

Innovation Management in IT Industry

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Abstract: The extraordinary growth of the information technology (IT) industry has had innovation as a key element, motivating research on innovation management. The objective of this study is to organize and analyse the literature on innovation management in the IT industry. Through a systematic mapping study (SMS), 7259 studies were obtained of which 76 studies were selected and classified. This SMS made it possible to structure the knowledge developed in categories: research topics, types of research, contribution, research methods and bibliometric characteristics. The studies were mostly focused on the operations, organizational context, and support for innovation. In addition, a greater number of philosophical articles were found. Among the most used research methods were surveys, interviews, case studies, and literature reviews. Also, the frequency of published articles shows an increasing trend, especially in recent years. Finally, This SMS provides information on spaces that are still pending to be investigated or amplified.

Keywords: innovation; innovation management; ISO 56002; information technology; IT; IT industry; systematic mapping study; SMS; mapping; review; management

Submitted: January 3rd, 2022 / Approved: July 18th, 2022

1. Introduction

Information technology (IT) solutions provide companies with a differentiating element and a source of competitive advantage (Shao & Lin, 2016). These solutions have been forming part of the value chain, improving the products and processes that are carry out (Kohli & Melville, 2009; Phuttima et al., 2013). Achieving an impact on organizations, generating value, reducing costs and increasing economic performance (Aguilar et al., 2010; Moutinho et al., 2015). This has made it possible to assess the importance of IT and the growth of the IT industry (Bardhan et al., 2010). Growth is reflected in the increase of IT solutions and their participation in the different sectors, whether due to software, hardware, interconnected data, processes, creating new products or improving existing ones (Baller et al., 2016; Jamous et al., 2017; Kohli & Melville, 2009).

As IT has been innovating, it has been driving technological progress and the growth of industries in all sectors (Shao & Lin, 2016). An example of this is the growth of electronic commerce, which has been achieved thanks to the transformation and optimization of IT innovations (Demirkan, 2015). The application of innovation has reinforced the use of IT in organizations (Ordanini & Rubera, 2010). However, despite the contribution that innovation offers, there is little research on innovation in the IT industry (Shao & Lin, 2016). Innovation management is a mechanism that contributes to success and expected performance (Biancolino et al., 2013), so companies must incorporate the innovation approach as part of their management (Murphy, 2016). However, the creation of innovation strategies or the definition of an innovation process, which can be incorporated into its mana-

gement, are not always carried out (Sundbo, 1997) the strategic innovation paradigm is the most adequate to explain service innovations. Innovation management is a mechanism that contributes to success and expected performance (Biancolino et al., 2013), so companies must incorporate the innovation approach as part of their management (Murphy, 2016). However, the creation of innovation strategies or the definition of an innovation process, which can be incorporated into its management, are not always carried out (Sundbo, 1997). In this sense, innovation management allows to formalize and organize innovation processes, facilitating organizations to develop innovation activities in a systematic way (Pinheiro & Tigre, 2015).

According to bibliographic searches on innovation management, a low volume of studies in the field of IT is perceived. In addition, no systematic review of studies on these topics has been found. Therefore, the objective of this study is to have a vision on the state of knowledge regarding innovation management in the IT industry. It is expected to identify the topics that are being studied the most, those little studied or pending investigation. To achieve this knowledge, we have decided to work on a systematic mapping study (SMS), motivated in getting as much literature as possible. It was decided to adopt the formal process for an SMS defined by the authors (Petersen et al., 2015).

This document is structured as follows: in Section 2, the theory background is described to understand the motivation for the development of the SMS; in Section 3, the research methodology is presented; in Section 4, according to the research questions, the results are described; in Section 5, the results are discussed; and in Section 6 the conclusions are presented.

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2. Theory Background

Innovation is defined as a new or improved product or process (OECD/Eurostat, 2018), whose development, according to (Tidd et al., 2008), requires a human team, activities and tools integrated into organizational aspects. Therefore, it is necessary an adequate innovation management (Mantovani et al., 2013). Likewise, the execution of the innovation process may be affected by aspects of the external context (for example, market information, technology, consumers); and aspects of the internal context (difficulties in the generation and selection of ideas, the lack of qualified personnel, and the coordination, among others) (Nagano et al., 2014; Vega et al., 2022). In this sense, innovation management helps reduce the impact of these aspects. In the bibliography, it has been found that there were failures in innovations due to lack of adequate management (Tchuta & Xie, 2017).

For innovation management, models such as UNE (UNE 166002:2014. Gestión de La I+D+i: Requisitos Del Sistema de Gestión de La I+D+i, 2014), Temaguide (COTEC, 1999), CEN/TS 16555 (UNE CENT/TS, 2006), and ISO 56002 (ISO, 2019), among others, have been developed. However, these models are not fully applicable because of the diversity of contexts that industries have (Kitsuta & Quadros, 2017). This situation also occurs in the IT industry, we observe studies such us: proposals for innovation models integrated

into other process models (Eito-Brun, 2017; Kießling et al., 2010), the application of innovation processes in some companies (Galina et al., 2016), or the adoption of innovation management practices (Kitsuta & Quadros, 2017; Weber et al., 2017). These studies help to improve the understanding of innovation activities, therefore, to improve the competences and the results of innovations. From the above, there is the motivation to review the current state of research on the innovation management in the IT industry. Likewise, organize the studies and determine the topics developed, and the knowledge gaps that motivate new studies.

3. Research Methodology

According to (Kitchenham & Charters, 2007) SMS offer an overview of a research area through categorization, which allows knowing the topics that have been investigated and those spaces not yet worked on. For the development of the research, the formal SMS process proposed by (Petersen et al., 2015) was adopted. The development of this process is described below.^{3.1}

3.1 Research question

In Table 1, the research questions are described in order to categorize and structure the existing literature on innovation management in the IT industry.

Table 1: Research questions.

| College | Motivation |
|--|--|
| RQ1: What are the main topics of innovation management in the IT industry? | Identify the innovation management topics in the IT industry and their frequencies in the scientific literature. |
| RQ2: What types of research and contributions have been made? | Provide information on the types of research most used and the main types of contributions that have been obtained. |
| RQ3: What research methods have been applied in the studies? | Know the research methods most used according to the types of research developed. |
| RQ4: How has the evolution of the studies been over time and what have been the main sources of publication? | Review the trend of studies and types of publications over time. Likewise, know the sources where the authors usually make their publications. |

3.2 Search strategy

The search string was developed from two components: population and intervention (Kitchenham & Charters, 2007). These components were chosen to avoid restrictions and to have as many studies as possible. The keywords considered and the structured search string were:

Population: "IT", "information technology", and "software".

Intervention: "innovation management".

Search string: ("IT" OR "information technology" OR "software") AND "innovation management".

For the selection of digital databases, the recommendations of (Barney et al., 2012) were considered. These databases were: ACM Digital Library, IEEE Xplore, Scopus, Web of Science. In order to have greater coverage of studies, the following were included: EbscoHost, Emerald, Proquest, and Science Direct. The article search was in May 2021 and updated in November 2021.

3.3 Study selection and data extraction

The selection process had three steps in which exclusion (EC), and inclusion (IC) criteria were applied. Table 2 shows the details and the results obtained.

Table 2: Selection process.

| Description | Criteria | Number of studies |
|---|--|-------------------|
| Obtaining studies (previous section) | Search string execution. | 7259 |
| Step1. Studies are pre-selected | EC1: Exclude studies that are not in English, Spanish, or Portuguese. EC2: Exclude studies that are not published in indexed journals, conferences and book chapters. EC3: Exclude repeated studies. | 5913 |
| Step 2. Titles are reviewed | IC1: Consider studies whose titles focus on the main objective of the research. | 870 |
| Step 3. A quick review of each study is performed | IC2: Consider the studies whose summary, methodology and conclusion are related to the research questions | 76 |

At the end of the selection process, 76 studies were obtained, with them, the data extraction of each study continued. A form was developed to record the following data: study title, authors, year of publication, type of publication, source of publication, research method, language, abstracts, and keywords.

3.4 Classification scheme

To carry out clearly and systematic, the synthesis and analysis of the studies, the data extracted from the 76 studies were categorized and

structured. According the recommendations of (Petersen et al., 2015), one specific category and four general categories were considered. In each category, the classifiers proposed by some authors were taken as a basis; however, not all were used, these classifiers are described below.(1)

(1) Specific categorization

Research topic. The elements defined in ISO 56002 standard (ISO, 2019) were taken (see Table 3).

Table 3: Description of research topics.

| Element | Description |
|-----------------------------|---|
| Context of the organization | Refers to the internal and external context of the organization. Defines the scope of the innovation management system, and aspects such as culture and collaboration. |
| Leadership | Involves the leadership and commitment of senior management. The definition of strategies, policies, roles, responsibilities and authorities for innovation. |
| Planning | Includes the definition of innovation objectives and their planning, the identification of risks and opportunities. Also, the definition of organizational structures and innovation portfolios. |
| Support | It refers to the people, time, knowledge, finances, and infrastructure necessary for innovation. In addition, skills, communication, awareness, document management, strategic intelligence, and intellectual property. |
| Operation | Involves mainly the definition of the innovation creation process (generation of ideas, validation of ideas, development, and deployment of innovation). |
| Performance evaluation | It includes activities of monitoring, measurement, analysis, evaluation and internal audits of the processes. |
| Improvement | Refers to activities for the continuous improvement of the processes. The identification and treatment of non-conformities. |

(2) General categorization

Research type. The classifiers defined by the authors (Wieringa et al., 2006) were considered (see Table 4).

Table 4: Description of research types.

| Element | Description |
|----------------------|---|
| Evaluation research | The study reviews the use of a solution and present the results of its application in a real environment. |
| Solution proposal | The study proposes the solution to a problem, it may be novel or a significant extension of an existing technique. It does not carry out a complete validation. |
| Philosophical papers | The study presents a new way of looking at things through a taxonomy or conceptual framework. |
| Opinion papers | The study presents the author's opinion on the research topic. It is not based on related research or work methodologies. |

Contribution type. For this category the taxonomy described in (Paternoster et al., 2014) with the proposal of (Theisen et al., 2017) was used (see Table 5).

Table 5: Description of contribution types.

| Element | Description |
|----------------|---|
| Model | Generalization obtained in a conceptualization process about an observed reality and based on concepts. |
| Theory | Study whose result comes from cause-effect relationships. |
| Framework | Study referred to the process for product development. |
| Lesson learned | Study containing recommendations obtained and analyzed from a previous investigation. |
| Guideline | Group of recommendations. |

Research method. The classifiers were all those mentioned in the studies, among them: survey, interviews, case study, focus group, observation, action research, and literature review.

Types of publication. The criterion EC2 was considered.

Note that, in the case of the type of research, contribution and publication, the studies have a unique classification, while in the rest of the categories may contain more than one classification (The following link shows additional information about the 76 studies <https://drive.google.com/drive/u/2/folders/1m9KrYc-yRONyruVO7FdmC2FsyR-1TiAsn>).

3.5 Threats to validity

In the development of the SMS, some threats to the validity of the study were identified, which could affect the credibility of the results.

Validity of the construction. It is related to the identification of studies (Elberzhager et al., 2012). In our research there was the possibility of detecting few studies. In this case, we use the recommendations of (Kitchenham & Charters, 2007) and identify keywords from related studies. With this, the search string had the possibility of a greater number of studies. In addition, multiple databases were used, although there is the possibility that there may be publications in some non-consulted database. To standardize the study selection task among the researchers, the process was based on exclusion and inclusion criteria.

Internal validity. It is related to data extraction and analysis (Elberzhager et al., 2012). This threat was mitigated with the creation of a form to record the data of each study, and the category scheme for data synthesis and understanding of the results. As it is a work of the SMS type, an in-depth review of the studies is not required, however, in some studies this activity was carried out to ensure a better understanding. An expert researcher reviewed the results of each stage.

External validity. It has to do with the generality of the results (Easterbrook et al., 2007). In our case, no generalizations were made, therefore, this threat does not apply.

3.6 Limitations of the study

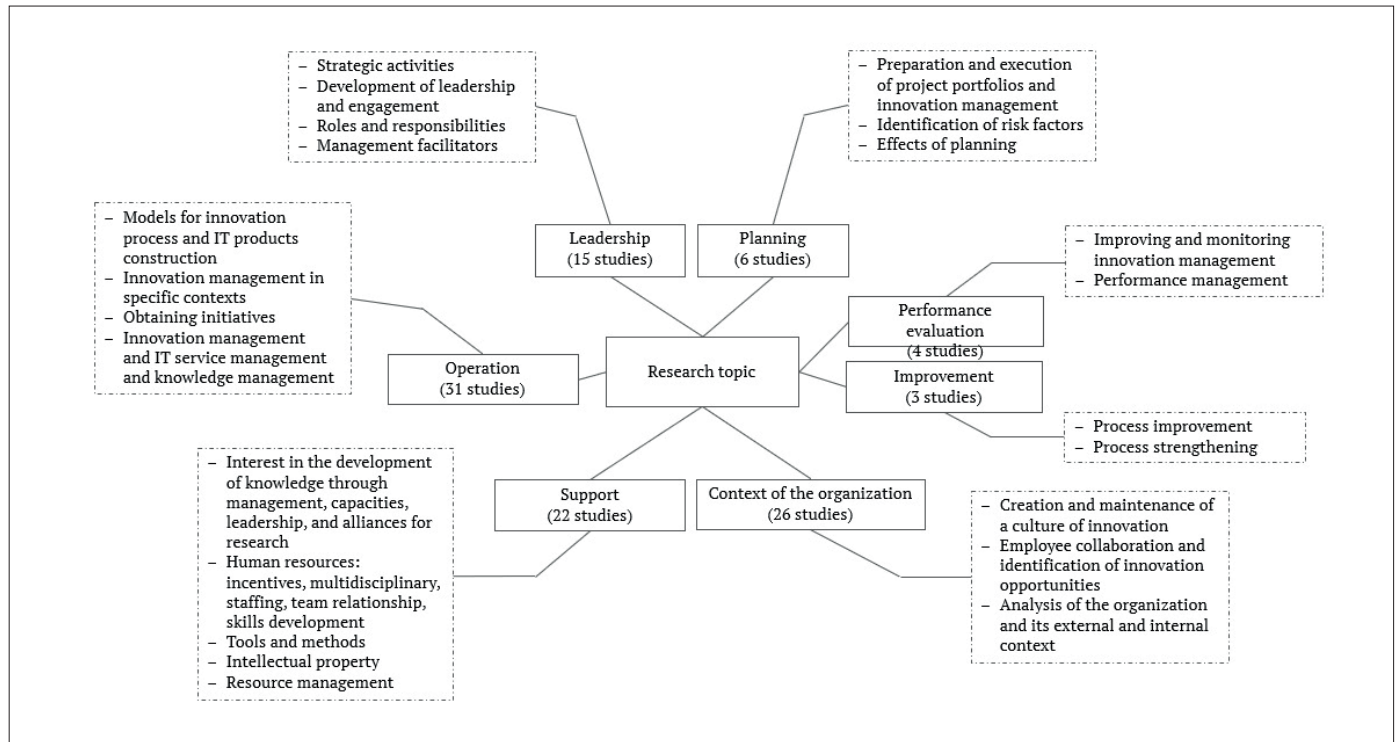
Our study has some limitations related to the validity described in Section 3.5. The main limitation was the level of depth in the review and analysis of the data, although this is not considered a serious limitation, because our objective was to map the topics under investigation. However, some considerations were made: (i) a methodology was applied according to the authors (Petersen et al., 2015), (ii) some studies were reviewed in greater detail to improve understanding and data analysis, and (iii) an expert researcher participated as advisor and reviewer at each stage of the research.

4. Results

Based on the analysis of the 76 studies, the research questions are answered as follows.

RQ1: What are the main topics of innovation management in the IT industry?

To answer this question, the classification by research topics was chosen in accordance with the elements of ISO 56002 (Section 3.4). It was observed that most of the studies are related to the research topic of operation (42.1%), the context of the organization (34.2%) and support activities (30.3%). On the other hand, fewer studies were found on leadership (19.7%), planning (7.9%), performance evaluation (5.3%) and improvement (3.9%). It should be noted that some studies were considered in more than one research topic. The number of studies found for each research topic and the main findings are shown in Figure 1.

Figure 1: Main findings in each research topic.

Some studies were classified in more than one research topic. In Figure 2, it can be observed that the topic of the context of the organization has a great relationship with other topics, mainly with leadership, support and operation. The organizational context aims to establish the innovation management system, so the contribution of leadership is necessary for the definition of strategic activities that promote the development of culture, collaboration and commitment. In relation to support, issues of resource management, development

of knowledge and skills stand out. In addition, the relationship with the operation topic is given by clarifying the process for the creation of the innovation. That is why there are studies with suggestions of innovation models and obtaining innovation initiatives initiatives.

Finally, a relationship was also found between the topics of support with operation and support with leadership (Figure 2), in both cases it is due to the management of resources and mainly due to the management of people, knowledge and communications.

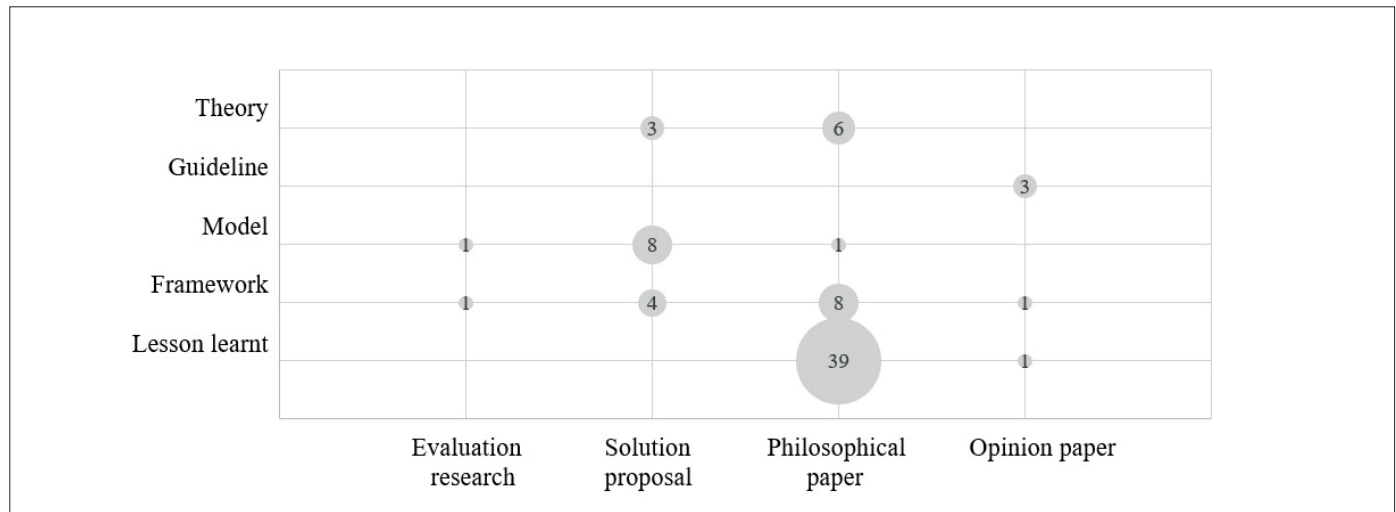
Figure 2: Number of studies according to research topic.

| | Context of the organization | Leadership | Planning | Support | Operation | Performance evaluación | Improvement |
|-----------------------------|-----------------------------|------------|----------|---------|-----------|------------------------|-------------|
| Context of the organization | 26 | 6 | | 5 | 4 | 1 | |
| Leadership | 6 | 15 | | 5 | 2 | 2 | |
| Planning | | | 6 | 3 | 4 | 1 | |
| Support | 5 | 5 | 3 | 22 | 5 | | 1 |
| Operation | 4 | 2 | 4 | 5 | 31 | 2 | 1 |
| Performance evaluación | 1 | 2 | 1 | | 2 | 4 | |
| Improvement | | | | 1 | 1 | | 3 |

RQ2: What types of research and contributions have been made?

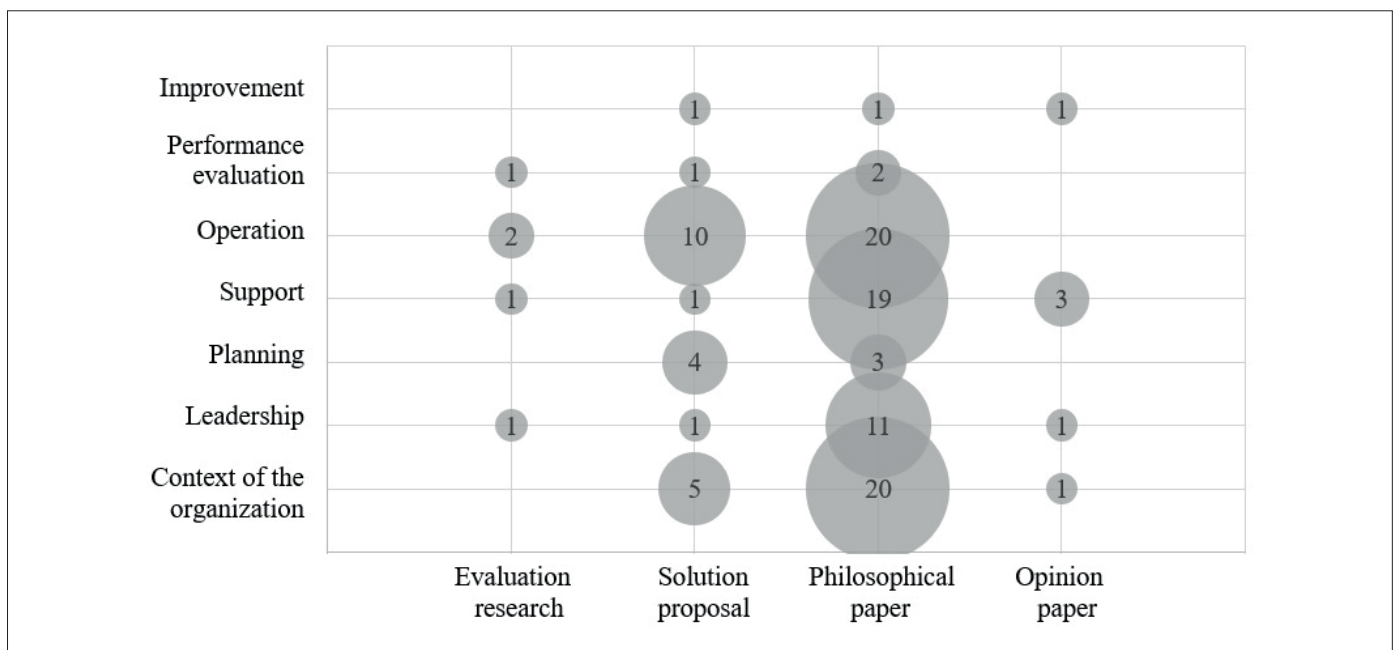
According to the types of research (Section 3.4), it was found that the most frequent are philosophical documents (71%), followed by solution proposals (20%). On the other hand, there was little presence of

opinion papers (7%) and evaluation research (3%). In the case of the types of contribution, most of the studies were lessons learned (53%), followed by frameworks (18%), models (13%) and theories (12%). Very few studies were of the guidelines type (4%). The distribution of the results can be better appreciated in Figure 3.

Figure 3: Number of studies per research type and contribution type.

In Figure 4, it was observed that the philosophical documents have allowed the development of research, mainly lessons learned

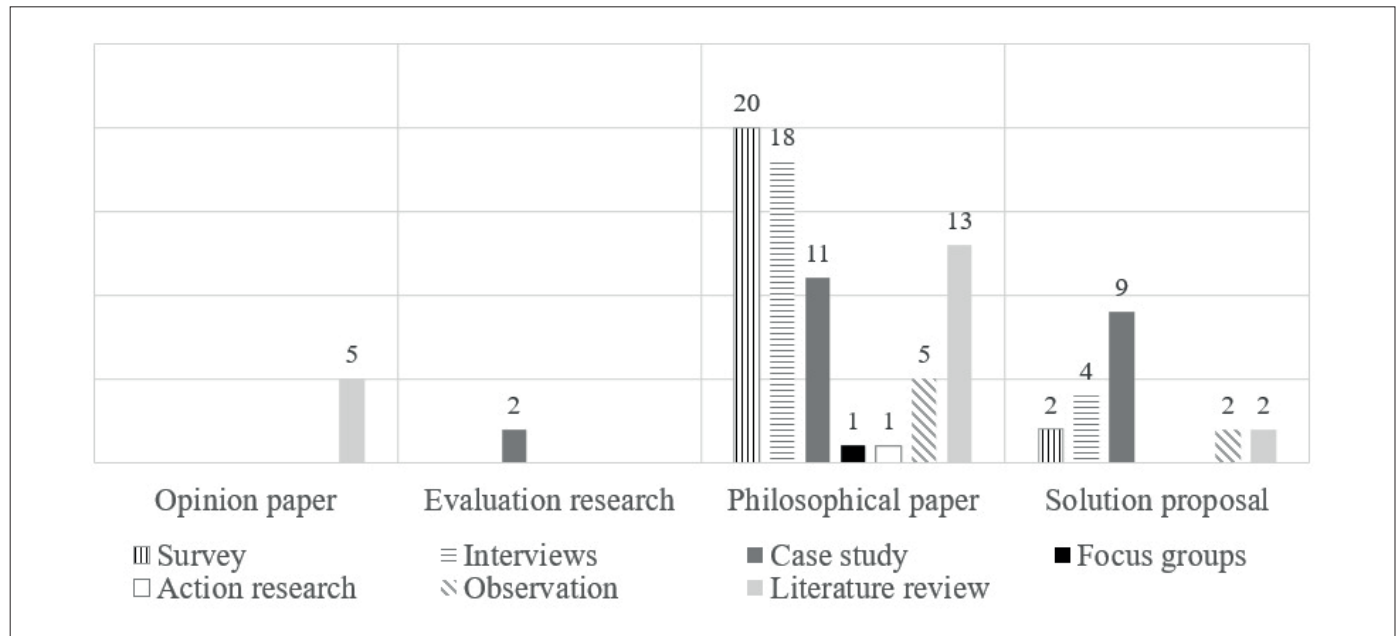
on topics of operation, the organizational context, and support.

Figure 4: Number of studies per research type and research topic.

RQ3: What research methods have been applied in the studies?

The most widely applied research methods were surveys, interviews, and case studies (22 studies in each method) followed by literature reviews (20 studies). The opposite occurred with the methods obser-

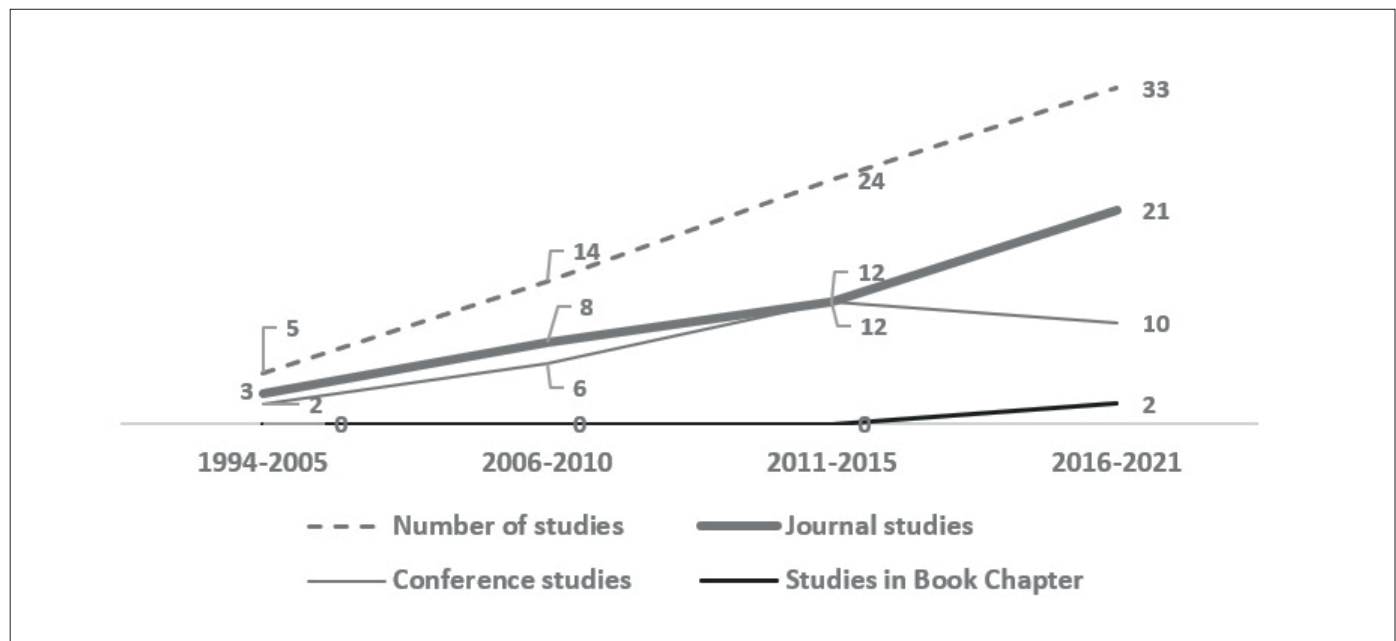
vation, focus groups and action research. Figure 5 shows that the philosophical papers used a greater variety of research methods, mainly the surveys, interviews, literature reviews, and case studies. In addition, in the solution proposals and evaluation research, the case study was the most applied method.

Figure 5: Number of studies per research method and research type.

RQ4: How has the evolution of the studies been over time and what have been the main sources of publication?

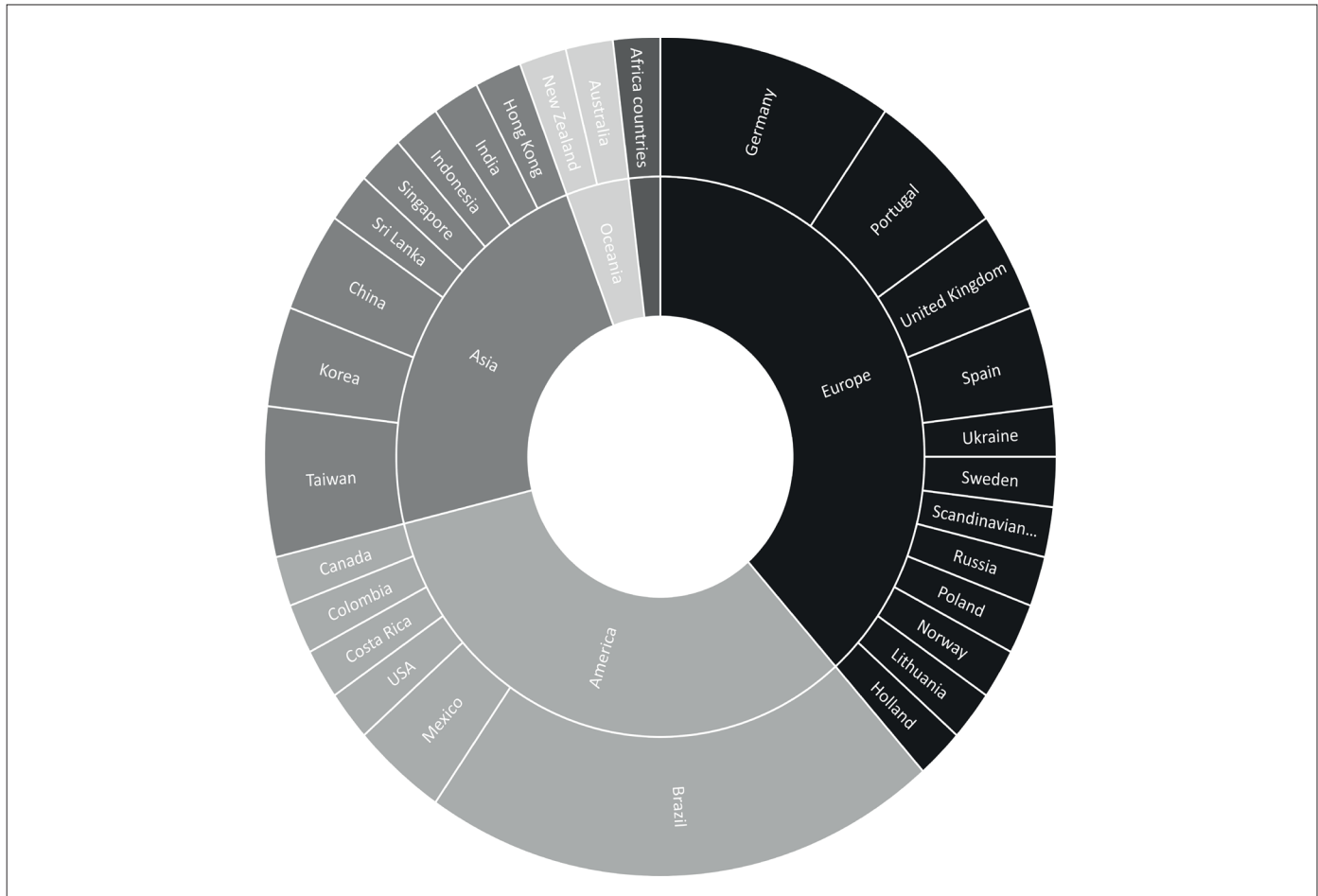
In the searches for primary studies, no filters were performed on the year of publication. Figure 6 shows that the presence of studies has been developing since 1994, observing a growing trend in recent years. Which shows us that there is an interest in this field of research. It is also demonstrated by the publication of the family of ISO 56000 standards, several of them between 2019 and 2020, and others under development.

The type of publication with the highest number of articles was journals (44 studies), followed by conference articles (30 studies) (see Figure 6). Recurring publication sources were not found. Only a few journals presented at most two studies, for example: Asian Journal of Technology Innovation, Communications in Computer and Information Science, European Journal of Innovation Management, IEEE Software, Technology Innovation Management Review, Technovation. Similarly, in the case of conferences the following were found 5th IEEE International Conference on Management of Innovation and Technology, ISPIM Conference and the European Conference on Knowledge Management.

Figure 6: Number of studies per year.

Additionally, the continents and countries of origin of the articles were explored (Figure 7). Some results aim that 26% of the studies were from European countries, with Germany standing out with 5 studies; followed by America with 22%, where the largest number of studies (11 studies) were from Brazil; and 16% were from Asia, mainly Taiwan (3 studies). In lower percentage were Oceania with 3% and Africa with 1%. It should be noted that 38% of the studies did not mention the country of origin and some studies were carried out in more than one country. These results are consistent with the World Intellectual Property Organization's 2021 World Innovation Index (OMPI, 2021), in relation to results at the continent level. The index highlights countries from Europe, America, and Asia.

Figure 7: Number of studies per country and continent.



5 Discussion

Based on the results obtained, it is determined that, although innovation is a topic coined since the last century, the process and management of innovation, for the IT industry, is a topic of greater interest in recent years in different countries of the world. Figure 6 shows that the publication of articles has a growing trend, 43% (33 studies) of the publications were presented in the last six years.

If we look at the research topics defined, the topic that demands the most interest is that of operation (42.1%), whose studies refer to the innovation process and management and their relationship with the construction of IT products. More specifically, the relationships discussed are innovation management with the product development process, IT service management, and IT governance. Other

relationship, also of greater interest, were aimed at facilitating innovation management through aspects of the organizational context and support activities for innovation (Section 4.1). Therefore, it is observed that the investigations are focused on structuring the innovation process and management to adapt them to the characteristics of the IT industry.

The second research topic of greatest interest is the context of the organization. In this topic, the studies highlight the creation and maintenance of a culture of innovation, as suggested by the ISO 56002 standard (ISO, 2019). Another relevant element is collaboration, between workers and external stakeholders, whose information contributes to the creation of innovation strategies. Likewise, we observe that the internal aspects of the organization (such as the structure and administrative processes) and external aspects (such as govern-

ment policies and the relationship with relevant industry institutions, also suggested by (Aranha & Carvalho, 2022)) are meaningful because they have effects on the capacities of the organization to generate innovation.

In the case of research topic on innovation support, the studies focused on people and knowledge. In this regard, the studies suggested improving the skills and knowledge of the teams, if necessary, carry out training. Other suggestions are to have multidisciplinary teams, provide incentives and support tools. Thus, it is observed that there is a concern to investigate the provision and improvement of the human resources needed to manage and produce innovation. These support activities are facilitated with the fulfillment of the activities of the organizational context and contribute to improve the development of operating activities for the creation of innovation.

The relationship between the three previous topics justifies the presence of a greater number of studies. It is perceived that the studies show us a broad interest not only in knowing and improving the innovation creation process but also in investigating those themes that are related to the operation or the creation process. In fact, manipulating one of them impacts innovation performance.

On the other hand, little attention has been observed in the research topics on leadership (19.7%), planning (7.9%), performance evaluation (5.3%) and improvement (3.9%). In the case of research topics on leadership, the ISO standard is aimed at company managers, as articulators of management. Therefore, the studies focused on management and communication skills, proper leadership and autonomy in management. Although, the four topics mentioned have few studies, this may be due to the recent presence of the articles (mainly in the last decade), in which the main concern in the investigations has been about the innovation creation process and the management activities that impact the process.

In the types of research and contribution, it has been possible to observe a greater interest in philosophical documents, especially contributions such as lessons learned and frameworks. Lessons learned presented recommendations on innovation management, IT service management, and software development. Likewise, the frameworks described and applied proposals for the innovation management related to software development. In both types of contributions, the research topic on the operation is appreciated. On the other hand, in the type of research on solution proposals there were few studies, 20% (15 studies), however, it can be noted that more than half of these studies presented proposals on models related to innovation management. In the case of opinion papers and evaluation research, the number of articles was much lower. The studies presented suggestions for the provision of resources and project management. In other words, the research aimed to improve the practices of those internal support processes that contribute to innovation.

It has been perceived that the most developed topics were operation, context of the organization and support, which are mostly of the philosophical document type. It can be argued that the studies, in these

classifications, show that there is an interest in developing conceptual structures around the research field. In this sense, the studies provide opportunities to expand existing knowledge, for example, through validations and evaluations of works already developed.

Finally, it was observed that the research methods used, especially in philosophical documents and solution proposals, were interviews, surveys, and case studies. Which shows us, for this field of research, the usual methods to know and evaluate the various problems, as well as to test and analyse the solution proposals.

6. Conclusions and future work

An SMS on Innovation Management in IT Industry has been developed. The study was carried out following the guideline of (Petersen et al., 2015), through which 76 primary studies were obtained. It was observed that, in the IT industry, the studies on innovation management are relatively new and in diverse themes. 52 studies were from the last 10 years and 31 studies were published in journals, observing a growing trend. Likewise, a strong interest was found in countries of Europe and America.

In the research topics, whose classification was carried out according to the ISO 56002 Standard, predominated the organizational context and the operational and support activities. A relationship between those topics was found. These investigations are mostly related to the innovation creation process. Likewise, the types of research that stood out the most in number were the philosophical documents and the solutions proposed whose contributions were mainly the lessons learned and the models. These demonstrate the interest of researchers in proposing good practices and schemes that improve management in this field of research.

The least researched topics were leadership, planning, performance evaluation and process improvement. It may be because it has not yet been possible to cover all the topics due to the recent boom of the publications. We agree with (Shao & Lin, 2016), that there is still little research on innovation in the IT industry.

Finally, the types of research were supported by various research methods such as: surveys, interviews, case studies and literature reviews, especially in philosophical documents and solutions proposed.

From the above, we conclude that innovation management research for the IT industry is growing. The research space on innovation management in the field of IT is wide and with various topics still to be investigated. As future work is the in-depth review of the studies on the practices and models in the topics of operations and the organizational context with the aim of being applied in real contexts.

Acknowledgement

Our thanks to the Huiracocha Doctoral Scholarship Fund of the Postgraduate School of the Pontifical Catholic University of Peru, and Software Engineering Research and Development Group of the Engineering Department of the Pontifical Catholic University of Peru.

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