

The Contribution of Information Engineering for Innovation Funding Source Obtainment

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Abstract

Continued innovation in products, processes, services, technology and on the company management, is essential to maintaining and achieve more competitiveness in organizations. To execute innovation projects, many companies seek external financial resources through development agencies. Taking into consideration few theoretical approaches on this topic, the Information Engineering presents itself as an element that can contribute for this process. Therefore, this study aims to find out how the information engineering can support and improve the process of funds obtainment to innovation purposes in organizations. This is an exploratory study through a systematic literature review method, which addresses three main steps: planning, processing and divulgation. The results show that the ability to manage information has a positive and direct influence on the performance of organizational innovation. Therefore, it is possible to realize that as the more information is structured and implemented more are the chances of successful in the innovation processes including funding source obtainment.

Keywords: funding source, information engineering, innovation, knowledge

1. Introduction

Organizations has become increasingly competitive, looking to stand out from the competition and attract new customers. To differentiate in the market, companies seek continuous improvement of alternatives in their products, processes, services and organization management. Along with the improvement, comes the need for innovation showing become an important mechanism for obtaining positive results across the market.

Many important innovations for competitive advantage not involve scientific discoveries. In addition, innovation can have important strategic implications to low-tech as well as high-tech businesses. For Porter (2008) innovation is one of the main ways to compete with the strongest competitors.

To execute innovation projects, many companies seek external financial resources through development agencies. There is the need to obtain the foreign investment that can be through funding, sponsorships government contribution among others. Obtaining those funds to invest in innovation can be improved from the appropriate use of information.

Information plays an important role in the process that involves innovation and information, which is not available to competitors and often the information provided to the market is interpreted in new or different ways (Porter, 2011).

Malerba (2004) points out that one aspect strongly emphasized in the literature is knowledge, to be the basis of technological change and play a central role in innovation.

The innovation enables the development and increased competitiveness of a business, while the Information Engineering provides all the information structure necessary for the organization to achieve the planning objectives, strategy, and development and information management. Thus, the Information Engineering is contributing to innovation in organizations.

Principles of Information Engineering and its methodology are described in various features, which enable you

to balance and organize tasks and ensure the quality and productivity of the development of information systems. The information as a strategic factor promotes a new interface between the information system and the end user. The implementation of the methodology in an organization provides greater productivity among users and engineers of information (Richmond, 1991).

Therefore in this article, we have as a research problem the following question: “How the Information Engineering can contribute to the raising of funds for innovation?”. Thus, this article aims at finding how information engineering can support and improve the process of raising funds for innovation in organizations. For this, an exploratory study is carried out by a systematic review of the literature method. Thereby, this work is justified by the limited approach and structure of information management in innovation, and thus the Information Engineering may be contributing element in this process.

For the realization of this article applies a search through Systematic Literature Review (SLR), in order to identify the contribution of engineering information to obtain funding for innovation. This search was conducted in the main portals scientific research. Boolean codes were used to refine the search, using terms defined according to the research objectives. The best articles and books were selected from the overall results and were read to meet the elements that relate engineering information to the models of investment in innovation. This paper presents a brief theoretical framework, the method used in the research, development of the systematic literature review, the results obtained in the searches and closing remarks.

1.1 Theoretical Foundation

1.1.1 Innovation

Take the constant need to renew and reinvent the company, makes a number of actions to achieve this goal. For this reason, many enterprises seek innovation. Innovate becomes essential for sustainable enterprises, since innovation can generate competitive advantages in the medium and long term, increased productivity, profit and potential for internationalization. Innovation can occur within various contexts in an organization, which it may be in product, process and business model.

Companies obtains and maintains international competitive advantage when making improvement, innovation and modernization. Innovation methods and control technology, comprising new forms of marketing, new products, new methods of production, identification of new customer groups, and so forth. Both innovation as the modernization require sustained investment, to understand the appropriate instructions to change and to perform them (Porter, 2011).

In his work, Cozijnsen, Vrakking and van Ijzerloo (2000) point out that the difference between success and failure in innovation projects are related mostly by implementation factors. In other words, time management, cost management, information management, and decision-making and resistance leadership.

Innovation management takes place in an internal and external environment, where the strategy and organizational structure presents itself as an important aspect of the internal environment of an organization, affecting innovation management practices (Ortt & van der Duin, 2008).

Johannessen and Olsen (2009) argue that, as innovation is seen as the main strategic knowledge resource for companies, the complexity among the business environment is growing along with the need for external information in the creation of innovation. The authors indicate that in this way, innovation cannot be seen only as an internal activity of an innovator, but as a broader process where external information processes play an important role for the innovative potential of the company.

1.1.2 Funds for Innovation

Because of the constant pursuit of development and competitiveness, many companies seek financial resources from direct support to their innovation projects. They can be described two types of mechanisms to support innovation: the direct support, made through fundraising; and the indirect support achieved through tax incentives (Pereira et al., 2013).

In many countries, there are investors and development agencies willing to fund the most innovative entrepreneurs. In order to work together to transform innovative ideas into businesses that will drive job creation and economic growth. It has been the example of the National Venture Capital Association in the United States, the National Bank for Economic and Social Development (BNDES) in Brazil, the Canada Foundation for Innovation (CFI) in Canada, Innovate UK and the Natural Environment Research Council (NERC) in England.

1.1.3 Information Engineering

The prerequisite for the integration of individual knowledge in the company is the existence of information systems, communication and effective learning. The absence of these systems can share the knowledge base of the enterprise-automated actors, who also have difficulty in exploiting the knowledge, and others in the company. This can also reduce the ability of interpretation and transmission of environmental information, which could be crucial to the ability to create and maintain sustainable competitive advantages (Johannessen & Olsen, 2009).

Richmond (1991) highlights the Information Engineering as a competitive advantage, a way to maintain and establish the current market. Moreover, that describes the Information engineering aims to provide the means to react quickly to changing information needs of the organization. In other words, establish the necessary infrastructure that can provide results quickly, and thereafter, allow the creation of efficient systems that are resilient to changes.

To Fusco (2003), the Information Engineering is an interconnected set of automated techniques, in which organizational models, data models, and process models are built in a comprehensive knowledge base in order to use to create and maintain information systems. This way also enables the organization to use the information systems in support of strategic development. The author also points out that the use of Information Engineering methods allow the provision of information to assess the alignment between strategic planning information and the company's business strategy.

In this way, it can describe the Information Engineering as technical tied to the theory, translated by technology that enables engineering. In addition, the information involving the transmission processes description and generation of knowledge. Resulting in a flow of information, managed by systems. Therefore, the Information Engineering performs the study and application technologies, using tools and processes, through planning and structuring seeking improvements.

2. Method

In the management of research, the process of review of the literature is a key tool used to manage the diversity of knowledge to a specific academic research. The purpose of conducting this type of study is to enable the researcher to map and evaluate existing intellectual territory, and specify a research question to further develop the existing knowledge structure (Tranfield, Denyer, & Smart, 2003).

This research refers to a qualitative, theoretical study, characterized as exploratory and used as a method to Systematic Literature Review (SLR). According to Rother (2007) a Systematic Review is a form of research that makes use of bibliographic and electronic sources of information to obtain search results from other authors, to theoretically support a certain goal. Brereton et al. (2007) points out that the goal of a SLR is to extract specific details of previously published articles and relevant to the research topic. For Mulrow (1994), the use of systematic procedures improves the reliability and accuracy of the findings and results of the study.

The steps for the development of research were drawn up as to identify the contributions of Information Engineering and knowledge in innovation systems and innovation investments. To apply the SLR, a research method was elaborated with the steps to be followed (Figure 1).

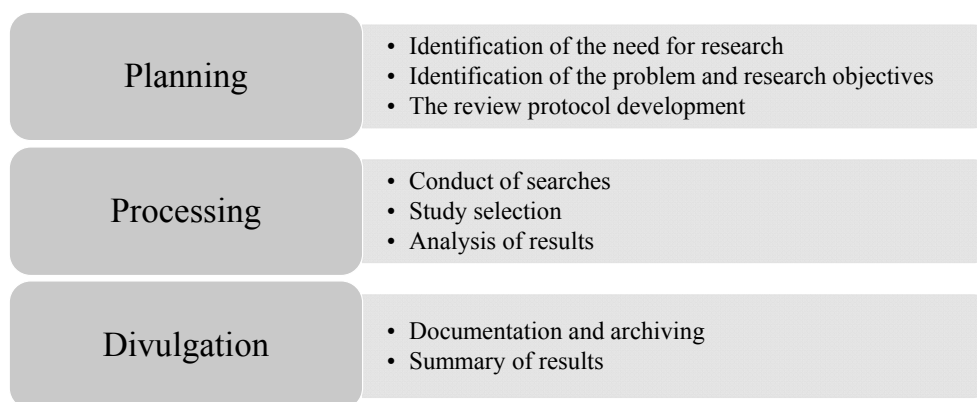


Figure 1. SLR method used in the research

Source: Adapted from Conforto, Amaral and Silva (2011).

Conforto, Amaral and Silva (2011) propose a model of systematic review with three-phases input, processing and output. Each of the phases have different stages, and here are considered some of these steps inserted in the review protocol. The research revision protocol of this article have the following steps:

Preliminary review—An initial search is performed without scientific rigor, to identify articles, journals and databases. The most relevant articles can serve as a basis for defining the keywords and search refinements.

Search string—The creation of the search string follows a process of testing, adjustment and setting. Therefore, we test the combination of words and terms. It uses a database of reference data for this stage of the research.

Inclusion criteria—Define the criteria for inclusion of articles considering the research objective.

Qualification criteria—Evaluate the importance of the article to the study. The purpose of this step is to identify the relevance of the article, the research method and amount of quotes.

Methods and tools—Defining steps for conducting searches, defining the search filters, selection of databases.

2.1 Development of Systematic Literature Review (SLR)

For the development of SLR follows the method described in the previous section. In the section, 2.1 are the phases and steps taken in this research.

2.1.1 Planning

The literature reviewed shows a content with different results in relation to the theme suggested in this work. The relationship between threads becomes somewhat scarce. Many of the results are just part of the theme, showing no issues relate the topics studied here. In this way, seek to clarify information, relate the topic and present the engineering elements of information in the forms of investment in innovation, proved an important activity that can bring the desired results in the research objectives.

Therefore, based on the research problem: “How the Information Engineering can contribute to the raising of funds for innovation?”. This article aims to identify the elements of Information Engineering who can collaborate in raising funds for innovation. The review protocol has the following parameters:

Preliminary review—In this research the most relevant articles were the basis for the definition of keywords and search refinements. It was used as database Web of Science, which through basic research identified the most relevant and most cited papers in relation to the topic discussed.

Search string—Making use of the database mentioned above, the terms and keywords made in the previous step were tested and adapted for obtaining the best search.

Inclusion criteria—In this research the objective is to identify theoretical models that address the issue. Therefore, items that do not present this information is deleted during the read cycle.

Qualification Criteria—For this study was considered to identify the amount of quotes, the relevance of the article to this work and the research method used.

Methods and tools—The steps for conducting this research searches occur as the method described in Figure 1. For the search filters in all databases was considered the use of defined terms in the preliminary review, papers from 2000, because it is a search that covers innovation, and language in English, Portuguese and Spanish. The databases used for the literature search were the Web of Science, Science Direct, Emerald and CAPES, the choice was randomly between available online.

2.1.2 Processing

For the conduct of searches by SLR keywords in order to following research question were identified: “As the Information Engineering can contribute to the raising of funds for innovation?”. The keywords that characterize the subject investigated are “innovation investment” and “information engineering”. However, the term “information engineering” can be identified in other sets of terms such as “information management” or “knowledge management”. Thus, these terms are used in cross-search the database during the search cycles.

For the selection of studies has been applied in the search cycle databases through the cross search terms and the set of read filter according to Figure 2.

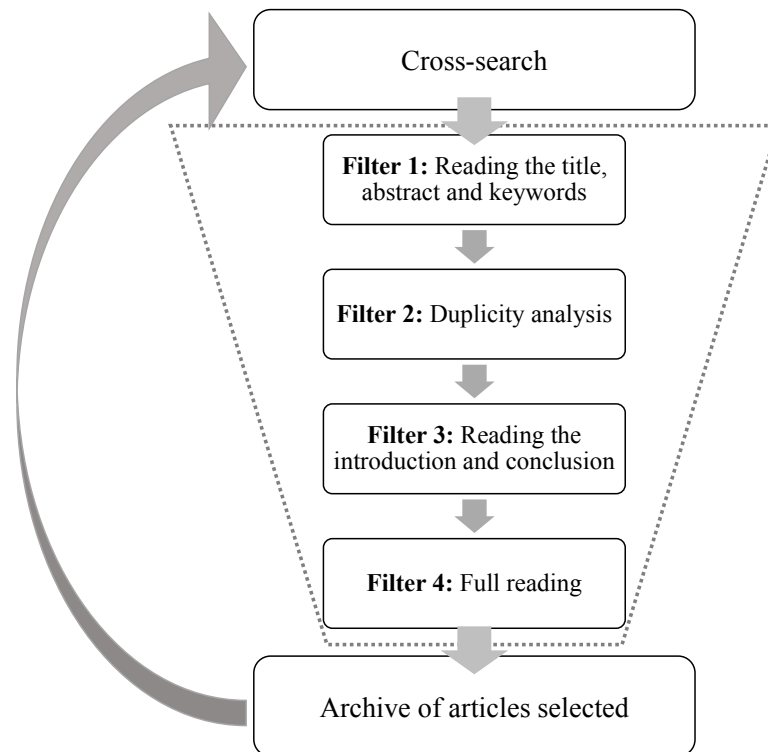


Figure 2. Cycle search in databases

The results of the research are based on the filters of the search cycle. For the research applied the terms of cross-selecting basic research, the search period and language. The first phase of the research focuses on the keywords defined previously, the result obtained 1539 papers, distributed in their databases. Search filters applied aim to select items that are aligned with the research objectives and adhere to the inclusion criteria. The application the filters occur in second phase of research method.

Table 1 shows the keywords used, the amount of work obtained from the databases during the search and the filtration process used.

Table 1. Keywords used in bases with the results of search and filtering

Databases		Found work
Keywords Phase 1	innovation investment AND information management	732
	innovation investment AND information engineering	113
	innovation investment AND knowledge management	690
Total research still without filters		1539
Filters Phase 2	1° - Read the topics, summaries (less 1431 articles)	108
	2° - Excluding duplications (less 12 articles)	96
	3° - Read introduction and conclusion (less 67 articles)	29
	4° - Full reading (less 7 articles)	22
Total adherents research		22

For applying the first filter, the themes of the works were analyzed, the key words and reading the summaries. The topics that are not related concurrently with investment in innovation and engineering information, using the latter term the variables of information management and knowledge management, were excluded resulting in

1431 papers not relevant to the subject.

The second filter analyze the duplicity, considering the 108 apparently relevant works. It is observed in the analysis that some searches are indexed in more than one database; therefore, they were excluded from 12 duplicate works.

For the 92 remaining works, the third filter has been applied, with further analysis, which were held readings of introduction and conclusion of each job. Search to identify studies that may contribute to the objective of this research. The result of this filter presented 29 papers relevant to the answer to the research question formulated.

Then applies the fourth filter, where 29 works selected previously undergo a thorough reading and when there is need excludes those who for some reason differ goal. At this stage, there were seven deletions. The end of the survey cycles resulted in 22 papers aligned to this article.

2.1.3 Divulagation

The documentation and archiving step is to catalog and archive the works selected in the filters. This process can be accomplished through reference management software, according researcher definition. They are documented the amount of items found, number of excluded items, variations of the terms used, among other items relevant to the authors.

For the synthesis of the results, it was decided to draw up a comparative table with the list of items related to each engineering information and investments for innovation. The table also describes the authors and publication year.

3. Results

For the 22 adhering works to the terms, it was possible to identify the Information Engineering present in the process of attracting investment in innovation, and some elements used for each work. The results synthesis are shown in Table 2.

Table 2. Summary of research results

Information Engineering in fundraising for Innovation			
Authors	Investment	Information	Process
Wang & Chang (2006)	Considers substantial investment	Implementation of Knowledge Management (KM) as a form of innovation, profit accumulation and increased competitiveness.	Structured
Pai & Chang (2013)	It presents low or high investment purposes	Conceptual model of knowledge management effects on the performance of organizational innovation.	Unstructured
Masso, Roolaht, & Varblane (2013)	Discusses foreign direct investment	The model allows estimation of the equation spending on innovation, the production function of knowledge and productivity equation.	Structured
Wang, Wang, & Horng (2010)	Completed research in and development	SMEs capabilities in exploiting the prevailing bulk of organizational resources since knowledge acquisition and absorption	Unstructured
Hotelano (2011)	Applied and described	Consider the sources of knowledge, types of investment in innovation and activities, and methods to manage innovative projects such as inputs needed for innovation.	Structured
Correa, Yepes, & Pellicer (2007)	Reports that in the construction sector is lower than in other sectors	Proposal for an innovation management model for construction companies to facilitate information flow within the organization.	In structuring
Silva, Simões, Sousa, Moreira, & Mainardes (2014)	Financial investment in important services	The larger the financial investment in the acquisition of infrastructure, the acquisition of external knowledge, among others, the greater the	Unstructured

		propensity innovation in services.	
Mambrini, Dattein, Medina, Cintho, & Maccari (2011)	Strong investment highlighted as innovative practice	Practices that excels in innovative culture: strong investment and incorporation of new knowledge; speed and agility on the uptake and implementation of new knowledge and technologies, among others.	Unstructured
Un & Sanchez (2010)	Theoretical framework of how companies invest in innovation	As companies, develop the capabilities to mobilize and create knowledge for innovation, as a business activity and the management of change in organizations.	Unstructured
Zhao, Yu, Xu, & Bi (2014)	Only foreseen the relation between elements	It appears that the specific investment ratio allows information to be shared among employees, resulting in effective coordination and improving the performance of cooperative innovation.	Unstructured
Vieites & Calvo (2011)	Only lists the topics	Information management is shown as the most important factor of innovation. Moreover, the results of innovation and information management influence on business results.	Unstructured
Allred & Swan (2005)	Reports on the influence of investment in innovation	Model of industrial structure developed and tested to better understand their influence on investment in innovation and company performance.	Unstructured
Mezhov, Rastova, & Shmatko (2014)	Evaluate investment strategies	Tools and mechanisms to improve innovation management based on new methodological approaches.	Unstructured
Kadar, Moise, & Colomba (2014)	Only lists the topics	Development based on knowledge requires investment in research, development, education, and the creation of a favorable environment for innovation.	Unstructured
Kauffman, Liu, & Ma (2015)	It illustrates how to identify effective strategy for investment	States that the great investment opportunities for organizations are the innovations that involve information technology.	Structured
Santos, Basso, Kimura, & Kayo (2014)	It depends on the effort to innovate	The management of information is presented in a subtle way; it means the need for collection and transfer of information to obtain the results.	Unstructured
Jbilou, Landry, Amara, & Adlouni (2008)	Only lists the topics	Organizational innovation is highly dependent on the ability and investment in knowledge management (internal and external) to support the decision-making process and to implement significant changes.	Unstructured
Wang, Butler, & Hsieh, Hsu (2008)	Only lists the topics	Describes the use of innovation in information technology to sustain performance tasks.	Unstructured
Johannessen & Olsen (2009)	Attracting investment through structuring	Vision and understanding of systemic process of knowledge for innovation and promoting sustainable competitive advantages.	Unstructured
Cozijnsen, Vrakking, & van Ijzerloo (2000)	Only lists the topics	The influence of information management on projects that have succeeded in innovation.	Unstructured

Hana (2013)	Citation	Shows need for updated knowledge, information and innovative team, to follow the large organizations that are dedicated to innovation and set their own direction.	Unstructured
Ortt & van der Duin (2008)	Only lists the topics	The role of information in the innovation process and communication with stakeholders during the decision process.	Unstructured

4. Discussion

This research aimed to identify the contribution of Information Engineering in the processes of innovation investments. All works that met the specifications and previously established search criteria were selected in read cycles. To note that a large part of the work there is a dependency relationship of the terms, as for companies to succeed in innovation, many studies suggest the need for systematic organization of information and knowledge.

Many studies also reveal the importance of implementing knowledge management, or other form of information management before making objectives relating to innovation, and even before investing financial capital. Studies show that owning the management of information and knowledge to innovate is one way of ensuring a return on invested financial resources.

By the results obtained, it appears that in most articles, about 82%, there is no structure to the process of attracting investment for innovation. There is a discussion regarding the matter, but without a system or procedure that can lead to obtaining resources. Studies on the targeting of resources for innovation are scarce and superficial. The most present results report that for a company to be competitive in the market should hold a management adequate information to be able to fulfill the innovation projects and conquer investments. In addition, many of these works present the best innovative results are due to funds used in the project.

Therefore, the results show that the ability to manage information has a positive and direct influence on the performance of organizational innovation. Moreover, the results of innovative projects are directly related to the applied investment. Thus, the informational management becomes an essential element in the decision-making in corporate strategies. When evaluated several factors to achieve innovation, information management proves to be the most important factor to be considered, followed by the capital invested. In addition, when it is about financial performance of an organization, both information management and knowledge as aspects of innovation are key to the results.

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