

Review

Innovation Management Systems and Standards: A Systematic Literature Review and Guidance for Future Research

M-Chukri Idris * and Alptekin Durmuşoğlu 

Department of Industrial Engineering, Gaziantep University, 27310 Gaziantep, Turkey; durmusoglu@gantep.edu.tr

* Correspondence: shekry@gmail.com

Abstract: In order to establish an innovation culture, a set of organizational procedures and practices called “Innovation Management”, which may differ among companies, should be followed. At the enterprise level, systematic innovation management becomes more complicated. A number of works covering various aspects of this subject have been published. However, a systematic synthesis of all of these contributions is still lacking in management literature. In this review, we aim to analyze and classify the main contributions published on the topic of innovation management systems/standards in management literature, seeking to discover the gaps which still remain in the literature, and to outline future avenues of research in this domain. More than 70 articles in Innovation Management Systems/Standards (IMS/St) studies published in peer-reviewed journals during 2006–2020 are reviewed and analyzed systematically by searching the science databases ScienceDirect, Scopus and Emerald, etc., and using Google Scholar and Mendeley Elsevier to identify related terms. A complete and accurate view of the latest literature on IMS/St is provided, which identifies the main topics developed in the management literature on IMS/St, as well as significant gaps, and demonstrates the low maturity level of the current state of the field. This paper contributes theoretically to the development of literature on IMS/St and provides a clear understanding of the state of the field during the period 2006–2020, shedding light on the research needed in the future in this field of study. From a managerial perspective, it can help companies to better understand the implications of IMS/St, and to harvest the best benefits from the implementation of IMS/St. Our study also answers these three important questions: 1. What are the main topics developed in the management literature on IMS/St so far? 2. Are innovation management standards mature from a practical point of view? 3. What are the main research gaps in management literature, and how could future avenues of research be shaped?



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1. Introduction

We can describe innovation as the development of new products or the significant improvement of new goods or services. It can also be defined as new marketing, organizational, or business strategies [1]. In the innovation management systems literature, innovation is commonly considered to be a fundamental dynamic of the enhancement of corporate competitiveness [2]. Perhaps for this reason, the innovation process is deemed an indispensable corporate process which has to be appropriately managed in order to foster business performance in the aspects of business profitability, productivity, quality of service, and customer and employee satisfaction [3], and to achieve a reasonable return on investment for the resources required by these processes.

Standardized innovation management systems (SIMS) are homogeneous management systems which accelerate the conversion of an organization's innovation strategy into

effective actions [4,5]. Thus, SIMSs ensure that innovation means not mere shiny novel inventions, but rather an organization's ability to recognize and pursue new areas of opportunity while reacting to fluctuating conditions in its environment [6]. In 2006, the Spanish Association for Standardization and Certification (AENOR) issued the Spanish UNE 166002: 2006, the first innovation management standard, as sets of principles intended to aid organizations in navigating the multifaceted process of innovation, schematizing their activities and improving management efficiency. In the same context, other countries have developed similar standards, such as the BS 7000-1: 2008 standard (BSI, 2008) in the UK (first edition in 1989), while some countries have amended the Spanish standards, such as Portugal (IQP, 2007), Mexico (NMX, 2008), Brazil (ABNT, 2011) and Denmark (Dansk Standard, 2010).

Two systematic literature reviews for innovation management systems were conducted. One analyzed 27 articles in order to build a tentative interpretative framework of innovation management systems which critically highlights and discusses their most common elements and aspects [7], and the other focused exclusively on models that graphically represent innovation management [8].

This paper offers theoretical contributions to the literature on, and provides for a clear understanding of, innovation management systems/standards (IMS/St) in the period 2006–2020, and guides researchers in this field of study by shedding light on the research needed in the future. From a managerial perspective, it could support companies in better understanding the implications and fields of application of IMS/St, and in developing a productive method to adopt one of these systems/standards. This study will answer these three main research questions:

MRQ1. What are the main topics developed in the management literature on IMS/St so far?

MRQ2. Have innovation management standards matured from a practical point of view?

MRQ3. What are the main research gaps in the management literature and how could future avenues of research could be shaped?

2. Methodology: Article Selection

Our approach to the literature review was designed to be organized, clear and reproducible [9]. The systematic literature review was conducted for the papers appeared between 1 November 2020 and 1 February 2021, and began with a search for peer-reviewed journal articles in scientific journal databases, as this review process is a tool for quality management that verifies the information presented by these articles [10].

We chose the Mendeley and Google Scholar search engines, as they are the main free tools for academic research that have expanded their research capabilities in recent years [11].

In searching and selecting the articles, five successive steps were followed:

1. As a first step, "Innovation Management" was searched as a keyword in the title, as is consistent with the current literature [9,12–14]; after combining the results from databases, 7476 outcomes were found.
2. In the second step, the number of articles was reduced to 599 after we applied three restrictions:
 - a. They should be peer-review published papers.
 - b. The papers should be written in English.
 - c. The publication dates should range from 2006 to 2020; 2006 is the year in which Spanish UNE 166002: 2006 standard was issued by the Spanish Association for Standardization and Certification, which was a major improvement in innovation management systems and standards. These characteristics excluded papers that may have had less scientific rigor, such as monographs, book chapters and other non-refereed journals.

3. In the third step, the sample was reduced to 431 titles after removing duplicates from the article list.
4. The fourth step, after having collected all of the results using reference management software, was to review all of the titles and abstracts in order to determine whether the basic relevance criteria were met [14,15], and then we excluded those beyond our context [12,16,17], i.e., articles not concerned with innovation management systems or standards were deemed irrelevant. As a result, 68 studies were accepted [18].
5. Finally, we manually resumed the search and tracked citations [14,16,19], which resulted in the addition of five more articles. In the end, samples of 73 publications were collected. Table 1 shows the above-mentioned steps, and Appendix A shows a list of the relevant papers.

The final sample was analyzed using an Excel datasheet [14], and the final database includes information such as the type of author (single author or collaboration), the type of paper (conceptual or empirical), the design, the type of research performed (survey, theoretical, data analysis), the applied methodology, and the key findings and contributions of each article.

After that, we pre-tested and shared the coding scheme with two field scholars in order to reach a consensus on the final information to be used. We synthesized the evidence, providing a clear perception of the status of the innovation management systems/standards literature. This systematic clustering process represents a consistent approach for future research.

Table 1. Steps in filtering the articles.

Filter	Description	Google Scholar	Mendeley Elsevier	Step Total
Step 1	Articles with selected keywords	5320	2172	7476
Step 2	After applying release date and peer review restrictions			599
Step 3	Removing the duplicates			431
Step 4	After reading the title and abstract, relevant articles remained			68
Step 5	Citation tracking			5
	Total			73

3. Descriptive Results: Analysis

3.1. Analysis of the Article Years, Type, Effect and Recurrence

The database of the results allowed the extrapolation of some interesting information, even at a general level. First of all, the annual distribution of the articles reveals that the subject was of less importance before 2012; seven articles were published in 2012, and the article frequency peaked at 24 articles from 2015 to 2017, as shown in Figure 1.

In addition to the 57 other academic journals represented, the Journal of Engineering and Technology Management, Procedia: Social and Behavioral Sciences and Technovation are the most relevant journals which have published articles on this topic, with three articles each. In total, 32 articles were published in the journals with scores of more than 0.5 (impact factor 2019), as shown in Table 2.

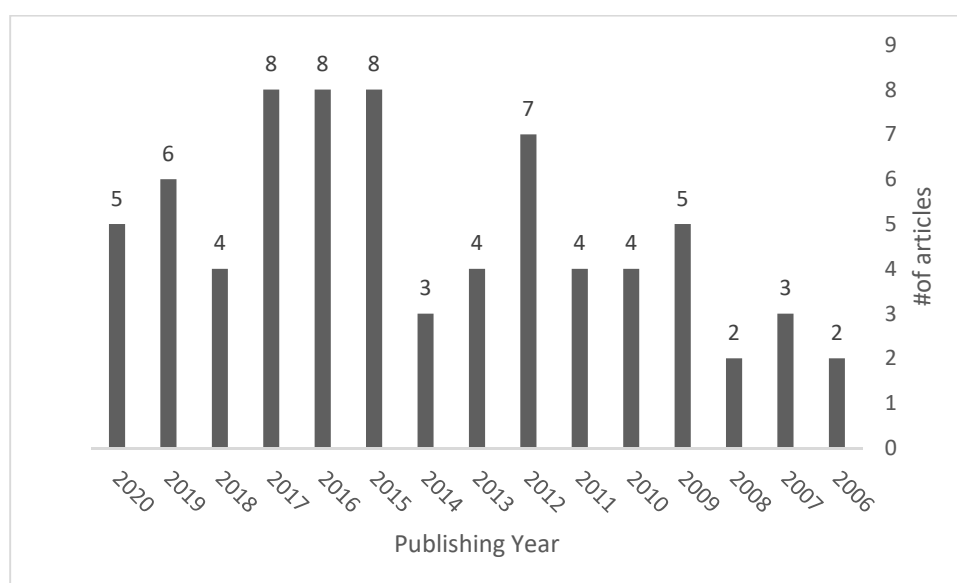


Figure 1. Number of articles per year.

Table 2. Journals, conferences and article numbers.

Journal Name	Impact Factor 2019	Case Study	Theoretical	Survey	Total
Journal of Engineering and Technology Management	—	3	0	0	3
Procedia: Social and Behavioral Sciences	—	0	3	0	3
Technovation	0.756	2	0	1	3
European Journal of Innovation Management	1.676	1	0	1	2
International Journal of Innovation Management	2.113	1	1	0	2
Procedia Economics and Finance	0.629	0	1	1	2
Vine	—	1	1	0	2
IEEE International Technology Management	0.524	1	0	0	1
Advances in Intelligent Systems and Computing	—	1	0	0	1
Canadian Journal of Administrative Sciences	4.691	1	0	0	1
Chinese Management Studies	1.6	0	1	1	2
Creativity and Innovation Management	1.667	0	1	0	1
R and D Management	3.727	0	0	1	1
Dyna (Spain)	1.263	0	1	0	1
Edulearn15: 7th International Conference on Education and New Learning Technologies	—	1	0	0	1
Engineering Management Journal	—	0	1	0	1
European Management Review	—	0	0	1	1
International Association for Management of Technology Conference,	—	0	1	0	1
Industrial Management and Data Systems	—	0	0	1	1
Information Technology and People	0.996	0	1	0	1
Innovar	—	0	1	0	1
Innovation and Ontologies: Structuring the Early Stages of Innovation Management	7.6	0	1	0	1

Table 2. Cont.

Journal Name	Impact Factor 2019	Case Study	Theoretical	Survey	Total
International Journal of Advanced Engineering and Management Research	4.111	0	1	0	1
International Journal of Economics and Management Engineering	—	0	1	0	1
International Journal of Innovation Science	—	0	0	1	1
International Journal of Management Reviews	4.028	0	1	0	1
International Journal of Operations and Production Management	6.395	0	0	1	1
International Journal of Quality and Reliability Management	2.734	0	0	1	1
ISPIM Innovation Symposium	3.347	0	1	0	1
Journal of Business Research	—	0	0	1	1
Journal of Cleaner Production	—	0	0	1	1
Journal of Construction Engineering and Management	1.305	0	1	0	1
Journal of Innovation Management Caetano JIM	—	1	0	0	1
Journal of Software: Evolution and Process	—	1	0	0	1
Journal of the Knowledge Economy	—	0	1	0	1
Management Research News	—	0	0	1	1
PICMET: Portland International Centre for Management of Engineering and Technology	—	0	0	1	1
Proceedings of the 8th European Conference on Innovation and Entrepreneurship	—	0	1	0	1
Processes	1.963	1	0	0	1
ProQuest Dissertations and Theses	—	1	0	0	1
Public Enterprise Half-Yearly Journal	—	0	0	1	1
R and D Management	2.908	1	0	0	1
Recent Advances in Business Administration	—	0	1	0	1
Revista Estudos e Pesquisas em Administração	—	1	0	0	1
Scientometrics	5.425	1	0	0	1
Technological Forecasting and Social Change	—	0	0	1	1
TMQ Techniques, Methodologies and Quality	—	1	0	0	1
Total Quality Management and Business Excellence	2.77	1	0	0	1
VTT Publications	0.731	1	0	0	1
Espacios	3.815	0	0	0	0
Research Policy	1.867	0	0	0	0
American International Journal of Business Management (AIJBM)	6.606	0	0	1	1
Technology Analysis and Strategic Management	—	1	0	0	1
Systems Research and Behavioral Science	2.181	1	0	0	1
Romanian Journal of Ecology & Environmental Chemistry	—	1	0	0	1
Journal of Environmental Treatment Techniques	0	1	0	0	1

3.2. Analysis of the Countries of Origin

The articles were created in a various geographical regions. As shown in Figure 2, 52% of the articles were from Europe, 10% were from Asia, 10% were from South America and 22% had no geographical identifications.

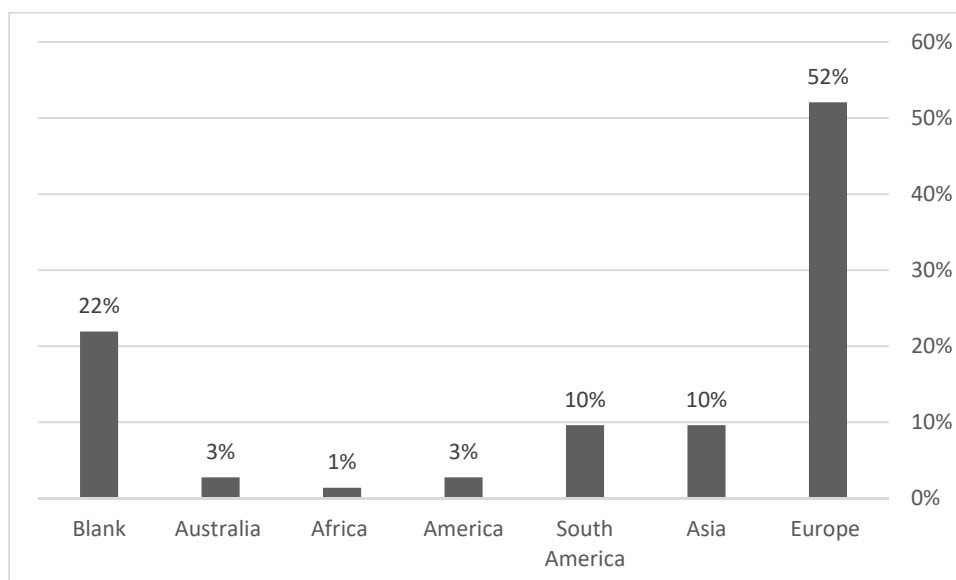


Figure 2. Geographic scope analysis.

The highest proportion from any one country was from Spain, at 14%. This result maybe related to the fact that Spain was the first country to introduce innovation management standards (Spain 2006 UNE 166002:2006–R&D&I Management: Requirements of the R&D&I management system) [20].

4. Comprehensive Review of IMS/St

From the point view of the methodological approaches adopted in the papers, the 73 selected articles were classified into three different groups: Theoretical (group A), Experimental Qualitative (group B) and Experimental Quantitative (group C). The studies in group C were further divided into two subgroups: articles that investigated the ways in which innovation management systems/standards affect company performance (subgroup C1), and articles that analyzed innovation management standards and systems (subgroup C2). This classification will be used to identify the ways in which the papers contribute differently to the innovation management literature. In addition, we considered the key topics and subtopics studied and the models developed (if any) for each article.

4.1. Group A: Theoretical Studies

Articles discussing theoretical perspectives and expanding the use of theories are of great importance for the development of the academic debate (see Table 3). During our examination of the articles, we found that about half of them (13/24) relied on literature analysis as the main tool for research, and three of them relied on data analysis, whether expert review data [21,22] or empirical data [23], to verify their outputs. Only two articles used national data to verify the companies' ability to face challenges through innovative management practices [24,25]. Four articles analyzed IMS/St innovation management standards by comparing them [26] or analyzing one of them in depth [27–29]. Only one article used a theoretical approach to develop an innovation management model, which the researchers called a “Cognitive Approach” [30].

Furthermore, 33% of these articles (eight articles) developed a new model, but five of them did not verify the outcomes [4,30–33], although each of them declared the unique characteristics for their models.

The innovation level in each sector in an organization can be identified at any time through an Innovation Management System Framework (e.g., [31,33]) that can create an environment in which innovation is a natural practice involving all of the stakeholders. Under challenging conditions of shifting resources in an innovative economy, Ref. [30]’s model may choose the company’s innovation development concept. Ref. [4] assumes that by using their framework, practitioners will be able to analyze their innovation management activities; recognize gaps, weaknesses, or defects; improve future extraction areas where innovation is only nominally adopted in their processes; and specify the areas in which interest and resources may be concentrated. Ref. [32] illustrates an approach that incorporates good and relevant techniques in the following management areas: (a) strategic management, (b) project management, (c) innovation models and methods, (d) innovation management standards, (e) knowledge management and (f) financial management.

Refs. [21,22] validated their models by having them reviewed by experts and senior managers. Ref. [22] shows that their Corporate Innovation Management Business Model encourages a company to recognize concepts, activities, or projects, eventually helping them to achieve market success. However, Ref. [21] illustrates, in their model, that customers and individuals can play a major role in the innovation process; in this model, Web 2.0 and Enterprise 2.0 technologies are important enablers. Only [23] used experimental data to validate the model, of which the implementation in business reality has process-oriented implications.

Table 3. Theoretical studies ($n = 24$).

Title	Year	Model	Main Findings	Model’s Added Value	Study Classification
A Proposed Innovation Management System Framework—A Solution for Organizations Aimed for Obtaining Performance	2012	1	New model	“Identifying the degree of innovation in any field of the enterprise at any time Establishing an environment in which innovation includes every stakeholder as a natural activity Concept analysis suggests ways to enhance ideas and boost the possible added value offered” [31]	Theoretical
A Systematic Literature Review on Firm-Level Innovation Management Systems	2015		“Proposes an interpretative framework of innovation management system and provides recommendations on how the proposed model can be used for implementation.” [7]		Theoretical: literature analysis
Achieving Performance of Organization by Developing a Model of Innovation Management	2013	1	New model	“Identifying the degree of innovation in any field of the enterprise at any time Establishing an environment in which innovation includes every stakeholder as a natural activity Concept analysis suggests ways to enhance ideas and boost the possible added value offered” [33]	Theoretical
Business Models for Corporate Innovation Management: Introduction of a Business Model Innovation Tool for Established Firms	2018	1	“BMI’s management approach differs from the approach needed for product or process innovation.” [22]	“Recognizing concepts, activities or projects in the company, eventually helping to achieve market success” [22]	Theoretical: literature analysis

Table 3. Cont.

Title	Year	Model	Main Findings	Model's Added Value	Study Classification
Cognitive Approach in Development of Innovation Management Models for a Company	2012	1	"The models can determine the innovative development concept of the company under challenging conditions of shifting resources and innovation-based economies." [30]		Theoretical
Fostering Innovation with KM 2.0	2010	1		"Customers and other people having roles in the innovation process Web 2.0 and Enterprise 2.0 technologies as significant enablers" [21]	Theoretical, data analysis
Innovation and Ontologies: Structuring the Early Stages of Innovation Management	2009	1		"Action-oriented consequences of methodology execution in business reality." [23]	Theoretical, data analysis
Innovation Management and Romanian SME's	2010		"The continuous incremental innovations made every day by employees will provide the company with the consistent growth it needs. Sustained innovation is generated by enabling the creativity of employees and teaching them how to identify unconventional opportunities." [34]		Theoretical: literature analysis
Innovation Management as Part of the General Management of the Organization	2018		"Innovation Management System enables businesses to create and execute strategic plans. Good innovation management provides an advantage with a major effect. Innovative projects, with an average of around 20%, contribute 6 to 30% of the increased revenue. Innovative management, with an average of almost 10%, can also generate savings." [24]		Theoretical: data analysis
Innovation Management in Global Competition and Competitive Advantage	2015		"Innovation management, including knowledge, technology, staff, vision, leadership and organizational structure, is a multidimensional concept. All dimensions should be controlled by appropriate strategies in order to be efficient." [35]		Theoretical: literature analysis
Innovation Management Measurement: A Review	2006	1		"Practitioners will be allowed to evaluate their activities in the field of innovation management, identify gaps, shortcomings or defects, and improve possible areas of extraction where innovation is only nominally used in their processes and identify areas where interest and resources could be focused." [4]	Theoretical: literature analysis
Innovation Management Standards: A Comparative Analysis	2011				Theoretical

Table 3. Cont.

Title	Year	Model	Main Findings	Model's Added Value	Study Classification
Innovation Management System Based on Performance Drivers: A Study Applied to The Brazilian Electric Power Sector	2017		"Innovation management system intends to strengthen/develop: (I) transparency in decision-making process of innovation, (II) innovation culture, by innovative thinking of the employees, (III) strategic business alignment of projects, (IV) risk mitigation of financial investment on projects, and (V) profit leverage through new creative solutions." [36]		Theoretical: literature analysis
Innovation Management System of Ecuador	2015		"Domestic innovation process (financing, research and results) has not been successfully demonstrated by National Innovation System." [37]		Theoretical: literature analysis
ISO 50,500 Series Innovation Management: Overview and Potential Usages in Organizations	2017		"Through the use of these documents, organizations can raise their awareness of the value of innovation management, broaden innovation capacities, and eventually generate more value for the company and its stakeholders." [27] For innovative organizations, using a systematic approach to handling innovation is an essential step.		Theoretical
Management Innovation: A Systematic Review and Meta-Analysis of Past Decades of Research	2019		"Innovation management is positively associated with organizational size, information management, organizational learning, overall performance of the company, and financial performance." [38]		Theoretical: literature analysis
Management Innovation: Correcting Mistakes	2015		"A national agency, Innovative Development Office, must be established in order to simplify the national innovation policy and save resources." [39]		Theoretical: literature analysis
MIM3: Methodology of Innovation Management for Obtaining the Level 3 Of I2MM	2017	1		"Good practices in the following fields of management: (a) strategic management, (b) project management, (c) innovation models and innovation methods, (d) innovation management standards, (e) knowledge management, and (f) financial management." [32]	Theoretical
Models with Graphical Representation for Innovation Management: A Literature Review	2017		Classify innovation management models, and illustrate the model's biases, gaps, strengths and weaknesses [8]		Theoretical: literature analysis
Smart Innovation Management in Product Life Cycle	2016		"Based on the previous innovative experiences of similar products, innovation can be achieved on technological grounds. Current decision-making events may be preserved for future use in an organized manner." [40]		Theoretical

Table 3. Cont.

Title	Year	Model	Main Findings	Model's Added Value	Study Classification
Standardization and Innovation Management	2017		"Innovation Management Standards can be used as management tools to enable information absorption by organizations, support stakeholders in speeding up their distribution and adoption, and create dynamic capabilities to sustain competitiveness and generate value." [41]		Theoretical
Toward a Multistage, Multilevel Theory of Innovation	2011		"Innovation is a multi-level phenomenon that emerges through individual creative efforts which, at the individual, group, organization, and social levels, are converted into innovative outcomes that emphasize the importance of organizational behavior in innovation." [42]		Theoretical
Toward a New Innovation Management Standard: Incorporation of the Knowledge Triangle Concept and Quadruple Innovation Helix Model into Innovation Management Standards	2017		"European Innovation Management Technical Specifications are tools for transforming concepts and research findings into innovations carried out by trained and motivated workers. Technical specifications of Innovation Management System (IMS) should be paired with Knowledge Triangle and Quadruple Helix approaches in order to prevent isolating the organization from carrying out innovation activities." [43]		Theoretical
Towards an Integrated Approach to Improving the Innovation Management Systems of Mining Companies	2019		"A framework for defining the key management areas that mining companies should consider in order to enhance their capacity for innovation and increase the efficiency of innovation."		Theoretical

4.2. Group B: Experimental Qualitative Studies

By using single-case or multi-case research methods, we collected 29 qualitative articles (see Table 4), three of which analyzed big data to validate their claims. Ref. [44] analyzed the data of 730 European companies to affirm that the spread of the UNE 166,002 Innovation Management Standard followed the logical S-shaped curve of the internationalization model. In order to recognize "Trust" as the prevalent sentiment associated with innovation, and given the increasing relevance of emerging technologies in the company's innovative activities and the declining of old technologies, Ref. [45] used data from 243 Spanish companies. Ref. [46] used samples of 460 Colombian companies, and found that it is possible to process innovation management and quality management in parallel and to promote each of them without harming the other. Ref. [47] used a sample of 122 Romanian companies and concluded that an Innovation Management System affects the company's ability and understanding of innovation actions positively, and increases the innovation quality, which directly affects the organization's business performance. Ref. [48] concluded—on the basis of 24 samples and one case study—that there is no direct correlation between the implementation of an innovative management system and increasing the competitiveness of construction companies, and that this may be due to the fact that these processes were in the early stages of implementation when conducting the research.

We also found that 34.4% of this group's articles developed and verified a new model with specific added value. Ref. [49] developed a model which encourages the utilization and exploration methods from the front end of the innovation process in order for them to be shared at the same stage of implementation, and continues to create a shared understanding of the vision and the use information and resources. The model of [50] improved the incremental and radical product and process innovations resulting from consumer demands, market pull and technology push activities in the company. Complicated recent situations of management systems inside companies [51] facilitated the integration of an innovation management system in the complicated system by developing a new approach, and to solve the same complex issues in companies, the model of [52] created a community of learning as a space for innovation within the organization.

Technology, marketing and innovation management could be integrated, as [53] suggested in their model. Ref. [54]'s model was built on the concept of stakeholders combined with knowledge mining. For managers to innovate systematically, Ref. [55]'s model provided guidelines, which were verified by three years of observation in a Spanish company. Ref. [56]'s model facilitated decision-making in innovative sustainable process design and enabled development teams to identify their own most useful standards, required gateways and key goals. Ref. [57]'s model was the most appropriate for high-tech enterprises, because it encourages market-oriented cooperation along the industrial chain. Ref. [25] used their model to consider and integrate the degrees of innovation (incremental and radical).

The impact of IMS/ST on companies' performances was analyzed in three articles. The findings of the case studies conducted by [28,58–61] were that innovation management techniques could be used to plan the activities and affect the company's performance positively. They further demonstrated that IMS/St is consistent with ISO 9001, and with maintaining, developing, and innovating R&D&I research. Ref. [62] analyzed and improved organizational culture and human resource management to establish more fertile ground for an innovation environment, which reflects more on the structure and practice of dealing with innovation problems every day [63]. However, Ref. [61] believed that the effectiveness of a self-certification program relies on the company's ability to manage processes, provided that internally guided motivation is established and the top management's firm commitment is ensured.

In studies of this group, various fields were studied, i.e., services [64], communications, construction, industry, nanotechnology [62], education [60], labs [65], mobile industry [66], aerospace [58] and countries (Peru, Colombia, Spain, France, etc.). Just one study examined the main innovation challenges of managing uncertainty and risk, and the difficulty of cross-functional coordination [67].

Table 4. Qualitative studies ($n = 29$).

Title	Year	Model	Main Findings	Model's Added Value	Study Classification	Samples Size
A Model for Corporate Renewal Requirements for Innovation Management	2010	1	New model	Utilization and exploration methods from the front end of the innovation process in order to be shared at the same stage of implementation, and continuing to create a shared understanding of the vision and the use information and resources	Case study	5

Table 4. Cont.

Title	Year	Model	Main Findings	Model's Added Value	Study Classification	Samples Size
Application of the IUMSS Methodology in an R&D-Oriented Nanotechnology Setting	2010		R&D standards are consistent with ISO 9001:2000 and maintain R&D&I MS		Case study	1
Building Knowledge for Innovation Management: The Experience of the Umanlab Research Team	2012		Different requirements within the rigor significance dilemma that affect information production.		Case study	1
Development and Operationalization of a Model of Innovation Management System as Part of an Integrated Quality-Environment-Safety System	2017		To have a positive impact on the company's capacity and experience in innovation actions and to increase the effectiveness of innovation that directly affects the organization performance.		Data analysis	122 out of 500
Diffusion of the UNE166002 Innovation Management Standard: A Forecast Model Approach to Internationalization	2014		The diffusion of UNE 166,002 follows a logistic S-shaped curve. It would approach 85,000 European certificates and, if it were an ISO standard, more than 1,200,000.		Data analysis	
Effects of Innovation Management System Standardization on Firms: Evidence from Text Mining Annual Reports	2017		"Trust" is the predominant emotion associated with the innovation. The increasing relevance of emerging technologies in the company's innovative efforts and the declining of older technologies.		Data analysis	243
Bases for the Development of R+D+I Teams in Companies in the Department of Quindío, Colombia	2016		It is possible to process innovation and quality management in parallel and promote each other, rather than to disadvantage each other.		Case study, data analysis	2 cases 460 data
Innovation Management (Une-Cen/Ts 16555-1:2013) Applied to Superior Education: Integration of Disruptive Technologies for the Teaching of Chemistry	2015		Techniques in innovation management can be used to organize high-level educational activities that can have a beneficial effect on student learning and achievement.		Case study	1
Innovation Management Processes, their Internal Organizational Elements and Contextual Factors: An Investigation in Brazil	2014		Failure to assess innovation systems as a homogeneous maturity block and orientation towards innovative performance. Managing uncertainty and risk and cross-functional coordination challenges are the core challenges of innovation.		Case study	4
Innovation Programs Models: Design and Management	2019		Innovation in products and services is focused on four axes: environment scanning, interactive learning, gamification, lean thinking, and design thinking. Although business model innovation based on the same processes and methodologies needs additional capabilities and resources, all of them concentrate on the business context, consumers as value co-creators, digital channels, and ecosystems.		Case study	8 service company

Table 4. Cont.

Title	Year	Model	Main Findings	Model's Added Value	Study Classification	Samples Size
Integration of Market Pull and Technology Push in the Corporate Front End and Innovation Management: Insights from the German Software Industry	2009	1	It cannot be assumed that technology promotion and market pull are the right or wrong way to sustainable innovation. The effect of “regulatory drive” is also important.	Company's market demands, market pull and technology promotion activities to integrate technology and innovation management are leading to incremental and radical product and process innovations.	Case study	1
Investigating the Use of Information Technology in Managing Innovation: A Case Study from a University Technology Transfer Office	2012	1		Development based on the integration of technology adoption, marketing and innovation management	Case study	1
IT-Supported Innovation Management in the Automotive Supplier Industry to Drive Idea Generation and Leverage Innovation	2013	1		A model focused on the combination of stakeholder's concept and information mining	Case study	
Management of Research, Development and Innovation Systems and the New Np 4457 Standard: An Implementation	2008		Implementation of SIMS Np 4457 supports value creation by innovation activities.		Case study	1
Model for Systematic Innovation in Construction Companies	2014		It is not obvious that a correlation exists between the implementation of an innovation management system and the enhancement of the competitiveness of construction companies. This condition may be due to the fact that these processes were in the early stages of implementation when the study was conducted.	The model tested and its result approved by case study	Case study, data analysis	24
Organizational Improvement through Standardization of the Innovation Process in Construction Firms	2012	1	Innovation management can be standardized, which can lead to the company being improved in an organizational way. At the same time, this improvement promotes organizational problem-solving regularly, and enhances technical skills, information management, business profit and customer satisfaction.	Providing the managers with guidance so that they can innovate systematically	Case study	1
Self-Certification Framework for Technological Innovation: A Case Study	2016		Self-certification program success depends on the ability of the company to manage processes. It is essential to develop an internally guided motivation and ensure the firm commitment of the top management. It has a positive effect on performance in innovation and marketing.		Case study	1
Semantic Innovation Management System for the Extended Enterprise	2011		The effectiveness and possibility of using semantic web technologies to enhance innovation management.		Case study	1
Standardized Innovation Management Systems: A Case Study of the Spanish Standard UNE 166002: 2006	2011		The standard facilitates innovation and improvement of internal transition and technology assimilation procedures, thus promoting improved outcomes of innovative products and services.		Case study	1

Table 4. Cont.

Title	Year	Model	Main Findings	Model's Added Value	Study Classification	Samples Size
Standardization as Open Innovation: Two Cases from the Mobile Industry	2009		In neutral areas such as standardization, open innovation can occur.		Case study	2
Standardizing Innovation Management: An Opportunity for SMEs in the Aerospace Industry	2019		Standardized innovation management would increase the competitiveness of the company and enable it to continue to improve over time by better managing all its R+D+I activities, allowing it access to a range of preferential advantages (tax deductions, special tenders, additional funding lines, etc.).		Case study	1
The Challenge of Integrating Innovation and Quality Management Practice	2016		Quality management practices are contributing to a decline in innovation space. It is possible to process innovation and quality management in parallel and to promote each other rather than disadvantage each other. Organizational culture and HR management analysis and development to build more fertile ground for an innovative environment, and to pay more attention to the structures and procedures of addressing innovation issues on a daily basis. By paying more attention to innovation management, superior consumer value can be achieved.		Case study	2
The Need for Innovation Management and Decision Guidance in Sustainable Process Design	2016	1		Supporting decision-making of innovative sustainable process design and encouraging development teams to set their own most informative requirements, appropriate approaches, and main objectives	Case study	2
The Standardization Model of Innovation: Case of High-Technology Enterprises	2016	1	Three key elements of innovation need to be stressed in standardizing the innovation model: strategic innovation planning, internal R&D practices and external cooperative innovation. It should be noted that IPR management, market focus and cooperation across industry chains are important.	Note IPR management, consumer focus and cooperation along industry chains for HTEs (high-technology companies)	Case study	1
Towards Systematic Business Model Innovation: Lessons from Product Innovation Management	2012	1	A more systematic and comprehensive approach may be effective as it expands the best practices already developed for product innovation management.	Consider and integrate the degree of innovation (incremental or radical).	Case study	11
Implementing an Innovation Management System at the National Research and Development Institute for Industrial Ecology (ECOIND)	2020		Identify, introduce and describe the processes related to innovation and establish the interaction of these processes with the other processes of the management system		Case study	1

Table 4. Cont.

Title	Year	Model	Main Findings	Model's Added Value	Study Classification	Samples Size
Communities of Learning as Support for one Knowledge and Innovation Management System: A Case Study	2020	1	Practice methodology that fosters the creation and strengthening of a community of learning composed of mentors and apprentices within the organization	Creation of a community of learning as a space for innovation within the organization	Case study	1
Making “Hidden Innovation” Visible: A Case Study of an Innovation Management System in Health Care	2020		The system has contributed to some extent to making hidden innovations more visible, and to enabling sharing and learning not only among the hospitals, but also with external partners.		Case study	1
Managing Innovation in Complicatedly Organized Facilities	2020	1	New sources and ways of incorporating innovations into the existing system of urban planning, as well as transformation of the innovation management system itself by taking into account the interests of the city's stakeholders.	The system-based nature allows to present in detail the structure of the object in the aggregate of all connections; its synergism determines the possibility of multidimensional development of the object and their management in the conditions of not only external but also internal innovations.	Case study	1

4.3. Group C: Experimental Quantitative Studies

As mentioned earlier, the Experimental Quantitative Studies were divided into two subgroups. In Group C1, articles investigating the ways in which the innovation management system/standards affect company performance, we studied the papers in which one or more directions of the company's performance were the focus. Operational procedures for product innovation performance meeting the unidimensionality, reliability, and validity criteria were proposed by [68], and these procedures were validated by structural equation models in 253 French biotech manufacturing companies. The research concluded that the impact of IMS on the company's performance was directly analyzed in seven of these articles [2,20,69–73]. Ref. [71] linked the main components of the innovation process with growth success, and this finding was confirmed in six companies. From a sample of 763 companies, Ref. [69] found that innovation is poorly related to company sales, although administrative innovation, rather than technological innovation, has become the most important innovation element impacting sales.

In that same context, Ref. [72] argued that excellent company performance may be due to organizational innovation and technical skills in products and processes. Ref. [20] used a sample of 1000 companies to demonstrate that Innovation Management Standards have a strong positive relationship with a company's Innovation Capability (IC) and Business Performance (BP), while [73] concluded—from a sample of 3668—that management innovation positively affects company performance in the form of subsequent productivity growth.

As mentioned above, except for [69], which pointed out that there is a poor link between IMS and sales, all of them showed that IMS has a positive impact on company performance. The impact of IMS on Innovation Performance was examined by four studies [70,74–76], but after evaluating five certified and four non-certified companies, it was found that commercialization and diffusion for product/service and innovation achievements benefit even more from the reinforcement of a formal innovation management system when the IMS organizational strategy of innovation is applied. Concerning the predictive factors of the company's innovation performance, Ref. [70] studied a sample of 566 companies and found that using IMTs in the companies could create these factors, particularly when considering incremental innovation results. Furthermore, the use of

innovation management technology has a major impact on the performance of incremental and radical innovation, as radical and incremental innovation contributes to innovation performance [75]. Therefore, all types of innovation and their benefits will also be helped by the implementation of SIMS [76]. Ref. [70] mentioned that when a company has not yet reached a reasonable size but is willing to certify IMS, this often overloads it.

Further details of all of these studies are shown in Table 5.

Table 5. Group C1: experimental quantitative studies/IMS and performance ($n = 12$).

Title	Year	Main Findings	Model's Added Value	Study Classification	Sample Size	Subject
A Measurement Scale for Product Innovation Performance	2006	The operational measures developed here satisfy the criteria for unidimensionality, reliability, and validity.		Survey	132 out of 253 targeted	Performance
Do Standardized Innovation Management Systems Matter for Innovative Capability and Business Performance?	2020	Significant connections exist between standardized innovation management systems, innovative capability and business performance.		Survey	217	Performance
An Innovation Management System to Create Growth in Mature Industrial Technology Firms	2015	New model	Penetrate the glass ceiling of exploitation and establish new undisputed growth flows. A systematic process to establish innovation streams outside of the existing comfortable exploitation region can be followed by management teams in mature technology industries. Highly important in the efforts to pursue profitable growth.	Interview-survey	28, from 6 firms	Performance
Does Innovation Lead to Performance? An Empirical Study of SMEs in Taiwan	2007	Innovation is poorly related to company sales, although administrative innovation has become the most important element in explaining sales rather than technological innovation.		Survey	763 out of 877	Performance
Emerging Technologies Beyond the Chasm: Assessing Technological Forecasting and Its Implications for Innovation Management in Korea	2016	There is a gap in the process of commercialization. Interaction between innovation practitioners is about overcoming the gap. Government support is quite helpful.		Survey	218 out of 256	Inn-Performance
Importance of an Innovation Management System	2013	When the company has not yet reached a reasonable size and is willing to certify IMS, this is often overloading it. Commercialization and diffusion for product/service and innovation achievements benefit even more from reinforcing a formal innovation management system when IMS organizational strategy of innovation is applied.		Survey	4 + 5 certified	Performance
Innovation Management Techniques and Tools: Its Impact on Firm Innovation Performance	2018	Using IMTs in the companies could predict their innovation success, particularly when considering incremental innovation results.		Survey	566	Performance-management
Innovation Types and Innovation Management Practices in Service Companies	2007	In the telecommunications and financial sectors, product innovation is emphasized more than in the transport and retail sectors, while service innovation is emphasized more in the retail and transport sectors. Radical and incremental innovations are related to innovation performance. Radical innovations are related to innovation management practices.		Survey	47% of 214	Performance

Table 5. Cont.

Title	Year	Main Findings	Model's Added Value	Study Classification	Sample Size	Subject
Organizational Innovation as an Enabler of Technological Innovation Capabilities and Firm Performance	2012	Development of technological innovation capabilities is encouraged by organizational innovation. Organizational innovation and products and processes technological capabilities will contribute to outstanding company performance.		Survey	144	Performance
The Impact of Standardized Innovation Management Systems on Innovation Capability and Business Performance: An Empirical Study	2016	Innovation management Standards have a strong positive relation with the company's Innovation Capability (IC) and Business Performance (BP).		Survey	1000	Performance
The Performance Implications of the UNE 166.000 Standardized Innovation Management System	2019	All types of innovation and its achievements are endorsed by the implementation of SIMS. The relationship between administrative and technological development is positive.		Survey	200	Performance-St
The Sources of Management Innovation: When Firms Introduce New Management Practices	2009	Management innovation is the product of the internal context of the company and the external quest for new information, as management innovation correlated with the co-occurrence of "context and search" is negatively affected. Management innovation positively affects company performance in the form of subsequent productivity growth.		Survey	3668 out of 8172	Performance

When reviewing the articles in Group C2, i.e., articles researching IM standards and systems, we found that [77] claimed that the innovation management standard Cen/TS 16,555 is ineffective, mainly due to the lack of consensus among European countries. Ref. [78] found that when agendas and methods are standardized, the management innovation process within the organizations may have a significant effect. In other words, the more standardized the company innovation processes are, the more incremental innovations take place in the organization, rather than more exploratory and revolutionary changes.

The primary innovation capabilities (innovation skills, information security, management and performance evaluation) and the significance of company management in the field of innovation in the public service sector were identified by [79] after examining a survey with a sample of 321 articles. However, Ref. [80] found that understanding innovation strategies, encouraging management, risk tolerance culture, and autonomy are also valuable innovation management tools.

Ref. [81] discussed four key reflections for the assessment of organizational innovation: the complexity of the organizational innovation, the life cycle of the organizational innovation, the extent of the use of the organizational innovation, and the quality of the organizational innovation.

Concerning Dual Innovation Management Systems, which consist of two innovation management systems, one for processing current business areas and the other for the development of new business areas, Ref. [82] identified this concept and found that CTOs who effectively implement dual innovation management actively strive to obtain technical information and information about their companies' social environment. Ref. [83] examined the role of management innovation in achieving technological process innovation, and explained the interlinkages of the two innovation types over time. Management innovation theory is expanded by conceptualizing management innovation in an inter-organizational environment. Refs. [79,84] developed their innovation management frameworks through questionnaires, but neither of their models were verified.

Further details of all of these studies are shown in Table 6.

Table 6. Group C2: experimental quantitative studies/IM standards or IM systems ($n = 8$).

Title	Year	Model	Main Findings	Study Classification	Study Purpose	Sample Size	Subject
Are National Systems of Innovation Converging? The Case of Cen/Ts 16555	2015		The standard of innovation management is ineffective due to the lack of consensus among European countries	Interviews	Analyze the recent efforts to standardize innovation management at European level as a practical test of the degree of internationalization of national innovation systems	33	Standard
Chief Technology Officer's Views and Behaviors in the Dual Innovation Management System	2009		Successful CTOs strive actively to obtain technical information and information about their companies' social environment. Consider and act based on their philosophy and knowledge. Show great attention in nurturing human resources.	Survey	Describe the concept of Dual Innovation Management System, consisting of two innovation management systems, one for processing existing business areas and the other for developing new business areas	50	Management
Management Innovation Through Standardization: Consultants as Standardizers of Organizational Practice	2012		When agendas and methods are standardized, the management innovation process within the organizations may have a significant effect, in other words, the more standardized company innovation processes are, the more incremental innovations take place in the organization rather than more exploratory and revolutionary changes Standardization is a key feature of the organizations	Survey	Argue that consultant-led management innovation is usually highly standardized	90 in 30 organization	Management
Management of Innovation Processes in Company	2015	1	Successful realization of the innovation processes requires a supportive environment for innovation creation.	Survey	Analyze the literature and research in detail to create a model for the company's innovation processes management	321	Management
Managing the Implementation of Innovation Strategies in Public Service Organizations—how Managers May Support Employees' Innovative Work Behavior	2019		Understanding innovation strategies, encouraging management, risk tolerance culture and autonomy are valuable innovation management tools Strategic management communication and economic rewards are not related to any stage of innovative work behavior	Survey	Identify which management strategies public managers can use to enhance their employees' innovative behavior.	1405	Management
Organizational Innovation Management: An Organization-Wide Perspective	2007	1		Survey	Develop and validate an organization-wide OIM framework.	201 out of 2100	Management
Organizational Innovation: The Challenge of Measuring Non-Technical Innovation in Large-Scale Surveys	2008		Four key reflections for assessing organizational innovation: (1) Complexity of organizational innovation; (2) Life cycle of organizational innovation; (3) Extent of use of organizational innovation; (4) Quality of organizational innovation.	Survey	Measure and monitor organizational innovations by large-scale surveys. Define and measure the organizational innovations in more detail by classifying them and comparing the different approaches of measuring them.	1450	Management

Table 6. Cont.

Title	Year	Model	Main Findings	Study Classification	Study Purpose	Sample Size	Subject
The Role of Management Innovation in Enabling Technological Process Innovation: An Inter-Organizational Perspective	2013		Explain the interlinkages of the two innovations types over time. Management innovation theory extended by conceptualizing management innovation in an inter-organizational context.	Survey	Address the gap that the role of management innovation in promoting technological process innovation in the inter-organizational context has not been fully explored.		Management

5. Discussion

The first research question put forward in the introduction of the paper was the following: MRQ1—What are the main topics developed in management literature on IMS/St so far? As shown in Table 7, of the 73 quantitative articles found, 50 studied innovation management systems as the mainstream of innovation management, and eight articles studied innovation management systems' impact on innovation performance.

Table 7. Articles by research subject.

Research Subject	Articles
1. Innovation management standards	15
2. Innovation management systems	50
3. IMS and Innovation performance	8

The standardization process is essential, as it provides common language, terminology, credibility, facilitated implementation, and a benchmarking basis [85]. Unifying these characteristics supports the adoption of IMS/St all over the world; as such, in Table 8, we classified the “Innovation Management Standards” articles into three sub-groups (compatibility, impact on companies, standard analysis).

Table 8. Innovation management standards subtopics.

Subtopic	Articles
Compatibility	6
Impacts on companies	7
Standard analysis	2

As to MRQ2—Are innovation management standards mature from practical point of view, as shown in the literature?—as shown in Table 7, only 15 articles studied innovation management standards, and this may be due to the relative newness of the standards or because they have not been widely disseminated globally, particularly because the ISO 56,000 series had only recently been released by the time of writing this article.

Standards analysis was mentioned twice, as [44] dealt with the predicted prevalence curve of the UNE166002 Innovation Management Standard, and [26] compared two IMSs—the Spanish UNE 166002: 2006 and the UK BS 7000-1: 2008—to improve the actions taken to create IMS in the European Committee for Standardization (CEN), which, as [77] found in their research, was ineffective. As shown in Table 8 above, there were seven articles analyzing the impact of IMS/St implementation on the enterprises, and explaining the ways in which the implementation of IMS/St can encourage innovation, improve procedures [28], and promote various types of innovation and outcomes [76]. From another point of view, IMS/St implementation can broaden innovation capabilities and encourage value creation through innovation activities [2,59], eventually creating more value for the organization and its stakeholders [27]. Researchers found that “trust” is the predominant value associated

with innovation among stakeholders [45]. The positive effect of implementing IMS/St on innovation and marketing performance was also validated [61].

Regarding compliance with ISO 9001, several articles concluded that IMS/St is consistent with this standard, and that they can be processed in parallel and reinforce each other [46,62]. In the context of the education sector, Ref. [60] found that IMS/St could be used to organize higher education level activities, and could have a significant effect on students' learning and achievements. However, in the context of the high-tech sector, Ref. [57] studied a telecommunications company in China and concluded that three main elements should be prioritized in IMS/St: "Strategic innovation plan, Internal R&D practices and External cooperative innovation", in addition to considering the intellectual property management, market focus and cooperation on the industrial chain. Furthermore, theoretical research has shown that companies which implement innovation activities while following IMS technical specifications can combine the "Knowledge Triangle" and "Quadruple Helix" approaches in order to keep from isolating themselves [43]. In addition to the above, the fact that a relatively large number of articles (23) suggest new innovation management models and a relatively small number of articles discuss IMS/St shows the low maturity level of the IMS/St.

This leaves MRQ3—What are the main research gaps in management literature and how could future avenues of research be shaped?—to be addressed. Apart from the gaps and future avenues of research which emerged from answering the previous research questions, some other areas in the IMS/St domain are of particular interest from a management point of view. In particular:

1. IMS/St needs to be studied in relation to the added values which have been mentioned for each of the new models above, in order to validate whether IMS/St (specially ISO 56000) covers each of them, and if not, to find the needed improvements for IMS/St to fulfill the needs of companies for these added values. The conformity of IMS/St with various sectors of services and industry could also be a very interesting topic for further investigation.
2. Various management standards (environmental management standards, sustainability management standards, social responsibility management standards, quality management standards, etc.) have been adopted in companies. The method of the adoption of IMS/St needs to be clearly studied in order to make the adoption process successful, and to reduce opportunities for conflict between these management standards and IMS/St.
3. More standard analysis of the present IMSts is still needed.
4. A comparative study on IMS/St standards is still needed in order to find the strengths and weaknesses of each of them (although one paper [26] considered here did address this issue). This provides a good opportunity to develop IMS/St standards.
5. The impact of IMS/St on each type of innovation still needs more research in order to give better understanding of it.
6. The impact of IMS/St on innovation performance should be tested and evaluated in different sectors.
7. The connection between IMS/St and value creation should be investigated.
8. The impact of IMS/St on the performance of companies in detail and overall, also deserves more attention, as the impact of IMS/St is linked to the readiness of companies to invest real money in the implementation of IMS/St.

6. Conclusions

This systematic literature review provides good reasons to believe that Innovation Management Systems/Standards (IMS/St) have not been thoroughly discussed, especially regarding their impact on innovation performance and companies' overall performance. This literature review used a well-structured and replicable methodology to find the main gaps in this research field, providing a better understanding of the directions and dimensions of the literature, and insight for future directions.

The main gaps are the lack of research in the following domains:

- (a) The methods of the parallel implementation of IMS/St and other management systems.
- (b) The impact of IMS/St on each factor of the companies' performance.
- (c) The analysis of the IMSts.
- (d) The impact of IMS/St on each type of innovation.
- (e) The empirical study of the IMS/St in different sectors (services, industry, etc.).

Moreover, this paper contributes to the IMS/St arena from a theoretical point of view in two major ways.

- (a) Previous reviews of the literature have been updated and extended, even if this is the first review of the IMS/St literature.
- (b) It provides recommendations for future paths of research for IMS/St domains.

Apart from the above-mentioned theoretical contributions, this paper also provides some managerial implications that could help firms to put it into practice. The literature shows that IMS/St can boost various types of innovation, and that it can increase innovation capabilities and value creation through innovation activities, thus eventually creating more value for the organization. Managers can also benefit from the implementation of IMS/St on innovation and marketing performance, which has been validated in the literature. These could be useful to managers who intend to adopt IMS/St, and could support them in better understanding the implications and fields of application of IMS/St, and in developing a productive method to adopt one of these systems/standards.

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Appendix A

Table A1. The chosen articles after the filtering steps.

Ref No.	Title	Year	Purpose
1	A measurement scale for product innovation performance [68]	2006	Review the findings of the research aiming at envisaging and establishing accurate measurements for two main dimensions of the efficiency of the performance of product innovation in the framework of firm competition.
2	A model for corporate renewal requirements for innovation management [49]	2010	Enhance the awareness of the constant renewal of the enterprise. The study addresses the management of innovation, strategic renewal, organizational learning, and organizational change and adapting. It intends to provide a detailed viewpoint on these four different approaches to enterprise renewal.
3	A Proposed Innovation Management System Framework: A Solution for Organizations Aimed for Obtaining Performance [31]	2012	In order to achieve the real success of the company, the authors suggest a model for the development of an innovation management system to address all significant aspects of the firm system.

Table A1. Cont.

Ref No.	Title	Year	Purpose
4	A systematic literature review on firm-level innovation management systems [7]	2015	
5	Achieving Performance of Organization by Developing a Model of Innovation Management [33]	2013	Propose an innovation management framework for marketing innovation, product innovation, process innovation, network innovation, human resources advancement in innovation, administrative innovation, strategic innovation and vision and policy of innovation.
6	An innovation management system to create growth in mature industrial technology firms [71]	2015	Suggest a multi-case study research framework that links critical components of the innovation system with growth performance.
7	Application of the IUMSS methodology in an R&D-oriented nanotechnology setting [62]	2010	Examine the usability of management system standards (MSSs) in a nanotechnology setting geared towards R&D.
8	Are National Systems of Innovation Converging ? the Case Are National Systems of Innovation Converging ? the Case of Cen/Ts 16555 [77]	2015	Study of recent efforts to unify European-level innovation management as a practical measure of the degree of internationalization of national innovation systems.
9	Building knowledge for innovation management: The experience of the Umanlab research team [65]	2012	Assess the production conditions of methodological expertise for innovation management.
10	Business Models for Corporate Innovation Management: Introduction of A Business Model Innovation Tool for Established Firms [22]	2018	Supply existing companies with Business Model Innovation Tool
11	Chief technology officer's views and behaviors in the dual innovation management system [82]	2009	Introduce the concepts of a Dual Innovation management system consisting of an innovation management system for managing the existing business areas and one for developing new business areas.
12	Cognitive Approach in Development of Innovation Management Models for Company [30]	2012	Consider the ability to use the cognitive approach to develop CIM models and implement successful innovation management systems.
13	Development and Operationalization of a Model of Innovation Management System As Part of an Integrated Quality-Environment-Safety System [47]	2017	Establish a relationship between innovation and unified management systems by suggesting, as part of an integrated quality, environmental and safety management system, an innovation management system model. Innovation management and its correlation to other systems of management. Provide an innovation management system model to companies as part of an integrated management system.
14	Diffusion of the UNE166002 Innovation Management Standard: a forecast model approach towards Internationalization [44]	2014	Study the spread of UNE 166002 standard for innovation management in Spain and predict the model of a hypothetical future standard for innovation management internationally.

Table A1. Cont.

Ref No.	Title	Year	Purpose
15	Does innovation lead to performance? An empirical study of SMEs in Taiwan [69]	2007	Explore the nature and form of everyday innovation activities of Taiwan's small- and medium-sized enterprises (SMEs) from a multi-dimensional perspective. In addition to discussing the relationship between innovation and organizational performance.
16	Effects of innovation management system standardization on firms: evidence from text mining annual reports [45]	2017	Study of the effects of the standardization of values and attitudes concerning the innovation in Spanish companies.
17	Emerging technologies-beyond the chasm: Assessing technological forecasting and its implication for innovation management in Korea [86]	2016	Evaluate technological prediction within a framework for innovation management.
18	R + D + I Teams. Bases for the development of R + D + I teams in companies in the Department of Quindío-Colombia [46]	2016	Study the possible integration of the public sector's innovation and quality management practices.
19	Fostering innovation with KM 2.0 [21]	2010	Develop a general framework that explains how the use of KM 2.0 technologies will benefit new generations of agile innovation processes.
20	Importance of an Innovation Management System [74]	2013	Respond to two questions. Firstly, what are the benefits of implementing an RDI management based on a certified system? Secondly, what is the impact of implementing a certified innovation management system depending on a Portuguese sample?
21	Innovation and ontologies: Structuring the early stages of innovation management [23]	2009	Analyse ontology as a modelling, analysis and comparison approach to the vague front-end of innovation management, especially the evaluation and selection of ideas.
22	Innovation Management (Une-Cen/Ts 16555-1:2013) Applied To Superior Education: Integration of Disruptive Technologies for the Teaching of Chemistry [60]	2015	Introduce disruptive technologies integration in chemistry teaching from an innovation management perspective.
23	Innovation management and Romanian SME's [34]	2010	Understand the relation between innovation and SMEs development in Romania.
24	Innovation management as part of the general management of the organization [24]	2018	Examine innovation management viewpoints and how companies can execute their innovation management practices and be prepared to face emerging challenges.
25	Innovation Management in Global Competition and Competitive Advantage [35]	2015	Assess the effect of innovation management on the competitive advantage by stressing the value of management of innovation.
26	Innovation management measurement: A review [4]	2006	Innovation measurement, conceptualized as a process, gives a way for a series of separate studies. The result is a lack of an overall framework that covers the various activities needed to convert the concepts into useful and marketable products. We're attempting to address this gap.

Table A1. Cont.

Ref No.	Title	Year	Purpose
27	Innovation management processes, their internal organizational elements and contextual factors: An investigation in Brazil [67]	2014	Study of the relationship between internal organizational components and the influence of contextual variables associated with the innovation management and its challenges.
28	Innovation management standards. A Comparative analysis [26]	2011	Analyse and compare the first two global standards of innovation management: Spain's UNE 166002:2006 and United Kingdom's BS 7000-1:2008.
29	Innovation management system based on performance drivers: A study applied to the Brazilian electric power sector [36]	2017	Suggest an innovation management system powered by performance motivators.
30	Innovation Management System of Ecuador [37]	2015	Clarify the emergence of Ecuador's national system of innovation management and review the public policies and financial movements to enhance this system.
31	Innovation management techniques and tools: Its impact on firm innovation performance [70]	2018	Discuss how the use of innovation management techniques (IMTS) affects the innovation performance of the company.
32	Innovation programs models: Design and management [64]	2019	Establish technological capabilities and measure innovation program performance for value creation for micro, small and medium-sized enterprises. Develop innovation programs as organized processes that integrate innovation in product, service, processes, marketing and business models, while at the same time developing capabilities that allow the company's leaders to take innovative action.
33	Innovation types and innovation management practices in service companies [75]	2007	Examine the various types of innovation prevalent in UK service industry companies, the degree of innovation, and the innovation-related practices and their relationship with the firm's performance.
34	Integration of market pull and technology push in the corporate front end and innovation management-Insights from the German software industry [50]	2009	Present a conceptual framework focused on theory and can be applied in today's corporate environment.
35	Investigating the use of information technology in managing innovation: A case study from a university technology transfer office [53]	2012	Analyse the use of information technology for innovation management.
36	ISO 50500 series innovation management: overview and potential usages in organizations [27]	2017	This paper discusses ISO 50500 series and motivates their anticipated effect on the creation of an innovation culture.
37	IT-supported innovation management in the automotive supplier industry to drive idea generation and leverage innovation [54]	2013	Identify the basic scheme of the innovation management system aimed at promoting current automotive supplier innovation management. Introduce a strategy through IT facilities to enhance innovation management.

Table A1. Cont.

Ref No.	Title	Year	Purpose
38	Management innovation through standardization: Consultants as standardizers of organizational practice [78]	2012	Claim that consultants-led management innovation is generally highly standardized.
39	Management innovation: A systematic review and meta-analysis of past decades of research [38]	2019	Conduct a systematic review and meta-analysis of the literature to have an insight into the current empirical research on management innovation.
40	Management Innovation: Correcting Mistakes [39]	2015	Discuss the issues of Kazakhstan's innovation development in view of the implementation of the programs approved in the industrial innovative development in the country.
41	Management of Innovation Processes in Company [79]	2015	This study aims to pursue a thorough analysis of the literature and research realized to create a model for the management of the company's innovation processes.
42	Management of Research, Development and Innovation Systems and the New Np 4457 Standard: an Implementation [59]	2008	Explain Brisa's innovation approach and the modification process carried out to satisfy all the criteria of the new standard.
43	Managing the implementation of innovation strategies in public service organisation-how managers may support employees innovative work behavior [80]	2019	Identify which management strategies can be used by public managers to improve their employees' innovative behaviour.
44	MIM3: Methodology of Innovation Management for Obtaining the Level 3 of I2MM [32]	2017	Create a methodological framework for enhancing innovation maturity management in order to achieve level 3 of the Integrated Innovation Maturity Model (I2MM), taking into account a holistic methodological approach involving good management practices in the following management areas: (a) strategic management; (b) project management; (c) innovation models and methods; (d) innovation management standards, (e) knowledge management, and (f) financial management.
45	Model for Systematic Innovation in Construction Companies [48]	2014	Define the methods and reasons for encouraging innovation in the construction firms.
46	Models with graphical representation for innovation management: a literature review [8]	2017	Suggest the type of innovation management models.
47	Organizational improvement through standardization of the innovation process in construction firms [55]	2012	Specify the innovation's motivators, success factors, advantages, and challenges in a medium-sized construction firm with a standardized system of innovation management.
48	Organizational innovation as an enabler of technological innovation capabilities and firm performance [72]	2012	Evaluate the relationship between organizational innovation and technical innovation capabilities and use a resource-based theoretical framework to study their effect on the firm's performance.
49	Organizational innovation management: An organization-wide perspective [84]	2008	Establish an organization-wide OIM framework and verify it.

Table A1. Cont.

Ref No.	Title	Year	Purpose
50	Organizational innovation: The challenge of measuring non-technical innovation in large-scale surveys [81]	2008	Evaluate and monitor organizational innovations by using large-scale surveys. Identify and measure the organizational innovations in more detail by classifying them and comparing the different approaches for measuring them.
51	Self-certification framework for technological innovation: A case study [61]	2016	Propose a framework for self-certification to assess technological innovation and approve quality products. How and why the company's efforts to introduce self-certification program will contribute to product and process innovation.
52	Semantic Innovation Management System for the extended enterprise [87]	2011	Propose a Semantic Innovation Management System (SIMS) framework.
53	Smart innovation management in product life cycle [40]	2016	Develop a framework of product smart innovation management that enables entrepreneurs and organisations to technically and rapidly implement the innovation process, as this framework would store expertise and previous innovation experiences with different products.
54	Standardised innovation management systems: A case study of the Spanish standard UNE 166002:2006 [28]	2011	Examine the possibility of standardized innovation management.
55	Standardization and Innovation Management Letter from Standardization [41]	2017	Is standardization an innovation driver or an obstacle?
56	Standardization as open innovation: Two cases from the mobile industry [66]	2009	Present standardization as a neutral field of open innovation. The numerous open membership policies in the standardization initiatives result in different processes of open innovation.
57	Standardizing innovation management: An opportunity for SMEs in the aerospace industry [58]	2019	Illustrate how real SMEs apply R+D+I management system by identifying and even testing the need to implement it.
58	The challenge of integrating innovation and quality management practice [63]	2016	Study the possible integration of the public sector's innovation and quality management practice.
59	The impact of standardized innovation management systems on innovation capability and business performance: An empirical study [20]	2016	Study the impact of Standardized Innovation Management System (SIMS) on the firm's innovation capability, innovation performance, and firm's results.
60	The need for innovation management and decision guidance in sustainable process design [56]	2016	Support the effective conversion of emerging technologies into innovation and industrial adoption within Europe. Innovation management and a new decision-making approach are advocated by the authors to enhance a holistic understanding of the economic, environmental and social challenges that new technologies need to respond to.
61	The performance implications of the UNE 166.000 standardised innovation management system [76]	2019	Examine the impact of the implementation of Standardized Innovation Management System (SIMS) in compliance with Spanish standard UNE 166.000 on technological and administrative innovations and the companies' performance.

Table A1. Cont.

Ref No.	Title	Year	Purpose
62	The Role of Management Innovation in Enabling Technological Process Innovation: An inter-organizational perspective [83]	2013	Address the gap that the role of management innovation in fostering technological process innovation in the inter-organizational context has not been fully explored.
63	The sources of management innovation: When firms introduce new management practices [73]	2009	Innovation in management and its precedents and ramifications for individual enterprises.
64	The standardization model of innovation: case of HTEs high-technology enterprises [57]	2016	This paper explores how to develop successful innovation management with standardization as an objective for HTEs.
65	Toward a multistage, multilevel theory of innovation [42]	2011	Suggest a cross-level theory to explain the terms in the process of innovation and outline the main concepts and themes that emerge in innovation research through analysis levels.
66	Toward a New Innovation Management Standard. Incorporation of the Knowledge Triangle Concept and Quadruple Innovation Helix Model into Innovation Management Standard [43]	2017	In perspective of the quadruple innovation helix model and the knowledge triangle concept, European Committee for Standardization (CEN) has established a critical review of European innovation management system as a technical specification.
67	Towards an integrated approach to improving innovation management system of mining companies [29]	2019	Identify the key elements of the innovation management system aimed at preserving the company's innovation practices, improving its innovation performance and enhancing its capacity to innovate, thus constantly expanding the opportunities for future innovation-oriented activities.
68	Towards Systematic Business Model Innovation: Lessons from Product Innovation Management [25]	2012	Systematically examine the similarities and discrepancies between innovation model of product and business to evaluate the potential of the transfer of insights and best practices.
69	Implementing an innovation management system at national research and development institute for industrial ecology–ECOIND [88]	2020	Presents the activities performed for the implementation of the innovation management system integrated into the existing quality, environmental, and occupational health and safety management system of the ECOIND institute
70	Communities of learning as support for one knowledge and innovation management system: A case study [52]	2020	Proposes the creation of a community of learning as a space for innovation within the organization
71	Does Standardized Innovation Management Systems Matter For Innovative Capability And Business Performance [2]	2020	Assessed whether standardized innovation management systems framework matter for innovative capability and business performance of companies.
72	Making 'hidden innovation' visible: A case study of an innovation management system in health care [89]	2020	Finding a way to make 'hidden innovations' visible is important if innovation is to be managed strategically within and across hospitals
73	Managing innovation in complicatedly organized facilities [51]	2020	To reveal the features and stages of innovation management in complicatedly organized facilities on the example of the city.

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