor, 2008). Good management practices require capabilities that may be lacking in a firm's workforce, specially in emerging economies (Hoskisson *et al.*, 2000; Marcotte, 2014; Sadun *et al.*, 2017).

In this context, the business innovation process has four stages: start-up, transition, scaling and exit. The challenge in controlling activities is observed mainly between the start-up and transition stages (Picken, 2017a, b). The transition period begins when the start-up gains market.

At this stage, informality must be replaced by structured management. It may also be replaced by formal and disciplined communication, required for rapid growth. As an organization grows and matures, performance management systems become increasingly important. The better the management of a company, the better its profitability, growth and chances of survival (Sadun *et al.*, 2017).

2.4.3.4 Digital marketing. The online social network Facebook registered more than 2 billion users in June 2017; this figure is practically ten times the population of Brazil (Constine, 2017). In that sense, US digital marketing spending will be about $120 billion by 2021. This means a 46 percent increase in all digital advertising in five years (VanBoskirk *et al.*, 2017).

With the growth of digital media, academics have also witnessed a major transformation in marketing studies, with the rise in the prominence of digital, social and mobile marketing. Social media has changed the way buyers share information with each other and interact with brands. Besides, the digital environment produces a wide range of data. The data are very informative for understanding customer behavior and developing marketing strategies (Kannan and Li, 2017; Lamberton and Stephen, 2016; Jackson and Ahuja, 2016).

2.4.4 Decision making. In developing a new product, start-ups may not only face risks, but they may also face uncertainties, i.e., they may be unable to recognize and articulate all relevant variables that affect performance. Under these circumstances, classic methods of risk management are not enough (Sommer *et al.*, 2009).

Honig and Hopp (2016) present two business strategies: a predictive model, focused on planning and an experimental model, where careful planning is deferred, in favor of experimentation, adaptation and iterative learning. Regarding the decision making, based on the literature review and the analysis of the data collected, the following items were considered relevant.

2.4.4.1 Effectuation. Cusumano (2013) states that start-ups need to demonstrate flexibility on strategy, business model and technology, once most markets in which they operate are springs or simply non-existent. In this scenario, it is necessary to understand how to make decisions in the absence of pre-existing goals.

Sarasvathy (2001) defined the effectuation process as the selection of a given set of tools and discovery of the possible effects that can be created from them (this sentence must be rewritten). The dimensions that create the effectuation logic are experimentation, affordable loss and flexibility (Ortega *et al.*, 2017; Long *et al.*, 2017).

2.4.4.2 Selectionism and trial and error learning. Given the uncertainty and unpredictable complexity, Sommer and Loch (2004) propose two alternatives: trial-and-error learning model and selectionism. Trial and error refers to flexible learning, adjusted to new information that are obtained in the course of project implementation. Selectionism refers to the driving of various parallel solutions to choose later which is the best. In situations of uncertainty and high complexity, selectionism as well as trial and error learning lead to higher performance, because they eliminate knowledge gaps between a company and customer (Loch and Kavadias, 2011; Sommer *et al.*, 2009).

2.4.4.3 Canvas/Lean start-up. Besides, it is possible to approach the entrepreneurial action and the business model generation. The business model is more suited to uncertain environments, because unlike a traditional design, it requires fewer data and analysis. Ries (2011) suggests that the business model is a way of articulating an opportunity aligned with the real needs of customers. To assist in structuring the business model, the literature indicates a number of approaches. One of these approaches is the Canvas, proposed by Osterwalder and Pigneur (2010).

Canvas facilitates communication with the different stakeholders, which makes it the starting point of creative discussion about new business opportunities, and mission as well as vision aligning activities of the firm. In addition, Canvas facilitates the identification of risks and failures (Trimi and Berbegal-Mirabent, 2012).

In a risky scenario of return for the investor, Ries (2011) proposes an approach that can make the process of starting a project less risky. It is the lean start-up methodology, which advocates experimentation instead of elaborated planning, customer feedback over intuition and iterative as well as interactive design, unlike traditional development (Blank, 2013).

According to Dybå and Dingsøyr (2008), Lean software development consists of seven principles: waste elimination, learning amplification, late decision, fast delivery, team empowerment, building integrity and holistic view. For Link (2016), the great advantage is that customers acquaint themselves with the product earlier and the start-up also gets feedback earlier too. Thus, there is less development danger for the market, as insofar the product and service arise in constant consultation with the target group.

2.4.4.4 Business plan. Other scholars (Hormozi *et al.*, 2002) suggest that business plan plays an important role in the success of a new business. This document consists of in-depth industry, customer and competition analysis (Zacharakis *et al.*, 2011). However, Blank (2013) considers that a business plan can originate products without market acceptance. This happens, because this approach responds to most questions of an enterprise without much interaction with the prospect client.

Another line of authors (Harms and Schiele, 2012; Ortega *et al.*, 2017) suggest that causation (business plan) and effectuation do not seem to be diametrically opposed concepts.

In fact, they can be observed in a single project in distinct phases or even in the same phase (Harms and Schiele, 2012). Nevertheless, it is noticeable that when the level of innovation and uncertainty are extremely high, the closest approach to effectuation is the most adopted (Ortega *et al.*, 2017).

3. Methodological track

In terms of research strategies, we opted for the multiple case studies. According to Yin (2014), the case study is the preferred method when we try to study the "how" and "why" of an event. The purpose of using multiple instances in this study enabled us to compare the product launch in different start-ups, identify the similarities and differences among the cases and seek to relate the each context.

The considered unit of analysis was the process of launching a new product. The selection of cases was based on dimensions that were considered important to the research results as a whole. Two significant cases were chosen in the Brazilian start-ups ecosystem. These cases are respectively: MercadoPago and GuiaBolso.

The data collection was carried out through interviews with key executives listed in Table III.

The information and secondary data related to each case were collected through technical and trade journals, books, magazines, newspapers, reports as well as publications of various associations. All of them connected with business, public records, statistics, historical documents and other sources of published information as well as records taken from the company's web pages.

Besides the individual case analysis, Miles *et al.* (2014) affirm that the reliability of a research can be evaluated through a series of tactics, such as triangulation and member checking. They were also strategies used with the purpose of accuracy, credibility, validity and applicability of this study.

In MercadoPago (Case 01), the respondent was the vice president of the company, recognized in the case as (R1Case01) and a manager. In GuiaBolso (Case 02), the respondent was the founder and co-president of the company (R1Case02) and a manager. The data analysis model was based on Miles *et al.* (2014) and contained the data condensation elements, data visualization, and the development and check of conclusions, which were used iteratively and simultaneously.

The data were condensed by writing summaries, coding, developing themes, generating categories and writing analytic memos, which allowed open and interpretive coding with the support of family codes deductively proposed from the theoretical framework of this research and those which emerged inductively. The codes have also been applied by a second researcher and then validated together.

When classifying NPVR for each case, the magnitude coding technique was used, using the categories proposed by Davis (2002). The magnitude coding is a resource indicated by Miles *et al.* (2014) in order to enhance the description of features within the qualitative research.

Table III.
List of interviewees for the study

Case	Start-up	Position	Code interviewee's	Documents code's	Duration of interview	Date of the interview
01	MercadoPago	Vice President and Country Manager	R1Case01	D1Case01	52 min	January 13, 2016
01	MercadoPago	Manager			40 min	January 30, 2016
01	MercadoPago	Vice President and Country Manager			36 min	March 28, 2016
02	GuiaBolso	Founder	R1Case02	D1Case01	40 min	January 12, 2016
02	GuiaBolso	Manager			30 min	January 21, 2016
02	GuiaBolso	Founder			50 min	March 12, 2016

The script for the interviews was drawn from the initial propositions, the research model and the theories presented. A pilot study was conducted. The questionnaire addressed issues, such as the opportunity recognition process, networking, market understanding, benchmarking, product development process, internal communication, activity control, investment in marketing, customer relationship, entrepreneur's decision-making process, business model, classification of the business based on the NPVR logic (Davis, 2002), risk assessment of market, user and technology (Table IV).

4. Results

This part of the research presents, discusses and analyzes the cases of MercadoPago and GuiaBolso from the point of view of the conceptual approach adopted.

4.1 MercadoPago

MercadoPago represented a different case of start-ups in general, since it was originated in the MercadoLivre ecosystem, which is the largest Brazilian online market. Therefore, some characteristics common to start-ups (Giardino *et al.*, 2014) were not observed. However, the uncertain environment, the generation from opportunity innovation, the error learning and the Lean start-up models were perceived. The construction of a project business plan was identified to set specific objectives for managers, monitor their implementation and the importance of communication in business management.

MercadoPago is the largest internet-based payment platform in Latin America. It was founded in MercadoLivre ecosystem and has about 158 million users. The company was founded in a moment of growth of the number of to electronic commerce consumers that made emerge the need for tools to secure the online brokerage business.

In this scenario, the facilitators started offering a service that checked the reliability of the request, which allowed the creation of a more reliable ecosystem in transactions. From the launch of its first version in 2004 in Brazil, Mexico, Argentina, Colombia, Chile and Venezuela, MercadoPago invested in new solutions to meet market demands. This maturation process was explained by the respondent (R1Case01). He attested that the MercadoPago, through the custody of transactions, enabled the online payment, allowed the buyer to have greater security, since the money was only transferred to the seller at the time the delivery confirmation. This was the first goal of the solution.

With the evolution of the market, the demand for installment payments was seen in 2007, when the MercadoPago offered the option of shopping in 12 installments.

Dimension	Objectives
Decision-making process	Analyze the maturity in decision making, analyze the business plan and understand the stages of product development
NPVR and MLERM	Identify the type of company (new ventures, New categories, new platforms or new products), check the relationship with the value chain, check the level of technological understanding, check the team experience, check the level of user understanding and understand the company risks based on MLERM
Communication and process management	Analyze the contribution of networking, evaluate internal communication processes, identify the level of control activities, along with the tools used, analyze the level of professionalism in product development, identify investments and strategies in digital marketing
Product development	Understand the process of opportunity identification, evaluate the process of benchmarking, understand the business model and check the life cycle stage

Table IV.
Points discussed in the interview

The release of the no-interest installment payment option on the platform was one of the main factors for the company's growth. In 2010, MercadoPago began offering the tool for virtual stores out of MercadoLivre.

Nevertheless, this technology did not adhere to the consumer in 2014. When the sellers wanted the invisible checkout, the clients did not need to do this login anymore, only type the credit card information. According to the director (R1Case01): "We are improving the product all the time, releasing new features, but always solving the problem for our customer base. They tell us what the problem is and we solve it."

This company evolution has a close connection with the vision of Lean start-up (Ries, 2011), once it is noticed that the validation of the learning with the customer is constant and that each product life cycle is rapid and continuous. This methodology defines "value" only for customer benefits generation, considering any addition to technology outside of this context as waste.

According to the documents provided by the company (D1Case01), MercadoLivre was founded in 1999 and is the e-commerce leader in Latin America. It is present in 16 countries. This company has an ecosystem that enables the buying and selling, payment, delivery, advertising and business management. Based on NPVR vision, this set of business units is an important fact, since it becomes more feasible to MercadoPago to display market viability. All in all, it has better conditions to meet its prospects.

In the volatile environment in which the company operates, a customer-centric approach is important to be able to respond to consumer behavioral changes and meet new expectations about its service. For this research, this point is important, because it directly influences the assessment of interaction through NPVR.

Regarding technology, MercadoPago presents itself as an agile, experimental and collaborative organization. It was observed the fact that the company is able to respond effectively to changing requirements and maturing exponentially the product. It was also noted that most of the new products were not designed from scratch, but evolved within the value chain.

4.1.1 Risk management in the case study. The MercadoLivre is a marketplace where buyers and sellers advertise their products. In 2004, this marketplace's customers were ready to make the exchange of each sale, but there were other problems to be solved, such as the payment security of this operation (R1Case01).

Considering the MercadoPago as a new category, its NPVR was calculated according to the formula indicated in Section 2.3 of this paper. Table V aims to systematize the observed risks and easy viewing of its distribution.

Applying the NPVR formula:

$$\text{NPVR} = (4 \times 0.4 + 5 \times 0.4 + 3 \times 0.2 + 4 \times 0.2 + 5 \times 0.4 + 3 \times 0.4)/10) \times \text{NPV}$$

$$\text{NPVR} = 82\% \ \text{NPV}$$

Therefore, NPVR is 82 percent of the original NPV, which indicates that 18 percent of the projected NPV was at risk. As the NPVR is integrated into the decision process, this risk level indicates that robust product-development process can make the inherent risks understandable and to some degree measurable and controllable.

The NPVR approach allows the identification and analysis of relevant risks in key dimensions in the development of start-ups. With the intention of supplementing and amplifying the scale of the risks in these two start-up cases under investigation. In the same vein, the MercadoPago was subject to the following risks: image, operational, ethical and technological.

Feature assessed	Score	Related risks	Evidence
Value chain	4	Market	Inside of the Mercado Livre's ecosystem (Shipping Market, ETC Market and KPL) Opportunities to achieve economies of scale, scope, and greater control over the value chain More uniform user experience that compels consumers to invest across its product line Partnerships with companies that have complementary assets and expertise to their business
Market segment	5	Market	Mercado Livre was the leader of the segment of the market targeted at the time
Innovation	3	Technical	A new technology, but with developed and tested prototypes The design of digital wallet was unexplored in 2004
Resources	4	Technical	Team was complete, new and experienced in information technology projects There were no online payment experts in Brazil and the team was formed internally
Interaction	5	User	Sought to understand the user at all stages of product development Conducted frequent surveys of buyers and sellers to understand their needs Benchmark with other companies
Specification	3	User	Presented a new design for an existing market segment, but new in Brazil

Table V.
NPVR score to Case 1 (MercadoPago)

Based on the interviewee's discourse analysis, the complementary risk framework was developed according to the MLERM (Oliva, 2016) (Table VI).

4.1.2 Factors conditioning the company's results. This part discusses the main actions of the company in this uncertainty environment for release and development of a technology. At this stage, it was observed that the MercadoPago focuses on process and productivity improvement to compete in a more established market. They also have a better long-term development.

Informality, common in the early years of a start-up, is no longer observed. The team is more established, which creates the need for more complex communication channels and delegation of authority. This life cycle stage can also be characterized by a new period of growth in new markets and in distribution channels, such as the launch of Mobile POS.

During the early stages of product development, however, the learning methodology by trial and error was observed. This happened, as the company worked in an environment of uncertainty: "it was challenging, there was much fear, then, yes, this trust barrier had to be broken and it had to be explained why it was safe" (R1Case01).

To deal with this situation, MercadoPago sought, through continuous tests, to prove each of its initial hypothesis, looking for a scalable and profitable business model. "We developed it all with mistakes and successes and improving this great software" (R1Case01).

Risk	Evidence
Ethical	Any ethical problem can jeopardize the brand image
Operational	An operational error can result in millions of dollars in damages, due to the several transactions that may occur
Safety	The company is audited based on the laws and regulations of the national financial market as well as on the standards of companies listed in Nasdaq, Mastercard or Visa
Technological	Any technological error can lead to customer losses
Image	The company should not engage in any media scandal, because it can jeopardize the brand's credibility

Table VI.
Complementary risks (MercadoPago)

In parallel to learn through trial and error, the application of Lean start-up was identified as a basis for product development. This enabled improved performance in the customer understanding and innovation risk management. In MercadoPago, validation tool was placed in the center of the business building. Its decisions were often based on hypothesis testing.

Regarding the company's management, in MercadoPago, business plan building by project was observed, in order to set specific objectives for managers and monitor their implementation. In this context, the communication factor was emphasized in the interview.

In terms of project tracking tool, the company uses software for projections, measurements and projects status communication to employees. Communication and project management are important for this study, because if implemented properly, they would promote commitment of the entire organization with long-term results. This may occur due to optimizing deliveries, cost reduction, productivity improvement and risks outlining (Table VII).

Element	Evidence	Relationship to literature
Opportunity	E-commerce growth that has generated the need for tools to make secure commercial intermediation online	Oliva *et al.* (2011), Oliva *et al.* (2014), Wang *et al.* 2013, Feinleib (2012), Siegel and Renko (2012), Smith *et al.* 2009, Crowne (2002), Shane (2000)
Benchmarking	Comparative study with companies in Silicon Valley	Tang (2015), Ekekwe (2014), Wireman (2010), Massa and Testa (2004), Fong *et al.* (1998)
Generation of innovation	Verified. Validated B2B Business Model	Aulet (2015), Euchner and Ganguly (2014), Goktan and Miles (2011), Galia and Legros (2004)
Product maturity	"Transitional phase", in which the rate of product innovation decreases and the rate of processes accelerates	Tidd and Bessant (2016), Goktan and Miles (2011), Cooper (2000), Utterback (1997)
Networking	The importance of the founder in building partnerships and prospecting clients was mentioned	Wang *et al.* (2013), Kaufmann and Schwartz (2008), Pittaway *et al.* (2004), Greve and Salaff (2003), Hansen (1995)
Internal communication	Salesforce (™) and Facebook at Work (™) were used by the employees to know each project stage	Picken (2017a), Feinleib (2012), Kitchen and Daly (2002)
Activity control	The company used Microstrategy (™) and SAP (™) to design activities	Picken (2017a, b), Coleman and Oconnor (2008), Sutton (2000)
Digital marketing	Verified. The company made investments in digital marketing	Constine (2017), Kannan and Li (2017), VanBoskirk *et al.* (2017), Lamberton and Stephen (2016), Jackson and Ahuja (2016)
Effectuation	The interviewee cites aspects of effectuation, because although MercadoPago was born in MercadoLivre, the initial team was lean and multifunctional	Long *et al.* (2017), Ortega *et al.* (2017), Cusumano (2013), Sarasvathy (2001)
Selectionism	The interviewee cites aspects of selectionism, such as A/B testing with the client	Loch and Kavadias (2011), Sommer *et al.* (2009), Sommer and Loch (2004)
Trial and error learning	The interviewee cites trial and error aspects learned from the product development	Loch and Kavadias (2011), Sommer *et al.* (2009), Sommer and Loch (2004)
Canvas/Lean start-up	The company adopted the philosophy of rapid customer testing, focused on continuous improvement and flexible scope	Link (2016), Blank (2013), Trimi and Berbegal-Mirabent (2012), Ries (2011), Osterwalder and Pigneur (2010), Dybå and Dingsøyr (2008)
Business plan	All investment decisions had their own one-year macro plan that was divided into daily micro activities. Thus, each employee knew what his goal was for following twelve months	Ortega *et al.* (2017), Blank (2013), Harms and Schiele (2012), Zacharakis *et al.* (2011), Hormozi *et al.* (2002)

Table VII.
Summary of the company (MercadoPago)

4.2 GuiaBolso

According to the documents provided by the company (D1Case02), the GuiaBolso app was launched in April 2014. It was the first application of automatic financial control in Brazil. Its system allows connection to bank accounts and automatically downloading all the information of user's expenses as well as revenues, all without the need for inserting data manually.

The first release of the company was a website, in 2012, which performed financial consulting, but without the possibility of automatic readings of bills, what limited its scalability. Nevertheless, with the launch of its first version for smartphones in 2014, the GuiaBolso grew its user base and, in 2015, it totaled more than 1.8 million users. On average, they had 14 percent improvement in their financial conditions, after a month of application usage.

GuiaBolso, which has less than four years in the market, still had start-up features, listed in this study in "start-ups" item, such as flexibility in decision making, only one product in the portfolio, rapid development of the tool and complete organization. The company was represented by the constant presence of partners in all business processes. However, they had no financial self-sustainability, caused by the absence of cash flow.

The GuiaBolso was founded at a time of economic growth in Brazil. It expanded the middle class in the country while there was an increase of the indebtedness of the poorest and increased inflation. In this scenario, the GuiaBolso was founded with the purpose of assisting the Brazilians that had access to credit more recently.

Regarding the technology, two factors were noticeable. The first was the benchmarking with the solutions developed abroad, which was present from the product design to its prototyping. In relation to the product strategy, GuiaBolso could identify a local opportunity and set an international model for the Brazilian market, all despite the cultural, legal and economic differences among countries.

Moreover, as a pioneer in this value proposition in Brazil, GuiaBolso demonstrated an effective strategy in marketing and technology that increased brand recognition and access to customer data through its system. This allowed the connection with bank accounts, automatically downloading all the user's expenses and revenues information, without the need to make manual entry.

On the other hand, for being the first mover, the start-up has undergone some risks. Two of the main risks were: the business concept approval by the banks that are introduced in a traditional and heavily regulated industry, and the construction of the security infrastructure of the data available to users and customer education on the benefits of the application.

In addition to benchmarking, the second factor present in product development was user-centric design, i.e., the company values the interaction between the product and the app intuitive interface investment. This happened to speed up the learning curve of the new users and increase the conversion rate.

For the respondent (R1Case02), at the launch of the application, the company's metrics had a positive development, as the first website of GuiaBolso still depended on manual entry of user data. This reduced engagement. Based on this observation and the research about customers, the company quickly changed its technology. This change carried out more than one release in two years to create a product which is more appropriate to the customers' needs.

4.2.1 Risk management in the case study. From risk assessment in its different categories, it is possible to perform the calculation of NPVR. Table VIII aims to systematize the risks explained above and facilitate the viewing of its distribution.

Based on these data, the NPVR found is 55 percent of the original NPV. This indicates that 45 percent of the projected NPV was at risk. As the NPVR is integrated into the decision process, the risk level displays the actions which could be taken to reduce the risk, particularly in relation to resource assessment. Associated with lower scores, market segment and specification, other risks are particular consequences of the market and uncertainties associated with the company's first mover status. Moreover, they are more

Feature assessed	Score	Related risks	Evidence
Value chain	4	Market	Access to the Endeavor network and partnership with banks Brought important advisors to the development of business Partnerships with universities to work with issues related to consumer behavior
Market segment	2	Market	New market segment
Innovation	3	Technical	New technology with limited tests
Resources	2	Technical	Team was incomplete and limited of experience in similar projects
Interaction	5	User	Mainly through benchmarking, sought to understand the user's needs Through the web version of the financial advisor, prior to application, there were made more than 40.000 consultations
Specification	2	User	Was the first in a new market Introduced a new design for the Brazilian market

Table VIII.
NPVR score to case 2 (GuiaBolso)

difficult to manage. In addition to these risks, the GuiaBolso was subject to the following two risks: client and team.

Based on the analysis of the interviewee's discourse, the framework of complementary risks was developed from the MLERM (Oliva, 2016) (Table IX).

4.2.2 Factors conditioning the company's results. In GuiaBolso, the implementation of all entrepreneurial activities mapped in this study was observed, from the effectuation of the business plan for the project. At the beginning of the company, there was no one on the team with experience in software development. In addition, they had to hire another sector manager to drive this process which demonstrated the selection of available means for the business (effectuation). At the same time, GuiaBolso launched the website simultaneously to the app construction (selectionism).

Still at the stage of the website, the company demonstrated to learn by trial and error, "people had no idea how to answer the questions of the financial advisor for more theoretically simple they were" (R1Case02). The philosophy of Lean start-up was present in all processes of the company and this was observed in the focus on meeting customer needs. These were identified by constant interaction with users. Finally, the company also demonstrated the implementation of the business plan for the project, through quarterly schedules that were divided into weekly activities (Table X).

5. Model proposition

Data were condensed by first and second level coding, with reference to the proposed coding aspects of the deductive methodology. Nevertheless, it was sought to recognize and classify data that were not within the codes previously established through the research model.

Thus, based on the combination of deductive and inductive methods, the data were analyzed, described and displayed through tables and textual descriptions. A model was generated in order to assist future start-ups in launching new technologies in the Brazilian market, which is shown in Figure 1.

Each cell of the called start-up RMM was inserted based on this research order. This order entailed the time and the resources, which delimited the launch and development of a

Risk	Evidence
Client	They did not know if the customer would value the app
Operational	New team with little experience

Table IX.
Complementary risks (GuiaBolso)

Element	Evidence	Relationship to literature
Opportunity	Increase in population debt and inflation. The company aimed to help this new consumers generation to control their finances and understand the products offered by the banks	Oliva *et al.* (2014), Wang *et al.* (2013), Feinleib (2012), Siegel and Renko (2012), Smith *et al.* (2009), Crowne (2002), Shane (2000)
Benchmarking	The company had direct contact with big companies, such as the Mint, Level Money and the Moneytree	Tang (2015), Ekekwe (2014), Wireman (2010), Massa and Testa (2004), Fong *et al.* (1998)
Generation of innovation	Not verified, business model was not yet implemented	Aulet (2015), Euchner and Ganguly (2014), Goktan and Miles (2011), Galia and Legros (2004)
Product maturity	"Fluid phase", in which market pioneers propose a high variety of designs	Tidd and Bessant (2016), Goktan and Miles (2011), Cooper (2000), Utterback (1997)
Networking	Observed in the construction of society and strategic partnerships (Harvard, Endeavor, Kellogg School of Management)	Wang *et al.* (2013), Kaufmann and Schwartz (2008), Pittaway *et al.* (2004), Greve and Salaff (2003), Hansen (1995)
Internal communication	The use of specific software was not mentioned	Picken (2017a), Feinleib (2012), Kitchen and Daly (2002)
Activity control	Verified the use of practices to control activities	Picken (2017a, b), Coleman and Oconnor (2008), Sutton (2000)
Digital Marketing	Verified, the company made investments in digital marketing	Constine (2017), Kannan and Li (2017), VanBoskirk *et al.* (2017), Lamberton and Stephen (2016), Jackson and Ahuja (2016)
Effectuation	The interviewee cited aspects of effectuation, such as hiring an inexperienced employee with technology to be the product owner	Long *et al.* (2017), Ortega *et al.* (2017), Cusumano (2013), Sarasvathy (2001)
Selectionism	The interviewee cited aspects of selectionism, such as the launch of the website simultaneously with the app construction	Loch and Kavadias (2011), Sommer *et al.* (2009), Sommer and Loch (2004)
Trial and error learning	The interviewee cited trial and error aspects learned from the product development	Loch and Kavadias (2011), Sommer *et al.* (2009), Sommer and Loch (2004)
Canvas/Lean start-up	The company adopted the philosophy of rapid customer testing, focused on continuous improvement and flexible scope	Link (2016), Blank (2013), Trimi and Berbegal-Mirabent (2012), Ries (2011), Osterwalder and Pigneur (2010), Dybå and Dingsøyr (2008)
Business plan	All investment decisions had their own business plan with quarterly goals that were divided into weekly activities	Ortega *et al.* (2017), Blank (2013), Harms and Schiele (2012), Zacharakis *et al.* (2011), Hormozi *et al.* (2002)

Table X.
Summary of the company (GuiaBolso)

new technology. The first (bottom) line of the matrix describes aspects related to the product. Moreover, the companies had faced some product development stages. This process began with the identification of opportunity and benchmarking as well as the development of product innovation and maturation. They evolved from left to right, and were correlated with time.

The second line relates to communication – networking, internal communication, activity control and digital marketing. In the same way of the product, it also developed from left to right. The central line was the risk analysis based on Davis (2002) and Oliva (2016). The top shows the entrepreneurial actions over uncertainty, effectuation, selectionism, trial and error learning, lean start-up as well as business plan.

Regarding the percentage in each column of risks, the calculation was done as follows (Tables XI, XII and XIII).

The evolution occurred from left to right, and had a connection with the time and resources that the company has. The more extreme right side characteristics (cells) the company had, the lower were the risks associated. Figure 1 shows the matrix compared

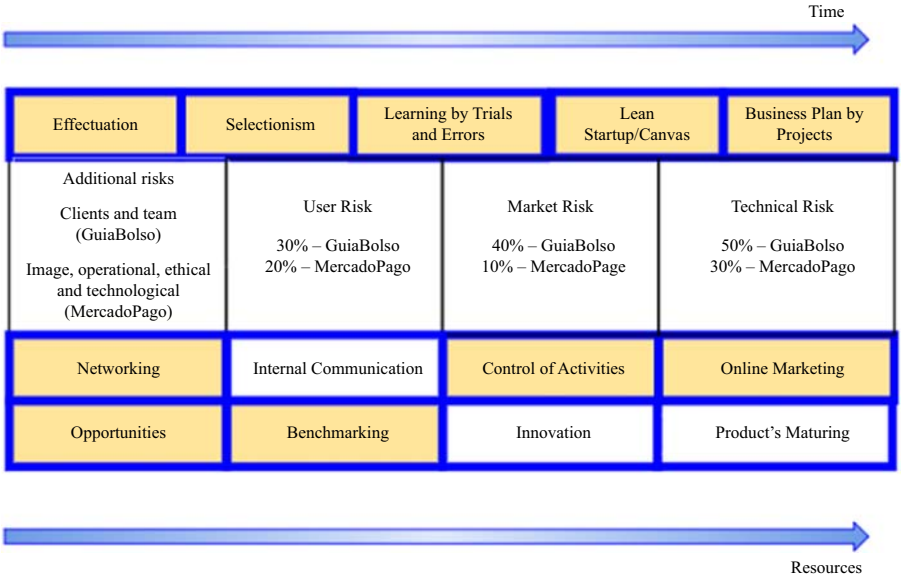

Figure 1.
Risk management matrix

between GuiaBolso and MercadoPago. Matrix cells surrounded of blue represent the features present in MercadoPago, and in yellow those of GuiaBolso. You can see that the two companies are in a more stable stage than the early years of a technology company. However, based on the MercadoPago history described in this study, we concluded that the GuiaBolso still needs to evolve to achieve greater maturity product and business model.

6. Conclusion

When undertaking the research, we set ourselves two goals: first, to analyze the management process of the risk of introducing products or services by start-ups operating

Table XI.
User risk calculation

Start-up	Interaction grade	Specification grade	Sum	Risk (100%-sum)
GuiaBolso	5	2	7 (70%)	30%
MercadoPago	5	3	8 (80%)	20%

Table XII.
Market risk calculation

Start-up	Value chain grade	Market segment grade	Sum	Risk (100%-sum)
GuiaBolso	4	2	6 (60%)	40%
MercadoPago	4	5	9 (90%)	10%

Table XIII.
Technical Risk calculation

Start-up	Innovation grade	Resources grade	Sum	Risk (100%-sum)
GuiaBolso	3	2	5 (50%)	50%
MercadoPago	3	4	7 (70%)	30%

in the Brazilian market; and second, to propose a model for risk management in the introduction of new technologies by start-ups. Both goals were achieved through the analysis of two Brazilian start-ups (GuiaBolso and MercadoPago) and through the development of the RMM.

We covered a great deal of theoretical ground in this study. By critically reviewing the complex nature of entrepreneurship, we exhibited a solid first step in building a map of the state-of-the-art knowledge of the enterprise risk management (ERM).

The types of risks an entrepreneur may face and relevant mitigating strategies were largely underexploited and not clarified (Tipu, 2017; Forlani and Mullins, 2000). In addition, the literature reviewed that most studies are conducted in developed countries (Tipu, 2017). Therefore, this study contributed to improving the understanding of risk patterns of entrepreneurship in emerging markets.

This study also presented a model (RMM) that is able to synthesize the main dimensions of business risks, which is considered a multifaceted and complex phenomenon. This phenomenon has posed several challenges to researchers in understanding the nature of risk holistically.

Our conclusions highlighted the implications for management. Our findings may have relevance for entrepreneurs, managers and venture capitalist. For example, a budding start-up can self-assess by the RMM in an unpredictable context or a venture capital can evaluate the start-ups through the same model. Then, an appropriate risk management plan may be developed.

Therefore, the model proposed in this study aimed to obtain critical information about the start-up risk management as insofar it provided: to entrepreneurs an insight into the main dimensions of business risks, and to investors a structured vision and practical information about the investment risks.

In addition, RMM can be considered an ERM model, because it has two characteristics seen as critical to distinguish ERM from traditional approaches to risk management. These characteristics are comprehensibility and integration (Bromiley *et al.*, 2014; Arena *et al.*, 2011; Liebenberg and Hoyt, 2003).

We concluded that strategies with high expected returns often require the company to take risks. The risk management is crucial in generating potential gains. For this, a model designed to reduce the likelihood. It is important to emphasize that the RMM was not intended to prevent risky ventures from occurring. However, it allowed companies and venture capitalist to take more higher-return ventures than competitors.

In relation to future research, we suggest the refinement of the methodology and empirical data available for analysis. We would investigate how new firms adopt risk management strategies during their start-up phase and how the application of RMM.

A study which examines the proposed model in other countries and with a larger number of companies could provide further validation. Besides, future research could confirm if our findings can be replicated elsewhere, or are only replicable in the Brazilian context.

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