

Enterprise Risk Management and Innovation Performance: a Study of Brazil's Large Companies

Autoria

Silvye Ane Massaini - Samassaini@gmail.com

Prog de Pós-Grad em Admin de Empresas - PPGA - Universidade Presbiteriana Mackenzie

Curso de Pós-Grad em Controlad e Contab/Facul de Economia, Admin e Contab – PPGCC/FEA - Universidade de São Paulo

Fábio Lotti Oliva - fabiousp@usp.br

Prog de Pós-Grad em Admin/Faculdade de Economia, Admin e Contab – PPGA/FEA - Universidade de São Paulo

Mestr Prof em Empreendedorismo/Facul de Economia, Admin e Contab - MPE/FEA - Universidade de São Paulo

Resumo

Business literature suggests that innovation is an important factor in gaining a competitive advantage. However, innovation can also be seen as a factor that adds further risks to a company's activities due to its complexity and uncertainty. This study aimed to understand the influence of enterprise risk management's practices on innovation performance, focusing on Brazilian large companies. The research has a descriptive approach based on an extensive review of the literature and data collected from a questionnaire survey (n = 97) was analysed by using PLS-SEM. The findings point to a positive and significant relationship between ERM's practices and innovative performance. In addition, the 'internal environment' and the 'risk appetite' are statistically significant variables for that association. Finally, it was possible to infer that the greater the perception of risks in innovation process, the greater the innovative performance of researched companies. The study findings have implications for management practices since it could help managers to understand how risk perception and ERM practices can influence the results in innovation. Therefore, the research can contribute to the improvement of innovation process risk identification, serving as a basis for decision-making and the establishment of policies for risk management.

Enterprise Risk Management and Innovation Performance: a Study of Brazil's Large Companies

Abstract

Business literature suggests that innovation is an important factor in gaining a competitive advantage. However, innovation can also be seen as a factor that adds further risks to a company's activities due to its complexity and uncertainty. This study aimed to understand the influence of enterprise risk management's practices on innovation performance, focusing on Brazilian large companies. The research has a descriptive approach based on an extensive review of the literature and data collected from a questionnaire survey (n = 97) was analysed by using PLS-SEM. The findings point to a positive and significant relationship between ERM's practices and innovative performance. In addition, the 'internal environment' and the 'risk appetite' are statistically significant variables for that association. Finally, it was possible to infer that the greater the perception of risks in innovation process, the greater the innovative performance of researched companies. The study findings have implications for management practices since it could help managers to understand how risk perception and ERM practices can influence the results in innovation. Therefore, the research can contribute to the improvement of innovation process risk identification, serving as a basis for decision-making and the establishment of policies for risk management.

Keywords: Innovation; Enterprise Risk Management; Innovative Performance.

1. Introduction

Risk management has played an important role in the field of business as an instrument to enhance the probability for companies to achieve their strategic objectives (Bromiley *et al.*, 2015).

Besides this relevance, only in the last two decades has the risk management process shuffled from a financial and project perspective to a strategic understanding. This new concept, named Enterprise Risk Management (ERM), represented a paradigm shift, from which a more comprehensive definition for the risk management process was designated (Deloach, 2000).

Allied to this approach is the evident need for innovation, considered by many authors as a fundamental element for achieving competitive advantages and a key element for the companies' survival in the business environment (Porter, 1990; Tidd and Bessant, 2018). However, the development of innovations is not a simple process, especially in a risk-driven environment. Technological evolutions, market uncertainty, financial risks, institutional and regulatory changes, and collaborative activities are often cited as factors that may lead to uncertainties and risks to the innovation process (Eisenhardt and Tabrizi, 1995).

In this context, this study aims to verify the influence of the practices of enterprise risk management in the innovation performance of large companies in Brazil. The analysis of this problem stems from the hypothesis that ERM can support managers in the decision-making about to continue with the initiatives for innovations, by considering that risk is an inherent factor in this process.

The research is relevant for several reasons. First, while interest in the subject has grown over the last years, academic research on Enterprise Risk Management is still at an early stage (Bromiley *et al.*, 2015). Secondly, papers related to risk are generally published in

accounting and finance journals and are rarely addressed by management journals (Bromiley *et al.*, 2015). Moreover, only a few studies touch on the relationship between ERM and innovation (Taran, 2013; Oliva *et al.*, 2014).

Taran (2013) also points out that knowledge in this field is still relatively small and it is necessary to develop an empirical basis to guide professionals over risk management. This management guidance is necessary to support the redesigning of strategies towards innovation in order to incorporate actions for risk management. For Bromiley *et al.* (2015), the regulations and standards issued for risk management make use of vague terms, making it difficult to internalize and operationalize. Also, the benefits of implementing ERM are still seldom explored in the literature (Hoyt and Liebenberg, 2011).

Hence, from a theoretical perspective, the study is justified by integrating two fields (innovation process and risk management), which are commonly discussed separately. From a practical perspective, the research aims to contribute to the identification of possible innovation process risks, serving as a basis for decision-making and the development of risk management policies.

2. Literature Review

2.1 Enterprise Risk Management (ERM)

According to the Committee of Sponsoring Organizations of the Treadway Commission (COSO), the risk is defined as “the possibility that an event will occur and adversely affect the achievement of objectives” (2007, p.16). Specifically, corporate risks refer to the liabilities and dangers that a corporation faces which can affect business objectives, arising from external factors (such as political, economic, social, environmental, legal and technological risks), or from internal factors (such as operational risks, financial, human, reputational, etc.) (COSO, 2007, IBGC, 2007).

The concept of ERM was introduced in the mid-1990s and was defined as a systemic and integrated approach to manage all the risks to which a company is exposed (Dickinson, 2001). According to the Risk and Insurance Management Society (RIMS, 2011), ERM is a strategic business discipline that supports the achievement of an organization's objectives by addressing the full spectrum of its risks and managing the combined impact of those risks as an interrelated risk portfolio.

The most popular models for corporate risk management are expressed by the Committee of Sponsoring Organizations of the Treadway Commission (COSO, 2007), the Australian Standards and New Zealand Standards (AS/NZ 4360, 2004) and the International Organization for Standardization (ISO) 31,000 (ABNT, 2009). They provide a generic, but a previously defined framework for implementing risk management in organizations in order to provide a greater level of effectiveness and efficiency in this process.

According to literature, the Enterprise Risk Management frameworks can be analyzed from five main stages (ABNT, 2009, COSO, 2007):

- risk identification: consists of the execution of activities to identify internal and external events that affect the achievement of the company's goals (COSO, 2007).
- risk assessment: is a process based on the analysis of the identified risks, seeking to establish their probability of occurrence and impact in the company's activities (COSO, 2007). This step is considered crucial as it concerns how risk will be managed (Brustbauer, 2014).

- response to risks: concerns the execution of actions to align the risks with the company profile. Among the main responses are: avoiding, accepting, mitigating or sharing the risks (COSO, 2004).
- control and monitoring: consists of the implementation of policies and procedures to ensure that responses to risks will be carried out satisfactorily.
- communication: aims to ensure that all stakeholders in risk management obtain the necessary information about this process (COSO, 2004).

2.2 Innovation Performance and Enterprise Risk Management

In accordance with the Organization for Economic Cooperation and Development (OECD, 2005), innovation performance refers to the development and implementation of innovations from the view of the organization. This includes products, processes, and methods that companies are the pioneers to develop and those that have been adopted by other firms. It is important mentioning that innovation refers to either the implementation of a new or significantly improved product (goods or service), process, marketing method or organizational method. The minimum requirement to define innovation is the degree of novelty for the enterprise, which is something not necessarily aimed at the market (OECD, 2005).

Several studies propose that risk-taking is inherent to the innovation process and that innovations bring new risk factors to organizations (Ahuja and Lampert, 2001; Zahra, 2005; Keizer, Halman, 2007; García-Granero *et al.*, 2015). According to Etges and Cortimiglia (2019), innovation and risk are inseparable. The literature on innovation often points out that companies should actively monitor, evaluate, analyze and address risks in order to mitigate them as much as possible. Considering this context, Taran *et al.* (2013) suggest the greater the complexity and uncertainty of innovation, the greater the risks inherent to the innovation process.

Therefore, risk management can help executives to make critical decisions to abandon an innovation project, providing an effective filter of good and poor ideas that is fundamental to achieve innovation performance (Keizer *et al.*, 2005). Tao *et al.* (2010) reinforce this statement concluding that risk management can increase the outcomes of incremental innovation.

The relation between ERM and innovation performance is especially important considering emerging economies, characterized by unstructured national innovation systems and constant economic and market instability (Etges and Cortimiglia, 2019).

3. Research methods

This study examines the relationship between ERM practices and the innovation performance of large firms in Brazil.

The conceptual framework presented in Figure 1 combines five constructs, namely, ERM practices (independent variable), innovation performance (dependent variable), internal environment (independent variable), innovation process risks (independent variable) and risk appetite (moderator variable).

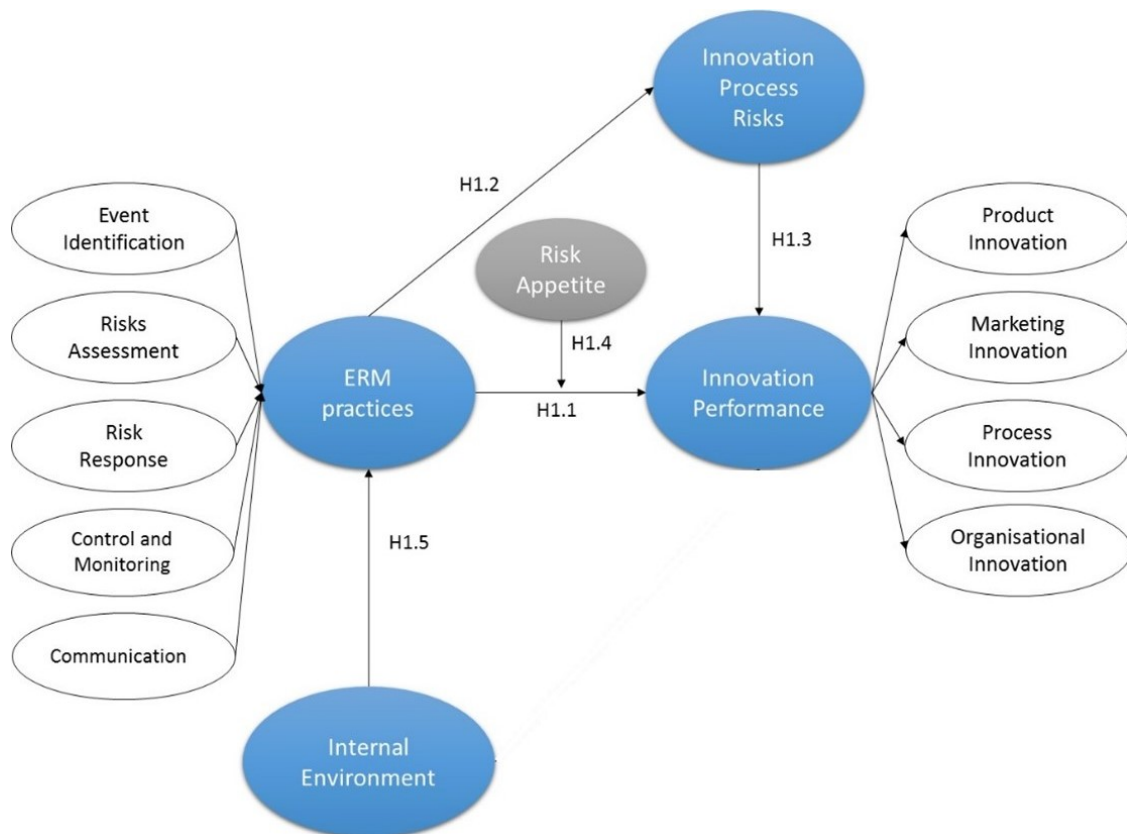


Figure 1 – Research conceptual model

The study has a descriptive and quantitative approach and was conducted through a questionnaire survey. The questionnaire had 19 questions, divided into four sections: the first and last section covering the demography of the firms and the characteristics of the respondents; the second section included questions on the ERM practices, while the third section covered the organization's innovation performance over a three-year period, including sentences to evaluate the influence of risks on their innovation process.

The sample was drawn from a special edition of Exame Magazine, ranking the 1,000 largest and best companies in Brazil (Exame, 2016). Exame Magazine is acclaimed as a recognized periodic, widely applied in the Brazilian business administration research. The focus on large companies is justified for the fact that, according to IBGE (2016, p. 59), large companies (with more than 499 employees) have “more governmental incentives to innovate”. Moreover, researches show that most ERM practices are developed by large companies (Deloitte, 2013; NC State; AICPA, 2015). The sample, composed of 1,000 firms, was selected by means of the convenience sampling technique. Information and invitations were sent through e-mails to the organizations with links to the on-line questionnaire survey (on QuestionPro). At the end of the survey period, 97 of the sampled organizations provided positive responses, on which the study analysis is based.

The sample captured companies from 19 different sectors. The main industry was Electro-Electronic, with 10.31% of cases, followed by Energy (9.28%), Metallurgy and Mining (9.28%), and General Services (8.25%). On average, the companies have 5,556 employees, with a minimum of 530 and a maximum of 23,000 employees. Regarding the investment in R&D, companies direct 2.13% of their gross operating revenue in research and development. This percentage is close to the numbers indicated by the Technological Innovation Survey - PINTEC in Brazil (IBGE, 2016).

3.1 Research measures and constructs

The dependent variable 'Innovation Performance' was measured by considering the previous study of Massaini and Oliva (2015), that reflects four types of innovation (product, process, marketing and organizational), measured by 16 items, using a likert scale.

The formative construct 'ERM Practices' was composed of five dimensions based on the approach assigned by previous studies (Brustbauer, 2014; Oliva, 2016; COSO, 2004). The construct was composed by 20 items to evaluate risk identification, risk assessment, risk response, risk control and risk communication.

The reflective and second-order construct 'Innovation process risks' were measured from the review of Keizer *et al.* (2005), Keizer and Halman (2007), Wu and Wu (2014) studies, that resulted in 24 itens (e.g. regulatory risk, market risk, supply risk, etc).

To measure the 'Risk appetite', the study used scales adapted from COSO (2009) and García-Granero *et al.* (2015).

Finally, 'Internal environment' was measured by using characteristics of the organizations, such as support from top management, internal culture and structure focused on corporate risk management, the existence of a risk committee and a remuneration policy or formalized incentive programs based on long-term indicators. The items of this dimension were adapted from Galorath (2006), ABNT (2009), COSO (2007), Lam (2011) and IBGC (2007).

The respondents were asked to indicate the degree of agreement for each item on a 0-10 Likert scale, ranging from 0 (disagree very strongly) to 10 (agree very strongly) and considering over the last 3 years in the company.

3.2 Method of data analysis

Prior to analysis, a database revision was performed to verify missings and identify outliers, using Mahalanobis distance. In addition, as recommended by Hair Jr. *et al.* (2014), the data distribution was verified through asymmetry and kurtosis tests, in order to identify if the data are far from being normally distributed.

To evaluate the model given in Figure 1, the study used the partial least squares structural equation modeling (PLS-SEM) technique. SmartPLS (Version 3.2.6) was applied for analyzing the data collected for this study. In addition, the exploratory factorial analysis (EFA) was used in the research to aggregate the data of the second-order constructs, aiming to obtain the factorial scores and refine the variables of the research.

4. Research analysis, findings and discussion

4.1 Evaluation of measurement model

To evaluate the reflective outer models, this study examined the convergent validity, discrimination validity and reliability of the scale (Hair *et al.*, 2014). The analysis initially revealed that the outer loadings of the variables RISK1 and RISK4 were lower than 0.7, a fact that resulted in their removal from the model. After this procedure, all loadings were higher than 0.7, as recommended by Ringle, Silva and Bido (2014) and Hair Jr. *et al.* (2014).

The results of the examination of convergent validity, reliability and discriminant validity of the reflective indicators are presented in Table I.

Table I – Evaluation of the reflective constructs

Construct	Reliability		Convergent Validity	Indicators (items)	Outer Loading
	Cronbach's Alpha	Composite Reliability	Average Variance Extracted		
Criteria	Alpha > 0.7	CR > 0.7	AVE > 0.5	-	Loading > 0.7
Innovation Performance	0.890	0.923	0.751	MARK INNOV	0.905*
				ORG INNOV	0.892*
				PROC INNOV	0.817*
				PROD INNOV	0.850*
Internal Environment	0.880	0.912	0.676	IE1	0.728*
				IE2	0.854*
				IE3	0.864*
				IE4	0.848*
				IE5	0.810*
Innovation Process Risks	0.915	0.932	0.697	R COLLAB INTEL	0.845*
				R FIN OPER	0.832*
				R SUPPLY	0.859*
				R MKT	0.820*
				R PROJ TEC	0.887*
				R REGUL	0.761*
Risk Appetite	0.779	0.856	0.600	RISK2	0.702*
				RISK3	0.762*
				RISK5	0.800*
				RISK6	0.829*

	Internal Environment	Risk Appetite	Innovation Performance	Innovation Process Risks
Internal Environment	0.822			
Risk Appetite	0.621	0.774		
Innovation Performance	0.430	0.584	0.867	
Innovation Process Risks	0.160	0.199	0.332	0.835

* significant coefficient at 0.05.

To evaluate the formative construct 'ERM practices', a correlation analysis was carried out. This analysis indicated the existence of statistically significant Pearson's correlation among the indicators of the construct (eg 0.923, 0.901, 0.881). Also, the significance of the outer weights of the model variables was observed, using the bootstrapping method with ten thousand samples. The analysis of the outer weights and the significance of the indicators revealed that only the item Risk Communication (RISK_COMM) presented an outer weight greater than 0.5, being statistically significant at the 5% level. In these cases, Hair Jr. et al. (2014, p. 103) states that "the statistical insignificance of the indicators should not be interpreted as indicative of a poor fit of the measurement model." Therefore, the authors recommend, instead of evaluating the relative importance of the indicators (outer weight), turn to the outer loading of the indicators of the construct. Consequently, The analysis showed the outer loadings for each indicator are greater than 0.7 and are statistically significant at the 5% level of confidence.

In order to verify possible problems regarding Common Method Variance (CMV), the Harman Test was executed. The exploratory factorial analysis resulted in the formation of 5 factors, representing a total of 81.21% of the extracted variance. As the first factor represented 40.73% of the data variance (less than 50%), it is plausible to suppose do not present major problems related to the bias of the method.

4.2 Evaluation of the structural model

The results show that the variables 'ERM practices' and 'Innovation Performance' present large and significant effects R^2 (70.1% and 43.0%, respectively) according to Ringle, Silva and Bido (2014). However, the variable 'Innovation process risks' has an insignificant statistical effect, presenting $R^2 = 0,00$. This is explained by the fact that there is no statistically significant relationship between 'ERM practices' and the 'Innovation Process Risks' in the model.

The variable 'ERM practices' is more corroborative with the fit of the model ($f^2 = 2.344$). In addition, the variable 'Performance in innovation' also has a large and significant effect ($f^2 = 0.754$). However, as pointed out in previous analyses, the latent variable 'Innovation process risk' does not present a significant effect for the model, considering the 5% confidence level.

As indicated in Table II, the variable 'Internal Environment' has the strongest effect on 'ERM practices' (0,837); followed by 'Risk Appetite' \rightarrow 'Innovation Performance' (0,405), 'Innovation Process Risks' \rightarrow 'Innovation Performance' (0,249), and 'ERM practices' \rightarrow 'Innovation Performance' (0,241). The hypothetical path relationship between all constructs is statistically significant at 5%, except for the path between 'ERM practices' and 'Innovation Process Risks'.

Table II - Path coefficient and testing of hypothesis

	Original Sample	Sample Mean	Standard Deviation	T Stats.	P Values
Internal Environment -> ERM	0.837	0.842	0.033	26.113	0.000
Risk Appetite -> Innovation Performance	0.405	0.408	0.099	4.085	0.000
Innovation Process Risks -> Innovation Performance	0.249	0.252	0.076	3.259	0.001
ERM -> Innovation Performance	0.241	0.247	0.101	2.393	0.017
ERM -> Innovation Process Risks	0.013	0.040	0.180	0.072	0.942
Internal Environment -> Innovation Performance (indirect effect)	0.204	0.212	0.081	2.539	0.011

The primary aspect analyzed in this study refers to the relationship between the adoption of ERM practices and their influence on companies' innovation performance. The results in Table II demonstrate that an increase of one unit in 'ERM practices' causes an increase of 0.241 units in 'Innovation Performance', corroborating the hypothesis that corporate risk management practices contribute positively to innovation performance, as highlighted by many authors (Keizer and Halman, 2007; Taran *et al.*, 2013; García-granero *et al.*, 2015).

Another concern about the relationship between risk and innovation concerns the appropriate degree of risk management. This is because, as pointed out in the research, the risk appetite and the perception of the influence of risks in the innovation process seem to contribute positively to the innovation results. Therefore, it is important to consider that ERM practices should be executed in order to enable the exploitation of the opportunities and risks that support innovative activities, preventing an overly conservative position from discouraging or stifling innovation processes (Taplin and Schymyck, 2005).

Table II additionally shows that 'Innovation Performance' is influenced by the company's risk appetite. In other words, increasing one unit in 'Risk Appetite' results in a 0.405 unit increase in the company's innovation performance. It is important to emphasize that risk appetite guides the allocation of resources in the firm's actions that are compatible

with its profile. For this reason, it is an important aspect of corporate innovation results (COSO, 2007).

Besides, the analysis of the indirect effects in the model shows that 'Internal Environment' also produces results in the variable 'Innovation Performance' (0,204). This can be theoretically justified by considering that while factors such as top management support, risk management culture, governance structure, effective communication, information systems, etc. can drive ERM practices, these characteristics can also influence the company's innovation outcomes (Tidd and Bessant, 2018).

The exogenous variables together explain 43.0 percent of the variance of the endogenous construct 'Innovation Performance' ($R^2 = 0,430$), while 'Internal Environment' contributes to explaining 70.1 percent of the variance of 'ERM practices', as shown in Figure 2.

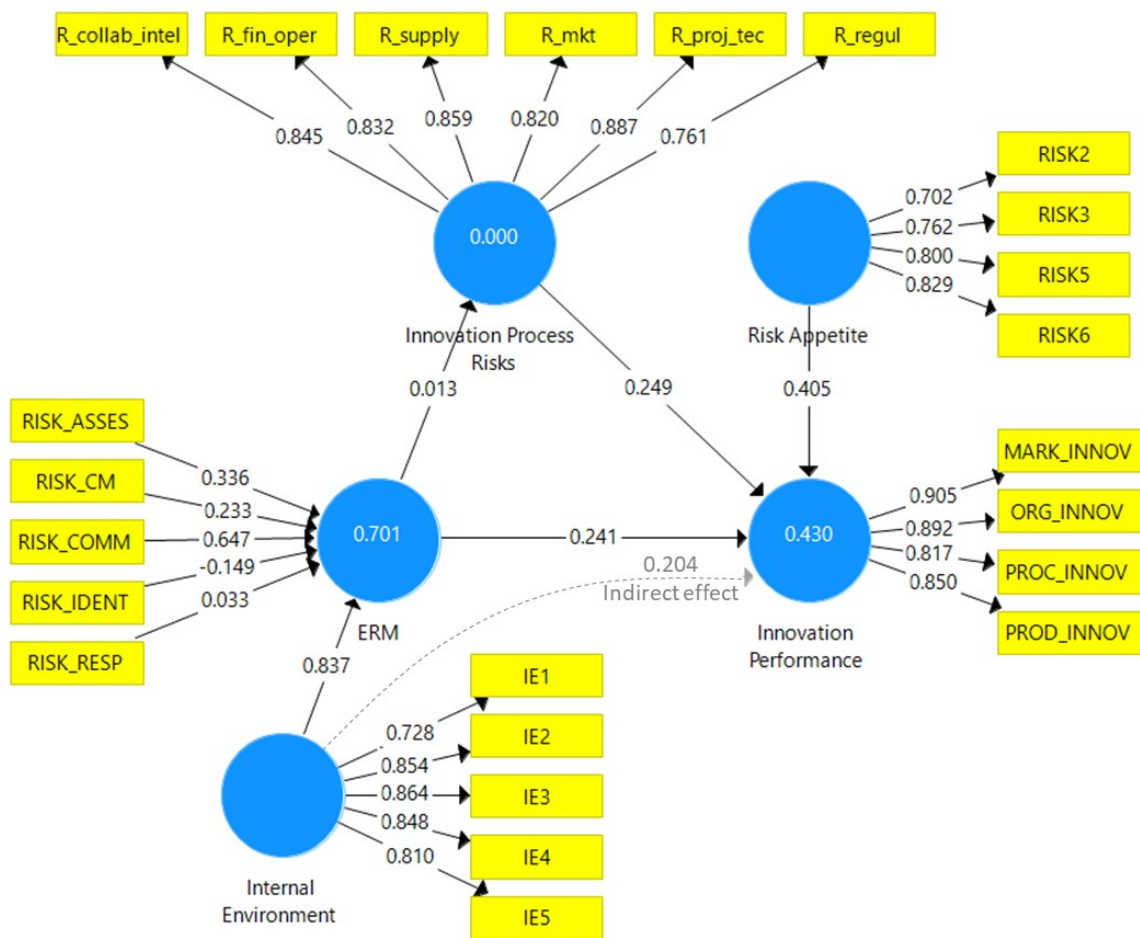


Figure 2 - Result of path analysis

To check the moderating effect, a variable was included in the model, which allows evaluating the differences caused in the 'Innovation Performance' considering the interaction between the variables 'ERM practices' and 'Risk Appetite' (moderator variable), as shown in Figure 3.

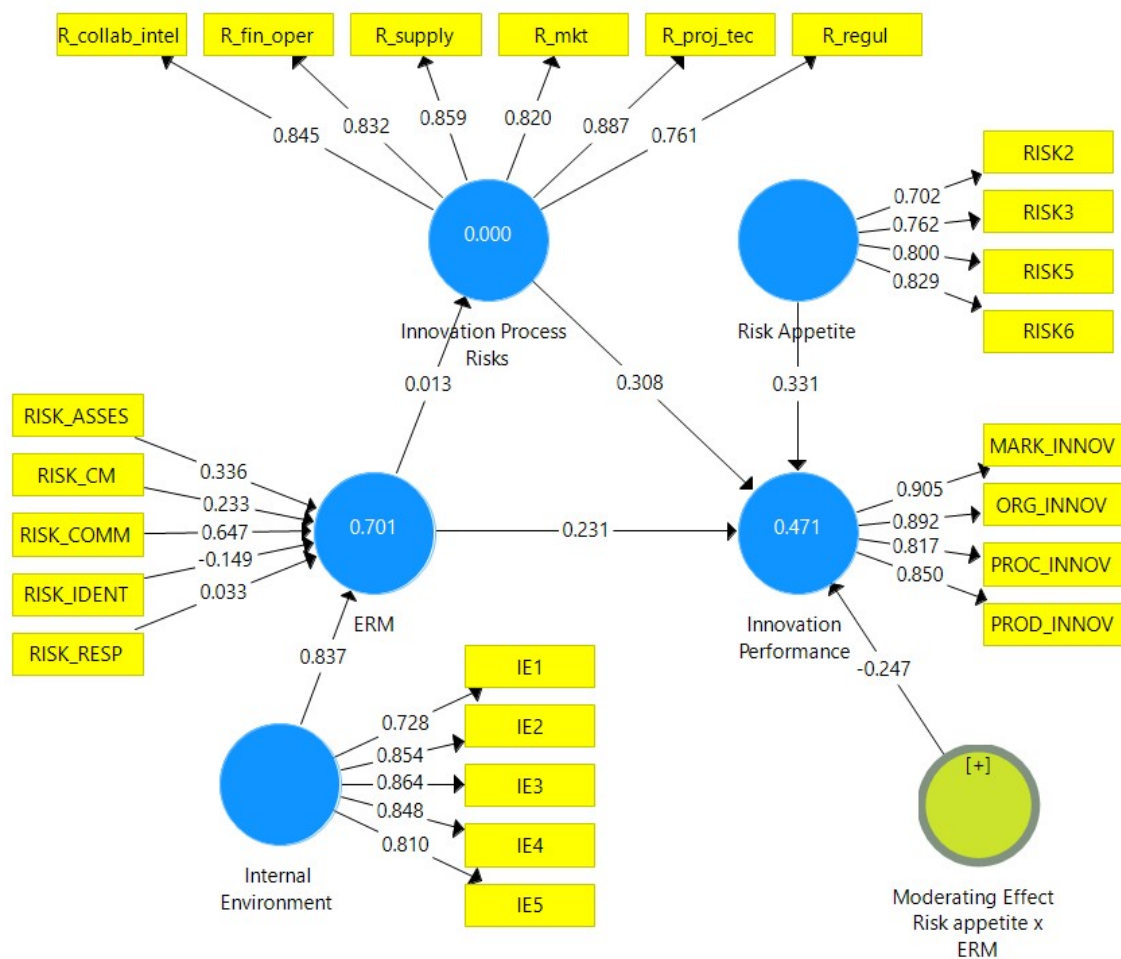


Figure 3 - Result of moderated path analysis

The result of the interaction suggests that the moderating variable 'risk appetite' has a negative effect on 'Innovation Performance' (-0.247), considering a level of 5% confidence.

5.3 Discussion

The study results provide empirical support to three of the five hypotheses presented in this research.

H1.1 Corporate risk management (ERM) practices are significantly and positively related to the company's innovation performance.

As pointed out in the path analysis, this hypothesis was confirmed at a significance level of 5%, since the practices of enterprise risk management can contribute to innovation performance for the firms in the sample.

Considering that innovation can also be seen as a process that adds even more risks to the organizations (Ahuja and Lampert, 2001; Keizer et al., 2002; Zahra, 2005; Wang *et al.*, 2010; García-Granero *et al.*, 2015), it can be assumed that companies that have deliberate practices of identification, assessment, response, control, monitoring and communication of corporate risks can achieve better results in terms of innovation (Keizer and Halman, 2007; Taran *et al.*, 2013; García-Granero *et al.*, 2015).

H1.2 Enterprise risk management (ERM) practices are significantly and negatively related to the risks of the innovation process.

This hypothesis was rejected since there was no association, at a level of 5% of significance, of enterprise risk management practices with the risks of the innovation process. This fact can be explained by taking into account the concept of ERM by itself as a process that contemplates the entire company risks, with a prospective and integrated approach (Walker *et al.*, 2002). Based on the idea that the research focused only on the risks of the innovation process, it can be assumed that the lack of statistical significance for this relationship occurred due to the delimitation of the analysis. It is therefore suggested that a more comprehensive investigation be carried out in order to incorporate other types of risks (external environment, corporate, and strategic) to check the existence of a significant relationship.

H1.3 The innovation process risks are associated significantly and negatively with the enterprise's innovative performance.

This hypothesis was rejected because it was expected that there would be an inversely proportional relationship between the risks of the innovation process and the company's innovative performance. However, a positive and significant relationship was found at the 5% level of confidence. Contrary to what might be expected, this resolution is justified considering the direct association between risk-taking and the innovation process (Ahuja and Lampert, 2001; Zahra, 2005; Keizer and Halman, 2007; García-Granero *et al.*, 2015). It can be inferred that the greater the perception of risk in the innovation process, the higher the innovation performance. Therefore, it is assumed that more expressive results in terms of innovation are expected when the company runs more risks. This assumption is in line with Etges and Cortimiglia (2019), which states that innovation and risk are inseparable concepts.

H1.4 The relationship between enterprise risk management (ERM) and innovation performance is moderated by the company's risk appetite.

The fourth hypothesis was confirmed since the construct risk appetite is positively correlated with performance in innovation. When considering the moderating factor, it is possible to see the inversion of the sign of the relationship between the variables 'ERM' and 'Innovation Performance'. In summary, the greater the 'Risk Appetite' of the company, the lower the relationship between 'ERM' and 'Innovation Performance', which turns out to be negative. Consequently, it is understood that a high level of risk appetite can lead organizations to establish more conservative practices for risk management. At the same time, this practice may lead to the inhibition of the innovative process in an attempt to control a high level of organizational risk. The theoretical interpretation of this question is expressed by Taplin and Schymyck (2005), who highlight the need to establish an adequate degree of risk management in order to avoid that an overly conservative position may discourage innovation processes.

H1.5 The company's internal environment is significantly and positively related to enterprise risk management (ERM) practices.

The last hypothesis of the study was confirmed, considering that the internal environment has a positive and significant influence on the adoption of enterprise risk management practices. This result is congruent with that expressed in the literature since several authors argue that the implementation of the ERM can be favored through an organizational culture and structure focused on risk management, a support from the top management of the company, a risk management committee or/and a compensation policy that encourages enterprise risk management (Galorath, 2006, COSO, 2007, ABNT, 2009; Lam, 2011). In this sense, several risk frameworks highlight the importance of the internal environment and the organizational context for the establishment of ERM practices (COSO,

2007; ABNT, 2009). By analyzing the indirect effects in the model, it can be seen that the organization's 'Internal Environment' also produces results in the variable 'Innovation Performance'. This can be theoretically justified considering that factors such as the support of top management, a culture focused on risk management, governance structure, effective communication, information systems, etc. can drive ERM practices, while also influencing the firm's innovation performance. Some of these factors are listed in the literature as innovation enhancing aspects as well (Rothwell, 1980; Tidd and Bessant, 2018).

7. Conclusions

The main objective of this research was to verify the influence of enterprise risk management practices on the innovation performance of large companies in Brazil. By using information from 97 large organizations in Brazil, the model was evaluated and validated using a PLS-SEM approach.

The sample results indicated that the existence of ERM practices positively influences the innovation performance of the companies. This finding is relevant, considering the existence of several risk factors, such as technological risks, operational risks, project management risks, intellectual risks, supply risks, market risks, financial risks, collaboration risks, and institutional/regulatory risks, that may impact on the innovation process.

Another important point, highlighted in the structural model, is the strong direct and positive relationship between the company's internal environment and the ERM practices. This output enriches the discussion about the fact that the implementation of the ERM can be favored through an internal environment in which support from the top management and culture, structure and process focused on risk management are latent.

In addition, the significance of the moderating effect of risk appetite is an important guiding aspect to innovation performance of the companies in sample since a high level of risk appetite may lead organizations to establish more conservative practices for risk management in an attempt to control a high level of organizational risk, which, in turn, may lead to the inhibition of the innovative process.

Another interesting question concerns the effect of innovation process risks on innovation performance. It was inferred by the research that the greater the perception of the influence of risk in the innovation process, the greater the innovative performance presented by the companies surveyed. Therefore, it is assumed that more expressive results in terms of innovation are also due to the fact that the company runs more risks which, in its perception, can impact them in a more prominent way.

It is necessary to point out that the direct relationship between ERM practices and the risks of the innovation process was not statistically significant and may indicate that the perception of the influence of the risks of the innovation process on the innovative performance of the companies surveyed is independent of the ERM processes. This view is perhaps a reflection of the ERM's integrated approach or the low number of companies in the sample that have this process well established and formalized. These results can also suggest the existence of possible limitations that affect the adoption of ERM practices since the development and formalization of these practices depend on the context of each organization.

This current research presents several practical and theoretical implications for researchers and practitioners. The research also stands out for integrating two theoretical fields (innovation process and risk management), which are mostly discussed separately or under very specific perspectives. The key contribution of this study is that it joins different theoretical views to explain sources of innovation performance while considering the

importance of ERM practices, the internal environment, the innovation process risks and the role of risk appetite.

In addition, the research stands out theoretically by representing a possible positive relationship between the perception of risks and the improvement of innovative performance. In this sense, the study differs from other papers published, which consider only the negative aspect associated with risk, leaving aside possible positive implications that may result from risk taking and its administration in an ERM context.

The study findings have implications for management practice as it could help managers to understand how the risks can influence the relationship between ERM practices and their respective results in innovation. Hence, the research can contribute to the improvement of identification of innovation process risks, serving as a basis for decision-making and for the establishment of policies for risk management. Also, the importance of the internal environment of the researched organizations was highlighted, as a precursor to the implementation of ERM's practices. The study contributes to the current debate on the causes of innovation performance differentials among large organizations by taking into consideration the effect of enterprise risk management's practices, risk appetite, internal environment and types of innovation risks that firms are submitted.

Although this study has presented relevant considerations, some limitations can be pointed out. Firstly, the use of the structural equation modeling technique does not allow the validation of this model for later replication to other companies and/or conjunctures, and it is paramount to conduct new studies that can prove it. Secondly, the study offers no assurance that the measures used are faultless, despite theoretical backings and empirical validation of variables and constructs used. Also, the research is based on the opinion of the firm's executives, something which can vary and change over time. Finally, due to sample size limitations, the generalization of the findings may be limited once a larger sample could have permitted more realistic conclusions.

It is suggested, for new studies, the development of qualitative and longitudinal investigations which can examine heterogeneous issues, arising from the specificities of each company, such as the difficulty of internalization and operationalization of the risk management process. Last but not least, future research may contemplate equally pertinent issues such as subjectivity in risk management, its level of analysis in the organization and the temporal dynamics of ERM, which emerge as relevant topics of study in the area.

References

- ABNT (2009), "*ABNT NBR ISO 31.000 - Gestão de Riscos: princípios e diretrizes*", São Paulo: Associação Brasileira de Normas Técnicas.
- AS/NZ 4360 (2004), "*Risk Management: Standards Association of Australia and New Zealand*", Sydney: AS.
- Bido, D. S., Silva, D., Souza, C. A. and Godoy, A. S. (2010), "Mensuração com Indicadores Formativos nas Pesquisas em Administração de Empresas: como lidar com a multicolinearidade entre eles?", *Administração: Ensino e Pesquisa*, Vol. 11, n.2, pp. 245-269.
- Bromiley, P., Mcshane, M., Nair, A. and Rustambekov, E. (2015), "Enterprise Risk Management: Review, Critique, and Research Directions", *Long Range Planning*, Vol. 48, n. 4, pp. 265-276.

- Brustbauer, J. (2014), "Enterprise risk management in SMEs: towards a structural model", *International Small Business Journal*, Vol.32, n.6, pp.1-16.
- COSO, Committee of Sponsoring Organizations of the Treadway Commission (2004), "*Enterprise Risk Management Framework*". New York: American Institute of Certified Public Accountants.
- COSO, Committee of Sponsoring Organizations of the Treadway Commission (2007), "*Gerenciamento de Riscos Corporativos - Estrutura Integrada*", available at <http://www.coso.org/documents/COSO_ERM_Executive_Summary_Portuguese.pdf> (accessed 23 April 2015).
- COSO, Committee of Sponsoring Organizations of the Treadway Commission (2009), "*Strengthening Enterprise Risk Management for Strategic Advantage*", available at <http://www.coso.org/documents/COSO_09_board_position_final102309PRINTandWEBFINAL_000.pdf> (accessed 20 August 2015).
- Deloach, J. W. (2000), "*Enterprise-wide risk management: strategies for linking risk and opportunity*". New York: Financial Times Prentice Hall.
- Deloitte (2013), "*Exploring Strategic Risk: a global survey*", available at <<https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Governance-Risk-Compliance/dttl-grc-exploring-strategic-risk.pdf>> (accessed 24 July 2015).
- Dickinson, G. (2001), "Enterprise risk management: its origins and conceptual foundation", *Geneva Papers on Risk and Insurance*, Vol. 26, n.3, pp. 360-366.
- Eisenhardt, K. M. and Tabrizi, B. N. (1995), "Accelerating adaptive processes: product innovation in the global computer industry", *Administrative Science Quarterly*, Vol. 40, n.1, pp. 84-110.
- Exame (2016), "Melhores e Maiores: as 1000 maiores empresas do Brasil", *Revista Exame* (ed. especial), Vol. 43.
- Etges, A. P. B S and Cortimiglia, M. N (2019), "A systematic review of risk management in innovation-oriented firms", *Journal of Risk Research*, Vol. 22, n. 3, pp. 364-381.
- Galorath, D. (2006), "Risk Management Success Factors", *PM World Today*, Vol. 8, n. 11, s.p.
- García-Granero, A., Llopis, O., Fernández-Mesa, A. and Alegre, J. (2015), "Unraveling the link between managerial risk-taking and innovation: the mediating role of a risk-taking climate", *Journal of Business Research*, Vol. 68, n.5, pp. 1094-1104.
- Hair Jr., J. F., Hult, G. T. M., Ringle, C. M. and Sarstedt, M. (2014), "*A primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*". London: Sage Publications.
- Hoyt, R.E. and Liebenberg, A. F. (2011). "The Value of Enterprise Risk Management", *Journal of Risk Insurance*, Vol. 78, n. 4, pp. 795-822.
- IBGC, Instituto Brasileiro de Governança Corporativa (2007). "*Guia de orientação para o gerenciamento de riscos corporativos*". São Paulo: IBGC.

- IBGE, Instituto Brasileiro de Geografia e Estatística (2016). “*Pesquisa de Inovação 2014*”. Rio de Janeiro: IBGE.
- Keizer, J. A. and Halman, J. I. M. (2007). “Diagnosing risk in radical innovation projects”, *Research Technology Management*, Vol. 50, n. 5, pp. 30-36.
- Keizer, J. A., Halman, J. I. M. and Song, M. (2002). “From experience: Applying the risk diagnosing methodology”, *Journal of Product Innovation Management*, Vol. 19, n. 3, pp. 213-232.
- Keizer, J. A., Von, J. P. and Halman, J. I. M. (2005), “Risks in new product development: devising a reference tool”, *R&D Management*, Vol. 35, n. 3, pp. 297-309.
- Lam, J. (2011), “*Enterprise Risk Management Guide*”, Maryland: Association for Financial Professionals.
- Massaini, S. A. and Oliva, F. L. (2015), “Innovation Networks: the contribution of partnerships to innovative performance of firms in the Brazilian Electrical-Electronics Industry”, *Brazilian Business Review*, Vol.12, n. 3, pp. 16-41.
- NC State and AICPA (2015), “*Report on the Current State of Enterprise Risk Oversight: Update on Trends and Opportunities*”, available at <<https://erm.ncsu.edu/library/article/current-state-erm-2015>> (accessed 27 December 2015).
- OECD, Organization for Economic Cooperation and Development (2005), “*Manual de Oslo: Proposta de Diretrizes para a Coleta e Interpretação de dados sobre Inovação Tecnológica*”. São Paulo: OECD.
- Oliva, F. L., Sobral, M. C., Damasceno, F., Teixeira, H. J., Grisi, C. H. C.; Fischmann, A. A. and Santos, S. A. (2014). “Risks and strategies in a Brazilian innovation–flexfuel technology”, *Journal of Manufacturing Technology Management*, Vol. 25, n. 6, pp. 916-930.
- Oliva, F. L. (2016), “A Maturity Model for Enterprise Risk Management”, *International Journal of Production Economics*, Vol. 173, pp. 66-79.
- Porter, M. (1990), “*Vantagem Competitiva*”, Rio de Janeiro: Campus.
- RIMS, Risk and Insurance Management Society (2011), “*FAQ on SRM and ERM: Why Strategic Management?*”, available at <<http://www.rims.org/resources/ERM/Documents/>> (accessed 23 July 2015).
- Ringle, C. M., Silva, D. and Bido, D. S. (2014), “Modelagem de Equações Estruturais com Utilização do SmartPLS”, *Revista Brasileira de Marketing (REMark)*, Vol. 13, n.2, pp. 56-73.
- Rothwell, R. (1980), “*Policies in industry*”, In: PAVITT, K. Technical Innovation and British Economic Performance. London: MacMillan, pp. 299-309.
- Tao, L. , Probert, D. and Phaal, R. (2010), “Towards an integrated framework for managing the process of innovation”, *R&D Management*, Vol. 40, pp. 19-30.

Taplin, R. and Schymyck, N. (2005), “*An interdisciplinary and cross-cultural approach*”, In: TAPLIN, R. (Ed.) *Risk Management and Innovation in Japan, Britain and the United States*. London: Routledge, pp.1-20.

Taran, Y., Boer, H. and Lindgren, P. (2013), “*Incorporating Enterprise Risk Management in the Business Model Innovation Process*”, *Journal of Business Models*, Vol.1, n.1, pp. 38-60.

Tidd, J., and Bessant, J. R. (2018). “*Managing innovation: integrating technological, market and organizational change*”. John Wiley & Sons.

Walker, P. L., Shenkir, W. G. and Barton, T. L. (2002), “*Enterprise risk management: pulling it all together*”. Institute of Internal Auditors Research Foundation.

Wu, J. and Wu, Z. (2014), “*Integrating risk management and product innovation in China: the moderating role of board of directors*”, *Technovation*, Vol. 34, pp. 466-476.

Zahra, S. A. (2005), “*Entrepreneurial risk taking in family firms*”, *Family Business Review*, Vol. 18, n. 1, pp. 23-40.