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Article *in* Revista de Administração de Empresas · January 2024

DOI: 10.1590/S0034-759020240107

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Submitted 04-27-2023. Approved 09-19-2023
Evaluated through a double-anonymized peer review. Associate Editor: Rudra Pradhan
The reviewers did not authorize the disclosure of their identity and review report.
Original version | DOI: http://dx.doi.org/10.1590/S0034-759020240107

INNOVATION MANAGEMENT: STILL A LONG WAY TO GO

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UNDERSTANDING THE ROLE OF INNOVATION

The capacity to innovate is crucial for competitiveness and economic growth (Ikenami et al., 2016). It is associated with the search for differentiations capable of producing improved products and services for the market that generate sustainable competitive advantages (Vilha, 2010). The culture of innovation is recognized as a good organizational insurance for more longevity in an environment of fast-moving markets (Hidalgo & Albors, 2008). The key to creating and maintaining competitive advantage will belong to those organizations that manage to innovate continuously, but many companies fail to realize this (Zen et al., 2017). Besides the growth in investments in innovation, a survey carried out by The Boston Consulting Group (2006) found that 48% of senior executives were dissatisfied with their financial results. A similar conclusion was obtained in a survey with 519 executives at large US, UK, and French organizations, where only 32% of respondents were very satisfied with the return on investment or profits from innovation in 2012 (Koetzier & Alon, 2013). This essay discusses the advances and limits of innovation management in recent decades, aligned with the open innovation paradigm, and from the perspective of innovation as a process, addressing some of the main innovations in this field, namely, innovation management systems, innovation management standards, innovation management tools, and innovation capability self-audit tools.

The comprehension of innovation has changed in recent decades (Halfmann et al., 2018). It is seen as a discontinuous process, in a complex ecosystem, with different actors interacting in a national and increasingly global context. Innovation is in its 'fifth generation' (Rothwell, 1992) as the consequence of rich and diverse network connections, accelerated and made possible by a vast array of information and communication technologies (Tidd et al., 2005). Another more

recent perception is that innovations are the result of systematic investments (not necessarily financial) and efforts aimed at specific targets (Salerno et al., 2010) and are a cumulative process that must be carried out in an integrated manner, not just managing or developing skills in some areas (Tidd et al., 2005). In addition to a flash of genius, successful innovations generally come from a conscious and intentional search for these opportunities (Kruger et al., 2019), so little should be left to chance.

Innovation has been taken as almost everything and is everywhere (Kahn, 2018). Organizations and politicians are including it in their statements, organograms, and speeches. Departments and innovation centers already exist or are being created on university campuses, companies, cities, and regions. Through such pervasiveness, innovation is considered the most important and overused word in America (O'Bryan, 2013), resulting in incomprehension and mistakes (Kahn, 2018). A serious discussion of innovation requires rigor with its definitions.

The term innovation was first conceptualized by Schumpeter (1934) in "The Theory of Economic Development," in which he defined it as "the new combination of production means, which covers the five following cases, a new: good; method of production; market; source of supply; and organization of industry" (p. 32). The Oslo Manual has marked the field of innovation for the past 25 years, with impact reaching out to both research and industry. In its third edition, it brings the most used definition for innovation: the "implementation of a new or significantly improved product (good or service), or process, a new marketing method or a new organizational method in business practices, workplace organization or external relations" (Organisation for Economic Co-operation and Development [OECD]/Eurostat, 2005, p. 46). The fourth edition of the Oslo Manual (OECD/Eurostat, 2018) brought a new category of innovation, the "Business model innovations," "which can vary from partial business model innovations that only affect either a firm's products or business functions, to comprehensive business model innovations that involve both products and business functions" (OECD/Eurostat, 2018, pp. 76-77).

The concept of organizational innovation has developed from Schumpeter's initial work. It means changes in internal organizational structure and procedures that facilitate organizational change and growth in response to market demands (Damanpour & Aravind, 2012). This type of innovation has neither conceptually nor empirically been examined as widely at the firm level of analysis as technological innovation, which is outlined as a redesign of the company's goods and services (i.e., product innovation), and how they are produced and provided (i.e., process innovation) (Diéguez-Soto et al., 2016). The understanding of this concept is somewhat controversial. Different terms, such as organizational, administrative, and management innovation, have been used to conceptualize innovative changes in management practices and processes. However, despite their overlap, they are not identical (Volberda et al., 2013). Administrative innovation has a more restricted meaning and is typically associated with innovations around resource allocation, organizational structure, and human resource policies and excludes operations and marketing management (Birkinshaw et al., 2008). Organizational innovation has been used in broader terms, including any innovative activity within the firm. However, this definition

does not comprise the function of administrators or adjustments to how management tasks are carried out (Birkinshaw et al., 2008).

The term management innovation is used for the creation and implementation of a new management practice, strategy, structure, process, administrative systems, procedures, or management techniques to preserve or enhance organizational performance or effectiveness (Birkinshaw et al., 2008; Damanpour & Aravind, 2012). Management innovation consists of sustainably changing a firm's organizational form, practices, and processes in a new way to the firm and leveraging its technological knowledge base and erformance in terms of innovation, productivity, and competitiveness (Volberda et al., 2013). Management innovation has gained more acceptance in recent publications since it is viewed as more comprehensive (Ozturk & Ozen, 2020). Managerial innovations are often generated by the following phases: dissatisfaction with the company status quo; inspiration from outside; invention; validation; and diffusion (Birkinshaw & Mol, 2006).

Managerial innovations are keys to success for companies, and they require the support of high-level management, especially for radical changes (Dereli, 2015). According to Diéguez-Soto et al. (2016), professional management positively affects firm innovation, and management innovation acts as an antecedent and facilitator of product and process innovation. Volberda et al. (2013) bring some evidence from both small and medium enterprises (SME), and large firms that shows that successful innovation is largely explained by what has been called 'management innovation' not just the result of technological innovation. An investigation of the effects of management innovation in 1,065 firms in Turkey found that changes in managerial practices have a greater impact on process innovation than product innovation, especially in small firms (i.e., bellow 50 employees) (Ozturk & Ozen, 2020).

Proper management innovation seems to provide a competitive advantage for the firms (Dereli, 2015). The changes in management practices and processes are often intangible and difficult to replicate. According to resource-based view, introducing management innovations enables firms to have "valuable, rare, inimitable, and firm-specific resources and knowledge" (Ozturk & Ozen, 2020, p. 1). These innovations are unique to the company that develops them and are abstract in character. Despite the recent increase in academic interest, management innovation is still under-researched. It is the subject of only 3% of articles on innovation, according to the systematic literature review conducted by Crossan and Apaydin (2010).

BUILDING ENVIRONMENTS MORE OPEN TO INNOVATION

On a broader level, the attempt to build environments more conducive to innovation has occurred through initiatives such as the strengthening of the National Innovation System, the Triple Helix, the perspective of Open Innovation, and the construction of Innovation Ecosystems. These models have been operationalized in different ways and conditions and are not exclusive. Although there is significant private and public funding for projects and efforts for building and encouraging environments conducive to innovation, innovation management does not receive

the same importance. The leaders of organizations understand that innovating is a necessity, but few know about the important role of managing innovation and creativity in a specific context (Riederer et al., 2005).

This bias can occur for two reasons: the lack of clarity in understanding innovation in the most entrepreneurial and marketing sense and the resistance to establishing a more formal, organized, and effective procedure for managing innovation from a mistaken perception of antagonism between discipline and creativity (Coutinho et al., 2006). According to Tidd et al. (2005), most companies are expected to be reluctant learners. New routines need to be learned (and understood), which is often difficult, requires time and money for new experiments, disrupts company's routines, and requires new personnel and skills.

Innovation management, more than an innovation in organizational or managerial terms, comprises the systematic use of mechanisms to plan, organize, lead, and coordinate the company's resources and competencies to generate innovations in line with the company's strategies (Vilha, 2010). Melendez et al. (2019) highlight innovation management as a "mechanism that allows to shape the innovation process, facilitating companies to generate new ideas, practices, and products in a systematic way, producing a positive effect of innovation on the performance of companies" (p. 81). Innovation management can be understood as a process that must involve several hierarchical and knowledge levels and permeate the entire organization (Zen et al., 2017).

The literature on innovation management bridges the knowledge gap between the issue of managing technology and how that management relates to strategic management, which is essential to a company's long-term success and existence (Espinosa-Cristia, 2019). Teece (1986) seeks to understand why some innovative companies fail to make a profit from it and why a fast second participant or a slower third entrant performed better than the original company. The strategic management of innovation seems to be a fundamental and actual concept, which allows choosing the best partnerships, aligning the needs of consumers to be met, and the best time and way to bring the product to the market. Therefore, it must consider three factors: the structure of the company's complementary assets and their specialization; the firm's positioning in the market with respect to critical complementary assets; and managing market entry. Complementary assets and differentiated routines and skills provide the company with dynamic capabilities to sustain its competitive advantage (Espinosa-Cristia, 2019).

THE FORMALIZATION OF INNOVATION MANAGEMENT

Formal innovation management processes are still not a common practice (Kruger et al., 2019). One of the difficulties is that knowledge, innovation, and ideation processes are sometimes used interchangeably and cannot be taken as innovation management. Knowledge is a resource used in innovation and a possible result of the ideation process. The literature on innovation methods offers attractive problem solutions that are more contextual, short, and to the point, like Creative Problem Solving (CPS), the lean startup methodology, and the Design Science

Research Methodology (DSRM) etc. The lean startup methodology (Ries, 2011) has tried to combine working context with innovation inducement processes, very much seen in the Internet business. From this method, we inherited the MVP (minimum viable products) concept. The DSRM is an innovation process enrooted in the R&D community (Peffers et al., 2007) to support the design and implementation of artifacts, which connects research and professional practices to promote innovation, its implementation, and evaluation (Lapão et al., 2017).

The growing interest in innovation management has impacted the creation of international standards for innovation management systems and on the expansion of literature and studies on this topic (Moreno-Conde et al., 2019). The first management standard of RD&I - Research, Development and Innovation, Una Norma Española series - UNE 166000, was published in 2006 by the Spanish Standards Development Organization (AENOR). In 2013, the European Committee for Standardization created a European technical specification for innovation management (CEN/TS 16555 Innovation Management System). The first Brazilian norm for Innovation Management System was launched in November 2011 and is the NBR 16501:2011, Guidelines for research, development, and innovation management systems (RD&I), from the Brazilian Association of Technical Standards ABNT, based on the Spanish series. In 2020 and 2021, the Brazilian norm was updated, with the adoption of ABNT NBR ISO 56000:2021 and ABNT NBR ISO 56002:2020, which are identical in technical content, structure, and wording, to ISO 56000:2020 and ISO 56002:2019, respectively, which were elaborated by the Technical Committee of Innovation Management (ISO/TC 279). In the last 15 years, the expansion of the standardization of innovation management systems has been huge. Many other countries, such as Portugal (2007), France (2013), Ireland (2009), Russia (2010), Denmark (2010), and Colombia (2008), actually have their own innovation management system norm and certification entity. In Spain, a predecessor in this work that consists of governmental financial incentives, the Spanish Standardization Association (AENOR), has granted more than 600 R+D+i Management Systems certificates to prestigious organizations, both public and private, according to AENOR website, at https://www.aenorportugal.com/certificacion/idi/sistemas-de-gestao-de-i+d+i-une-166002. This number is still small since, in terms of comparison, in 2021, in Spain there were 31,318 certificates issued under the ISO 9001:2015 standard - Quality management systems, according to the 2021 ISO Census, available at https://www.iso.org /the-iso-survey.html. Despite the number of certifications awarded for innovation management systems being so small compared to the number of quality management system certifications, the latter was launched in 1994, or almost 30 years ago, and there is an intense potential to expand.

According to Hidalgo and Albors (2008), the use of certification systems in innovation management can bring several advantages, such as supporting the establishment of an innovation culture, increasing competitiveness, and taking advantage of a knowledge-driven economy. The benefits of an innovation management system certification are similar to other management certifications, such as the ISO 9001:2015 quality management system, which are: transparency of activities; add value to the company, improving its corporate image; implement managerial advanced activities and incorporate them into general management; plan, organize and oversee units; improve product portfolio; and ensure linkage with other management systems.

Innovation management rules foment an essential change in the strategic perception of the organization, which seems to improve its capacities, such as strategically managing human and other resources, networking with partners, creating adaptive and interactive organizational structures, individual and corporate motivation, developing an innovative strategic vision, and the need for new innovation management tools (IMT) (Hidalgo & Albors, 2008).

IMTs are tools, techniques, and methodologies that support the innovation process in firms and support them in achieving new market challenges (Hidalgo & Albors, 2008). There is a broad scope of IMTs available, like knowledge audits and mapping, technology search, patents analysis, customer relationship management, groupware, team-building, supply chain management, project portfolio management, CAD systems, rapid prototyping, and others. A list of IMT typologies, methodologies, and tools can be accessed in Hidalgo and Albors (2008). A survey conducted by Hidalgo and Albors (2008) on the main perceptions of IMTs, with 426 respondents, discovered that the most frequently employed IMTs were project management (82%), succeeded by business plan development (67%), corporate intranets (66%), and the last was benchmarking (60%). In their survey 37% of the respondents declared that most companies are not aware of the existence of IMTs, and 34% declared that only a few IMTs are sufficiently defined to be used successfully in companies. Managers realize innovation as an overall strategy rather than as specific, independent improvements, and they agree that IMTs are not customary, not easily identified, and inaccessible.

An innovation in the field of innovation management is the self-assessment of innovation capacity. Cormican and O'Sullivan (2004) developed the Product Innovation Management (PIM) scorecard, a self-assessment audit made up of 50 criteria or traits drawn from the critical success factors model, organized into five key activities: analyze the environment and identify opportunities; generate innovations and investigate; plan the project and select sponsor; prioritize the project and assign teams; and implement product innovation plan.

In the last fifteen years, the self-diagnostic models of innovation have been expanded, with the participation and incentive of the private sector and the big auditing and consulting firms. These models allow companies to analyze their innovation performance by identifying and evaluating their capabilities and weaknesses within the framework of innovation practices. The Innovation Scoring® Model Evaluation Report from COTEC Portugal (COTEC, 2016) analyzes and compares six different diagnosis and self-diagnosis models with recognized merit, which are: Innovation Scoring, IMP3rove, Fraunhofer, PwC's Strategy&, SPRING Singapore, and McKinsey. The models are influenced by the innovation management systems standards, especially the standard CEN/TS 16555-7:2015 Innovation management - Part 7: Innovation Management Assessment. The platforms differ in relation to several aspects, such as whether they are free, partially free, or fully charged; whether they have information audits in terms of the dimensions investigated and the criteria used, but in general they are quite extensive and detailed. There are no numbers available on how many companies performed the self-diagnosis on each platform, nor research on the use of this information and whether it was useful to promote the improvement of companies' innovation capacity.

INNOVATION MANAGEMENT AS A PROCESS

Innovation concept understanding has three main perspectives: outcome, process, and mindset (Kahn, 2018). Innovation as an outcome emphasizes output, usually related to the launch of new products and services. Studies of innovation as an outcome predominantly investigate the external and internal conditions under which an organization innovates (Damanpour & Aravind, 2012). Innovation as a process addresses how innovation efforts are and should be properly organized. Process models work with innovation patterns, phases [origin, development, commercialization, diffusion, adoption, or implementation], and checkpoints, building a new product development (NPD) process (Damanpour & Aravind, 2012). Innovation as a mindset focuses on individuals internalizing innovation and fostering a supportive culture throughout the organization. When organizations innovate, they more frequently need all types together.

For this essay, we present innovation management from the perspective of innovation as a process. These highly structured approaches to managing the innovation process emerged in the 1990s. In this sense, innovation can be understood as a flow that starts with a mass of innovative ideas regarding a specific problem, which are selected and refined until the best are brought to solve it and eventually to commercialization. Systems could manage this flow (Davila et al., 2006). The division of the product development process into distinct, discrete, and structured stages, with milestones in the form of quality control checkpoints, is a common feature of these approaches (Adams et al., 2006). Strategic decisions must guide innovation efforts, but organizational, managerial, and administrative structures support the innovation process. To understand innovation as a process, innovation should not be seen as a linear process, where resources are sequentially channeled at one end, from which emerges a new product or process (Adams et al., 2006). The system must be flexible and fluid in moving through all innovation stages and is different, to some degree, across and within organizations on a project-by-project basis (Adams et al., 2006).

"Innovation management systems are established policies, procedures, and information mechanisms that facilitate the innovation process within and across organizations. They determine the shape of daily staff interactions and decisions, the order in which work happens, how it is prioritized and evaluated daily, and how different parts of the organization use the organizational structure to communicate" (Davila et al., 2006, p. 8).

The literature on innovation management brings some systems proposals under the innovation as a process perspective. However, they rarely take the official international standards (ISO, CEN, ABNT, or others) for innovation management systems or their lessons. Vilha (2010) proposes the Technological Innovation Management (TIM) Model, which considers three dimensions: strategic, tactical, and operational. Another well-known model was developed by Tidd et al. (2005), which is simple, generic, and directed to the key aspects of innovation management. This model is divided into four phases: research; selection of technological and market opportunities; implementation (acquisition of knowledge and technology, project execution, the launch of innovation and sustainability); and learning and renewal. Adams et al. (2006) developed a summarized framework for the innovation management process, with

seven parts: inputs management, knowledge management, innovation strategy, organizational culture and structure, portfolio management, project management, and commercialization.

The most disseminated innovation management models are the 'Funnel of Innovation' and the 'Stage Gates' approaches (Vilha, 2010). They were developed between the 1980s and 1990s, and although they were created with a focus on new products, both have also been used for new services (Kitsuta & Quadros, 2019). The Funnel of Innovation approach, developed by Clark and Wheelwright (1993), is widely used in the consumer goods industries, where the volume of ideas for new products tends to be large, and the teams of innovation, through phases and evaluations, seek to reduce the number of ideas and prioritize efforts in those most likely to succeed in the market. The funnel provides an overall framework for generating and reviewing alternatives, the sequence of critical decisions, and the nature of decision-making.

The most used and influential model for innovation management is the so-called stage gates or Phased Review Process (Coutinho et al., 2006), which was developed by Cooper (1994) and is the third generation of a model developed in the early 1960s, called NASA's PPP (phased project planning), which served for the management of contractors and suppliers of the North American space program. Cooper (1994) developed the stage gates system around the five F: (i) to be Fluid (Fluidity) and adaptable; (ii) incorporating Fuzzy gates (the decisions are always conditional); (iii) provide Focus on resources and project portfolio management; (iv) be more Flexible than previous processes; and (v) and admit Failures. This process, with high flexibility and discretion for project leaders, can bring more errors.

Stage gates divide the development of a new product into a predetermined set of stages, each composed of prescribed, transversal, and parallel activities. The bridge (gate) between each stage controls the process and serves as a quality control and checkpoint. Cooper (1994) subdivides the innovation process into four stages and five gates. Starting from ideas, the first gate corresponds to the selection of ideas for the first stage of preliminary investigation. Then, we proceed to the business case assembly, development, testing, and validation stages. Once the last stage is completed, there is the last gate that leads to the product launch. The organization evaluates each innovation project during its progress and gradually increases its commitment, and the uncertainties and risks are discussed in each stage (Cooper, 2008). One of the central characteristics of the stage-gate system is that it is multifunctional, overcoming a limitation of the original PPP model, which was largely an engineering methodology. Each stage of the innovation process involves activities from many departments of the corporation and no stage is owned by anyone, reducing the influence created by functional fiefdoms" (Cooper, 1994).

Coutinho et al. (2006), based on the stage-gates model, subdivide the innovation process into six activities - raising initial ideas, defining the scope, assembling business cases, developing prototypes, testing and validating, and launching the product - and in five moments of decision-making - evaluating ideas, selecting ideas, developing, testing, and launching. To build an Innovation Management System (IMS), Coutinho et al. (2006) resumed the innovation process in just four segments: identification of opportunities; selection and prioritization; development and implementation of opportunities; and a system for evaluating the process and metrics. In addition to these, Longanezi et al. (2008) propose two more steps: environmental intelligence, and

definition of technological and market strategies. Before, these activities had been included in the stages of identifying opportunities, selection, and prioritization. Environmental intelligence permeates all organizational levels and activities, is a complex and time-consuming activity, and deserves dedicated coordination. The definition of strategies is the activity that should guide the entire innovation system. In this innovation system, the contact with customers or users starts at the beginning of the innovation process, and there is a greater regularity in the evaluation of projects (Longanezi et al., 2008).

Much of the research on innovation management has tried to identify general 'best-practice.' However, companies differ in sources of innovation and technological and market opportunities. Organization-specific characteristics hinder the notion of a universal formula for successful innovation (Tidd, 2001). There is still no evidence of a 'single' or 'best' system for organizations to carry out and manage innovation, the best tools that must be part of a complete innovation management system, or the right context to implement a specific agenda. Contingency theory increases the understanding of how context influences innovation management. A review made by Tidd (2001) suggests that "the complexity and uncertainty of the environment largely affects the degree, type, organization and management of innovation, and that the greater the fit between these factors, the greater the performance" (p. 176). Each company must identify its own solution. The type of innovation, incremental or radical (or even disruptive), also defines the innovation management model and techniques to be employed (Ocampo et al., 2019).

FINAL CONSIDERATIONS

An organization developed to address a specific market does not evolve and generates innovations naturally. Institutions need boldness and willingness; scientific knowledge and experience in their fields of activity; access to modern technologies for research; connections and partnerships at different stages of innovation; acting more dynamically; and being in tune with the sectorial, policies, and market challenges. In addition, organizations need the most adequate means of planning and management. Organizations need to be more serious about innovation, understanding their strategic nature, and building the capacity to manage it.

In the last decades, there has been a growing interest in accelerating the innovation capacity of organizational environments and business ecosystems, encouraging national and sub-national innovation systems, expanding funds, and reforming the legal frameworks of R,D&I. While governments plan, regulate, and finance, the performance of organizations, which are the true suppliers of goods and services to society, ultimately determines the success of policies (Howlett et al., 2015). Macro-level initiatives need to consider the organizational dimension and its possible sources of failure.

It is becoming increasingly clear that businesses that are more serious about innovation will thrive in this new age by creating and introducing new goods more effectively, efficiently, and sustainably. Additionally, it is becoming obvious that managing the innovation process effectively

is the only way to accomplish this objective. Therefore, managers must develop and provide the necessary infrastructures and support systems. Organizations can improve their chances of hiring the finest talent and creating a conducive environment for innovation by knowing the procedure and the elements that promote product innovation (Cormican & O'Sullivan, 2004).

Organizations that aim to innovate must build a formal process for innovating and make use of the most recommended innovation management tools and techniques (Adams et al., 2006). According to the fundamental assertion of innovation, which says: "How you innovate determines what you innovate" (Davila et al., 2006, p. 2), companies must pay attention to how they are managing it. The socio-technical systems used must also be adapted to the company for the innovation process to be managed effectively (Cormican & O'Sullivan, 2004). The implementation of an innovation management system is an innovation and is not a secret formula (Davila et al., 2006). However, we must be aware of the limitations of the innovation management systems and perceive that they enhance good management and do not substitute it.

In the last fifteen years, there have been many initiatives to improve the management of innovation, like the proposition of new innovation management systems models and sometimes their implementation; the expansion in the proposition of innovation management standards, such as the families' norms CEN:16555 and ISO:56000; the increasing use of innovation management tools; and the self-auditing innovation capacities web platforms. Standards facilitate the adhesion of organizations. All of these mentioned initiatives are recent, are still in the process of being improved, are still underrepresented compared to the universe of organizations that want and need to innovate continuously and efficiently and must be seriously evaluated to really have the capacity to deliver lessons and a pathway for organizations that want to be more innovative.

Adopting an innovation management system (IMS) is a high-level organizational decision and must be aligned with its strategic objectives. Phased innovation management systems have limitations. They focus on monitoring and controlling the technical risk of projects. However, the main objective can sometimes be acting very fast. Due to their formalism and stages, innovation management systems in phases can restrict the ability to shorten development cycles. They also strangle partial access to information. Technical risk needs to be balanced with market risk, and this requires adaptation and balance to the project management system (e.g., a specific partnership), which changes to the empowerment of managers and a lesser emphasis on formal control. The degree of complexity of a project determines the effort required and, therefore, the duration of the development cycle. The one-size-fits-all mentality often creates a system untailored to the most complex projects. Disruptive innovation is a notoriously unpredictable activity and needs greater flexibility.

Innovation management must also take advantage of opportunities arising from partnerships and the ecosystems in which organizations are inserted. Not all innovation processes are necessarily carried out by the same organization, and not all innovation management needs to be carried out by the same organization.

There is still limited knowledge about the management of innovation, the use of a system and routines for this purpose, and what works best and under what conditions. The available

evidence on innovation management systems and their results is still scarce, difficult to generalize, and sometimes contradictory. What exists are case studies, multiple case studies, and some surveys based on a few aspects of the innovation system, with general self-reported information by managers or designated representatives that can have multiple meanings and interpretations on several dimensions. It is not really known what works in terms of innovation management, for what types of innovation, and under what circumstances.

It is still a new and expanding process that needs more systematic and empirical scientific research. The growing interest and the need to accelerate the innovation capacity of organizational environments, business ecosystems, and innovation systems and subsystems demands urgent empirical knowledge for managers, researchers, and politicians interested in improving the performance of ICT, Universities, Research Centers, technology parks, large and medium-sized companies, startups, technology-based companies, and other actors in the innovation ecosystem.

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NOTE

Fundação para a Ciência e a Tecnologia (FCT - MCTES), Project UIDB/00667/2020 (UNIDEMI).

Ministério da Gestão e da Inovação em Serviços Públicos, Post-Doc scholarship.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

AUTHORS' CONTRIBUTION

Trajano A. T. Quinhões: Conceptualization, data curation, formal analysis, funding acquisition; Investigation; Methodology; Project administration; Supervision; Validation; Visualization; Writing – original draft; Writing – proofreading and editing.
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