A SYSTEMATIC LITERATURE REVIEW ON FIRM-LEVEL INNOVATION MANAGEMENT SYSTEMS

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ABSTRACT

Innovation management has been defined as a set of organizational routines and activities aimed at developing a culture for innovation. As it can be expected, these routines and activities vary enormously among industries and firms. The systematic management of innovation at firm-level becomes even more complex when one considers the multiple interrelations and cooperative activities that occur in an increasingly open innovation paradigm. For these reasons, all kinds of models and proposals for firm-level innovation management have been proposed throughout the years. Some are fairly generic, while others are either industry- or firm-specific. Moreover, some models consider only what is within the firm's boundaries, while others consider its relationships with the whole business ecosystem. Finally, some models approach innovation from a product development perspective, while others concentrate on process innovation. As a result, there has been much confusion about what is and what constitutes an innovation management system. In fact, with few exceptions that are either limited in scope or level of analysis, no comprehensive systematic literature reviews on firm-level innovation management systems have been conducted. In this context, this paper presents partial results of a systematic review of published literature regarding innovation management systems. A total of 642 works were analysed by three researchers. In particular, this paper focuses on 27 of the 102 most relevant works. The main outcome is a tentative interpretative framework of innovation management systems that critically highlights and discusses their most common elements and aspects: an innovation process and elements that drive or support innovation. Implications for theory and practice are drawn from this taxonomy, including suggestions on how to use the proposed model for implementing a firm-level innovation management system.

Key words: innovation management; literature review; innovation process; innovation drivers.

INTRODUCTION

Innovation is one of the most important drivers of competitive firm performance in the modern business environment (Rubera and Kirca, 2012). While some organizations chose to innovate in order to differentiate themselves, other are forced to innovate in order to survive. Schumpeter (1942) popularized the 'creative destruction' phenomenon, which refers to the change brought by to an economic system by innovation introduced by business firms. The innovators become able to enjoy a quasi-monopoly position, which can be later threatened by imitation or new innovations. Thus, it becomes necessary to continuously innovate to maintain market leadership.

Since Schumpeter established the importance of innovation, many streams of research have been developed to investigate this phenomenon. One of the most relevant, for individual business firms, regards firm resources, processes, behaviours, characteristics, and determinants that drive innovative capability. In this context, many innovation management systems and models have been proposed to organize and make sense of the various aspects that must be managed to allow a firm to be innovative.

Many of these systems originated in or were strongly influenced by the product development literature, such as the innovation funnel (Wheelwright and Clarke, 1995), the stage-gate process (Cooper, 1993), and the product innovation process (Crawford, 1994). Authors like Tang (1998), Coriat and Weinstein (2002) and Hobdat (2005) proposed fairly generic innovation management systems. On the other hand, some authors proposed systems focused on specific sectors, such as Terziovski and Morgan's (2006) model for innovation in the biomedical industry, or companies, such as Figueroa and Conceição's (2000) proposal of an innovation management system at 3M. Irrespective of the nature and type of innovation management system proposed, the systematic management of innovation at the firm level is highly complex, as the phenomenon itself is influenced by many inter-related variables and activities, which can be internal or external to the firm. Thus, even the generic systems cannot be adopted without some adaptation for a particular setting or firm. On the other hand, there have been very few efforts to effectively map and critically analyse models and systems for managing innovation proposed in academic literature. One of the few attempts is the work of Cagnazzo et al. (2008), but they fall short of their objective. Other attempts to systematically map literature on innovation management only address the elements and determinants that influence innovative behaviour, like Crossan and Apaydin (2010).

In this context, the aim of this paper is to identify and analyse processes, elements and aspects that are common to innovation management systems published in literature. This is achieved through a systematic review of literature. Such an analysis is useful to support the proposition of new, specific innovation management systems as it allows relating the elements that constitute the system to factors that influence innovative behaviour. This paper also proposes a generic innovation management system that integrates the most common elements from the literature.

INNOVATION MANAGEMENT SYSTEMS

Schumpeter (1942) defined innovation as the introduction of new goods, an improved or better method of production, the opening of new markets, the conquest of new sources of supply, and the carrying out of a new organization of any industry. Since then, numerous authors further defined and operationalized the concept.

Crossan and Apaydin's (2010) extensive systematic review classified the term innovation according to numerous interpretations. A first distinction is that between invention and innovation. To Crossan and Apaydin (2010), more than doing something new, innovation is the result of an intentional and successful implementation of a new idea that brings benefits to the organization. Innovation, thus, includes the production or adoption, assimilation and exploitation of added value. Crossan and Apaydin (2010) also differentiate innovation as a process from innovation as an outcome and identify three common classification themes: process vs. product, radical vs. incremental, and technical vs. managerial.

Another famous typology of innovation is the "4Ps" by Tidd et al. (2008). In this typology, product innovation regards new or changed products/services, while process innovation regards how the product/service is made. Similarly, position innovation deals with changes in the context that a product/process is introduced to the market, while paradigm innovation deals with changes on the mental models upon which a business is built.

The radical vs. incremental dimension of innovation expresses the level of change brought about by an innovation. Windrum and Goñi (2008) discuss how radical innovation brings uncertainty and impacts established competencies, consequently changing power structures and imposing tension and uneasiness on organizations. Conversely, incremental innovation, which can be implemented through basic management tools such as PDCA (Plan, Do, Check, Act) or total quality management, tends to have clearer rules and is usually associated with more predictable – although limited – impacts. The challenge for any innovation management system, thus, is to manage discontinuities, which depend basically on the nature of the innovation.

To Coriat and Weinstein (2002), the role of an innovation management system is to manage information and knowledge necessary to innovate, to develop learning processes and to coordinate conflicting interests that come up during events of change. In short, the selection of an innovation management system is a strategic choice that directly influences a firm's ability to compete.

Rothwell (1994) proposed a generational classification of innovation management models with five generations. The first generation, from mid-1950s to mid-1960s, was dubbed the Technology Push generation, as innovation management systems were based on simple linear processes starting from R&D. Next, during the Market Pull generation, from mid-1960s to early 1970s, linear processes were also the norm, but they usually started from market needs and these needs directed R&D efforts. The third generation, in the late 1970s, focused on coupling models based on sequential innovation processes that included feedback and integration between marketing and R&D. The fourth generation was prominent during the 1980s and was characterized by integrated innovation systems, with parallel and integrated development teams and strong integration with external agents. Finally, the fifth generation, starting in the 1990s, added the concept of integrated innovation networks, as information technology helps to fully integrate all parties involved, among which clients become particularly relevant. Moreover, co-development models and horizontal collaboration relationships become more common. Although dated, Rothwell (1994) introduced the notion that innovation could be managed as a system, and not necessarily as a linear process.

However, the concept of innovation process as the core of an innovation management model has a long tradition. In fact, following Crossan and Apaydin (2010), innovation management systems can be thought of as a set of particular innovation drivers that support or facilitate an innovation process

within a specific company. Tang (1998) proposes two categories of innovation process: creative problem solution and new product development (NPD).

The first type comprises activities of data collection, problem definition, idea search, solution search, solution adoption, and monitoring actions. NPD processes can be modelled after the development funnel (Wheelwright and Clarke, 1995), including activities of idea generation, project definition, concept development, concept implementation, and product launch. Testing and validating can be added, as in the stage-gate (Cooper, 1993) and product innovation (Crawford, 1994) processes. Other innovation management systems are focused on processes characteristics of specific types of firms, such as Song et al.'s (2009) service innovation process. Innovation processes can also be modelled according to a firm's strategic definition. Huang et al. (2010), for instance, propose an innovation management system for imitative strategies based on a four-stage process.

The second basic component of an innovation management system is the set of drivers that facilitate or support the innovation process. These are also known throughout the literature as determinants of innovation. Most of these determinants were identified through empirical research. For instance, Coriat and Weinstein (2002) observed that two main organizational dimensions contribute to an effective innovation management system: how activities are coordinated and how information is shared across organizational units.

Similarly, Kline and Rosenberg (1986) showed how the ability to manage short and long knowledge loops impact the innovation process, thus highlighting the importance of managing internal and external knowledge sources. In fact, many authors that investigate innovation management agree that managing information flows is essential to effective innovation processes, particularly for firms that operate in technology intensive sectors (Figueroa and Conceição, 2000). In this sense, Monge et al. (1992) highlighted the importance of motivation and communication, and found out that communication issues are particularly important for an effective innovation process. Some authors even tried to single out how innovation drivers impact innovation processes in specific industries. That is the case of Terziovsky and Morgan's (2006) research in biomedical industry, which identified the importance of a number of critical success factors for innovation efficiency in that sector.

Based on this brief literature review, we argue that literature on innovation management systems can be subdivided into three main groups: (i) proposals of fairly generic innovation management systems built around innovation processes; (ii) identification of drivers, aspects, elements, and firm characteristics that support or facilitate innovation processes; and (iii) applied studies that investigate one or both of the elements mentioned above in specific companies or industries.

Evidently, single contributions can belong to more than one of the groups mentioned above. Moreover, there is wide variability regarding the specific terminology used to refer to innovation management systems and its constituting parts. However, although the literature on innovation management systems (and its derivations) seems to be extensive and well established, there have been very few attempts to systematize it (Cagnazzo et al., 2008; Crossan and Apaydin, 2010).

METHODOLOGICAL PROCEDURES

In the management field, literature reviews are usually conducted following a narrative format. However, this method has been criticizes for lacking procedural objectivity and being too prone to selection and interpretative bias by the researcher, as well as lacking repeatability (Fink, 1998).

Conversely, a systematic review is a planned and structured approach to reviewing published academic research that follows a clear, systematic, repeatable and transparent procedure. Usually, systematic reviews are useful to thoroughly mapping the state of the art of a single subject, following a well-defined research question (Transfield et al., 2003).

In this study, the objective of the systematic review is to map the state of the art in published firm-level research about innovation management systems, including variants such as models, processes, and drivers of innovation. Thus, the main research question that guided the systematic review was "how can innovation be systematically managed within a firm?" The systematic review followed a three-phase procedure: data collection, data analysis, and synthesis (Transfield et al., 2003). The data collection phase was conducted in the Web of Science database. The terms used in the search were a combination of "innovation management" or "innovation process" with "model" or "system" (i.e., "innovation management system", "innovation management model", "innovation process model", "innovation process system"). The search encompassed the whole temporal range available in the database up to (and including) June 2013, but was limited to papers in the areas of business economics, engineering, operations research, management science, and public administration.

A total of 642 papers were found. The abstracts for the whole sample of 642 papers were independently analysed by four researchers regarding its adherence to the main research question. Each reviewer independently assessed if the paper was relevant based on the abstract; if at least three researchers voted against it, it was excluded. If the result was even (two against, two favourable), the abstract was analysed by a fifth researcher, who casted the final vote. Following this analysis, 542 papers were excluded from the sample. Next, the full text for the 102 remaining papers was analysed in the data analysis phase. This analysis was again conducted independently by four researchers. The aspects considered in the full content analysis included: research approach (empirical or theoretical) and strategy, theoretical background, methodological procedures employed, empirical application in a firm or industrial sector, proposition of a model or system, phases/steps/stages of the model or system, drivers of innovation (aspects, elements, dimensions, characteristics, etc., that drive innovative behaviour), specific innovation management tools or techniques mentioned, and generation of innovation management models (following the classification by Rothweel, 1994, and the precepts of Open Innovation as a sixth generation). Each of the four researchers fully analysed the 102 papers and made notes for each of the above mentioned criteria. These notes were uploaded on an electronic database.

The third and last research phase was the development of a tentative interpretative framework that would synthetize all notes and observations. This was conducted by the four researchers during ten work meetings, which lasted four hours each on average. The focus of the synthesis effort was the identification of significant similarities and differences between the models, systems, and sets of drivers of innovation proposed or mentioned in the papers selected. The joint analysis by the four researchers allowed the identification of (i) complete innovation management system proposals, that is, models that include both an innovation process and a set of drivers of innovation; (ii) simplified or generic models, composed by a single innovation process (usually very simple or abstract); or (iii) a set of drivers of innovation. Finally, the common elements identified in the comparative analysis were generalized, interpreted and combined in a novel proposition of a firm-level generic innovation management system.

RESULTS

From the 102 papers selected, 27 presented a clear and well defined proposal for at least one of the two constituting elements of an innovation management system, as defined in this research: an innovation process and a set of drivers that facilitate or support innovation process activities. This paper will focus on the partial results derived from this selection of 27 key papers. Among this final selection, seven papers were focused on innovation processes, ten papers were focused on drivers, and nine present both the innovation process and its complementing drivers.

Innovation Process

For the purposes of this research, the innovation process is understood as the sequence of stages, phases or activities that describe the life cycle of innovation in a firm. This process may involve and encompass many functions and competences, both internal and external

The innovation processes mentioned or proposed in the 27 final papers vary according to the type of firm or innovation (product, service, process, position, paradigm) and the level of detail provided by the paper. The innovation processes discussed in the final selection of papers converge to a generic, sequential four-step innovation process: (i) idea generation; (ii) idea evaluation, selection, and prioritization; (iii) innovation development; and (iv) innovation implementation or launch.

It is worth noticing that these four stages are very similar to the ones described in the innovation processes by Tidd et al. (2008) and Bernstein and Singh (2006):

i. Idea generation: individuals in the organization collect and aggregate innovation-related information and knowledge (technological and marketing trends, capabilities, opportunities, threats, etc.) from internal and external sources and generate innovation ideas;
ii. Idea evaluation: ideas are evaluated by management (usually, not only technical and economic viability are evaluated, but also alignment to the firm's general strategy);
iii. Innovation development: promising and viable ideas become formalized projects, which are prioritized and, following resource allocation decision mechanisms, receive organizational resources and support; and
iv. Innovation implementation: the innovation project is introduced to the market or firm.

Other steps can be added to the linear four-step generic innovation process according to a specific firm strategy and the type, nature, and objective of the innovation idea/project. For instance, Mir and Casadesus (2011) claim that firms aiming at innovation with high technological content should add a previous "technology monitoring, forecasting & creativity" step to fuel idea generation.

On the other hand, it can be argued that the four-step process is too generic. While investigating the innovation process in a leading biotech firm, Khilji et al. (2006) found out that the traditional linear, sequential innovation process described above is not adequate for organizations in the biotech sector, because the development of relevant innovation in that technological context requires a complex and extensive network of internal and external actors such as regulatory agencies, funding organisms, intellectual propriety mechanisms, and research and development institutions.

This same caveat can be extended to other sectors, given the complexity that prevails in most contemporary competitive scenarios. In sum, the generic, sequential four-step innovation process should be considered a basic framework that has to be adapted and customized to the specificities

and particularities that characterize each single firm, including its competitive context, history, governance, culture, overall strategy, and organizational structure.

Table 1 shows a synthetic comparison between the innovation processes' elements described or mentioned in the 27 key papers that went through the detailed analysis reported in this paper.

Table 1: Innovation process as seen by the innovation literature

Authors	Process name	Focus	Idea Generation	Idea Evaluation	Innovation Development	Innovation Launch
Rothwell (1992)	Coupling model	Industrial innovation	Idea generation	NA	Development; prototype production	Manufacturing; marketing and sales
Sundbo (1996)	Balancing innovation empowerment	Services/low tech innovation	Idea generation	Transform to an innovation project	Development	Implementation
Padmore et al. (1998)	Chain link model of industrial innovation	Product	Concept; design	Deploy; prototype; pilot	Production operation; Process/system development	Distribution; selling
Tuominen et al. (1999)	Elemental innovation process	Product	Opportunity identification; goal setting; need assessment; idea generation	Product design; evaluation; selection	Process design; manufacturing	Market introduction; sales
Verhaeghe and Kfir (2002)	Knowledge intensive technology organization	Product/service based on technology	Idea generation	NA	Technology acquisition; development; networking	Market introduction; technology transfer
Cormican and O'Sullivan (2004)	Basic model of product innovation management	Product	Analyse environment and identify opportunities	Generate; investigate; project prioritization	Plan project; select sponsor; assign resources	Implement product; plan further innovation
Dillon et al. (2005)	Value innovation process model	Product; service; business model	Business intelligence	Value modelling and analysis;	NA	Communication; implementation; value validation
Bernstein and Singh (2006)	Innovation process model	NA	Idea generation	Innovation support	Innovation development	Innovation implementation
Meijer (2006)	Process of innovation management	NA	Idea generation	Business feasibility analysis	Development; scaling-up; validation	Transfer to running business
Mir et al. (2006)	Modified Kline innovation model	Product	Potential market analysis	Innovation selection;	Product	Potential market analysis
Brem and Voigt (2009)	Corporate idea management process	Product; process	Trends and ideas	Definition of search field; idea generation	Idea structure and design	Idea enhancement
Song et al. (2009)	SIM (Service Innovation Model)	Service	Idea screening	Business and marketing opportunity analysis	Service design; test	Service launch
Dervitsiotis (2010)	Four stages of the innovation value chain	NA	Idea generation and capture	Project	NA	Idea generation and capture
D'Alvano & Hidalgo (2012)	Temaguide	Service	Scan	Focus	Resources	Implementation; learning

Authors	Process name	Focus	Idea Generation	Idea Evaluation	Innovation Development	Innovation Launch
Russo-Spena and Mele (2012)	5 "Co-s" model	Network innovation	Co-ideation	Co-valuation	Co-design; co-test	Co-launch
Sun et al. (2012)	Multi-level conceptual model	NA	Idea generation	Idea screening	NA	Idea implementation

Innovation Drivers

A number of elements that influence innovation have been identified and categorized in the 27 key contributions that were subject to the detailed analysis reported in this paper. A good summary of innovation drivers is that by Dooley and O'Sullivan (2000), who differentiate between tangible and intangible elements that influence, direct, facilitate or hinder innovation. According to the authors, intangible elements like culture, personal schemas, resistance to change, politics, and fears, are normally underestimated in innovation management systems in comparison to more tangible elements such as the resource infrastructure and the information systems that support the innovation process itself. The systematic review allowed to identify, categorize, and group the most common innovation drivers.

The most common innovation driver in the key papers reviewed is Innovation Strategy. Strategy includes the firm's medium-to-long term vision regarding innovation, including the foresight about market and technological developments and an action plan to develop innovative capabilities to explore opportunities and defend against threats. As Thom (1990) puts it, it is important for the company to express and formalize its strategic objectives because it is through these objectives that innovation is justified. An innovation-oriented strategy is essential to the establishment of long-term directions for the innovative efforts (Kramer et al., 2003). At the same time, it tries to guarantee top management commitment to a path that can be perilous, dangerous, and risky, while setting adequate reward mechanisms that favour non-conformity to current business practices. This driver also includes directives for resource management mechanisms that recognize the specificities of innovation projects (Damanpour, 1991; Wan et al., 2003).

Another very common innovation driver identified in the systematic review is the Organizational Culture. To Kocher et al. (2011), the organizational culture represents a guideline that orients stakeholders' expectations. Cormican and O'Sullivan (2004) relate organizational culture to an orientation towards knowledge sharing. However, the authors mention that the organizational culture is not always an innovation driver per se, as it can also be a barrier to effective knowledge sharing and interpersonal information flows, with obvious negative consequences on innovation performance.

The third most commonly mentioned innovation driver in our systematic review was the Organizational Structure. Lee and Om (1994) defined organizational structure in a wide sense, that is, the element that designs and operates the innovation-oriented organization. Organizational structure is an all-encompassing driver that includes mechanisms of structural complexity, decision making, formalization and distribution of power and assignment of roles to all involved. Similarly, this driver includes organizational procedures to regulate conflict resolution inherent to the innovative activity. Thom (1990) mentions that the organizational structure must allow permeability,

so innovation champions and idea generators may find and establish relationships with power promoters, that is, organizational agents that will allow ideas to be transformed in innovation projects.

Another key driver for innovation is management Leadership. The leader influences, directly or indirectly, the individual behaviour and commitment of all involved with innovation efforts. Effective innovation leaders combine personality traits, abilities, and attitudes that allow him or her to be recognized as visionary, sensitive to even the slimmest change in the business environment, and inspiring (Kramer et al., 2003; Mumford and Licuanan, 2004; Sun et al., 2012). Engaged and committed leaders are also essential in setting and maintaining innovation-oriented organizational culture, structure, and strategy.

Knowledge Management can also be highlighted as a key innovation driver. Padmore et al. (1998) argue that innovation happens when different kinds of knowledge are applied. In fact, successful innovation requires a blend of market, consumer, and technical knowledge. The knowledge management function is responsible for fostering idea generation and the transformation of these ideas in a visible, positive result for the company. Effective knowledge management practices include knowledge development and acquisition, which allows internal knowledge development and external knowledge acquisition, as well as knowledge dissemination and accumulation, which leads to organizational learning, improved communication, and the creation and exploitation of intellectual capital (Wong and Chin, 2007).

Indeed, an innovation driver identified in the key papers reviewed that is closely related to knowledge management is Communication. To Cormican and O'Sullivan (2004), innovation could be described as a process of information transformation and application in the right context, as appropriate information is reunited, processed, and transferred all over the organization in support of idea generation, evaluation, and transformation into innovation projects. Thus, effective communication management is essential to innovation.

Human Resources were also widely recognized as a key innovation driver in our systematic review. Lee and Om (1994) already highlighted the fact that the successful management of innovation requires the management of people. Moreover, the criticality of technical skills has been much discussed in the literature that deals with successful innovation drivers (Hayton, 2005; Hindle and Yencken, 2004; Wang and Chen, 2010). Thus, the assembly and development of work teams that take into account the individuals' personalities, inclinations, attitudes and competences is critical to the innovative organization. In particular, capabilities related to problem solving, communication, creativity, conflict resolution, experimentation and collaborative work are essential individual abilities in the context of innovation (Alpkan et al., 2010).

Complementary to the human resources, Physical Resources were also mentioned in the key papers reviewed. Combined with human resources, resources such as equipment and machinery allow to aggregate physicality to the ideas and concepts generated in the first stages of the innovation process. Moreover, technology can be interpreted as the embodiment of innovation, thus being essential to the latter phases of the innovation process. Dervitsiotis (2010) defines physical resources for innovation as all the available resources that complete the organizational knowledge and competences that drive the innovation process.

In some innovation management system proposals, the interaction with regional and national innovation systems is considered a key driver (Galanakis, 2006; Llamas-Sanchez et al., 2011; Ichimura et al., 2003). To Galanakis (2006), the national innovation system is composed by elements like the regulatory system, the national economic system, basic infrastructure (transport, energy, communications, etc.), demand conditions, and physical and human resources available. To interact with the national innovation system is a pre-requisite for effective innovation in a changing context where open innovation practices become more and more critical.

Table 2 summarizes the main innovation drivers found in the 27 key papers.

Table 2: Innovation drivers

Authors	Process	Focus	Strategy	Culture	Structure	Leadership	KM	HR	Physical Resources	Communication	Other
Thom (1990)	NA	SMEs	x		x						Innovation tools
Chiesa et al. (1996)	NA	NA				x		x	x		Systems and tools
Sundbo (1996)	Model of balancing innovation empowerment	Low tech products/services	x	x							Entrepreneurship; budget and schedule control
Padmore et al. (1998)	Chain link of industrial innovation	Product					x			x	
Tuominen et al. (1999)	Elemental innovation process	Product	x						x		Knowledge about clients
Dooley and O'Sullivan (2004)	Service innovation model	Service innovation	x			x	x			x	Power delegation; reengineering
Verhaeghe and Kfir (2002)	Knowledge intensive technology organization	Technology based products	x	x				x			Support functions; market research
Ichimura et al. (2003)	Basic concept of product innovation	Product	x		x						External environment analysis
Cormican and O'Sullivan (2004)	Basic model of innovation management	Product	x	x	x	x				x	Collaboration; performance management
Bernstein and Singh (2006)	Innovation process model	NA			x	x				x	Control mechanisms
Galanakis (2006)	NA	NA	x	x	x		x				Creativity; risk taking; national innovation system
Meijer (2006)	Process of innovation management at DSM	NA		x	x	x	x				Tools; rewards
Mir et al. (2006)	Modified Kline innovation model	Product	x	x	x		x		x		Cooperation
Wong and Chin (2007)	Organizational innovation management	NA	x	x	x	x	x	x			System adaptability; personal values; clients
Dervitsiotis (2010)	Four stages of the innovation value	NA	x	x		x		x	x		Client opinions

Authors	Process	Focus	Strategy	Culture	Structure	Leadership	KM	HR	Physical Resources	Communication	Other
	chain										
Kocher et al. (2011)	INNOVA TE4Future	SMEs	x	x	x						
Lee and Om (2011)	NA	Technological innovation	x		x			x	x		
Llamas-Sanchez et al. (2011)	Agenda 21	Process innovation		x	x			x	x		Institutional factors
Sun et al. (2012)	The multi-level conceptual model	NA	x	x		x	x	x			Methods
		Total	13	11	11	8	7	7	6	4	

Innovation Management System Proposal

A simple, generic firm-level innovation management system was proposed based on the common innovation process steps and innovation drivers identified in the results of our systematic literature review. This simplified proposal is depicted in Figure 1.

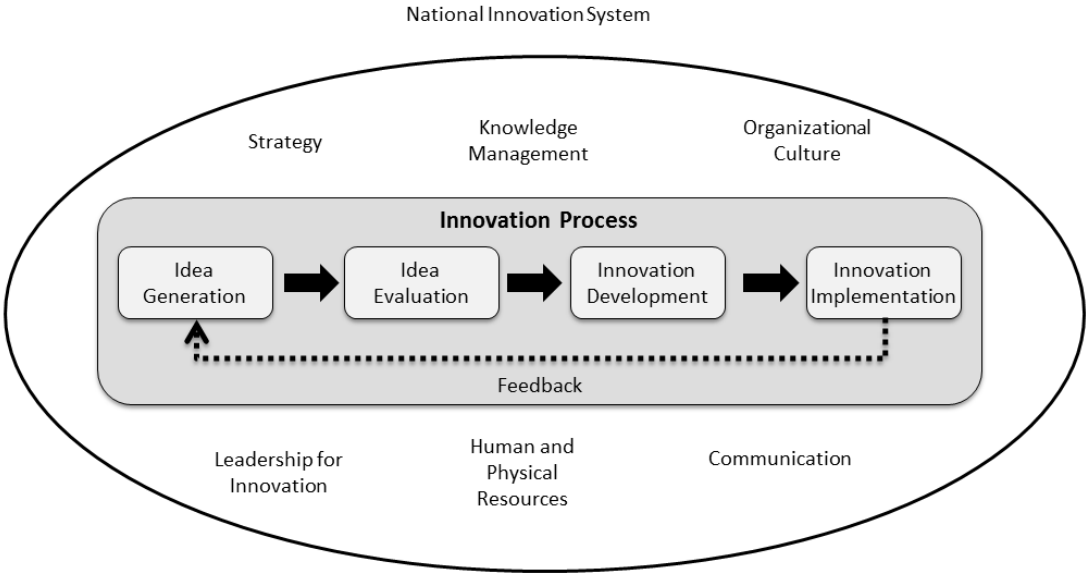

Figure 1: Proposal for a generic firm-level innovation management system

The proposed system is based upon the four-step innovation process described in section 4.2: idea generation, idea evaluation, innovation development, and innovation implementation. This process is fuelled by reward and feedback mechanisms.

Meanwhile, the innovation drivers permeate the whole innovation process in its various stages. The specific relationship between the drivers and the process stages will vary depending on the particularities of the organization and the business sector it operates on. This is an important aspect that has to be investigated and customized wherever the system is actually implemented. On the other hand, the national innovation system is depicted outside the firm boundaries. It represents the structures, entities and policies in the external macro-environment of innovation, including partnerships with research centres, universities, government agencies, clients, business partners, and competitors.

The generic innovation management system here proposed is simplified enough to be quickly comprehended by all involved, but it clearly lacks in detailed specifications. As it is, it can be used as a starting point by organizations that wish to define their own innovation management instruments. The conceptual elements present in the proposed system support decision making regarding the basic needs of every organization, but they surely can much more detailed, depending on the needs of the organization. Moreover, the proposed system serves as a checklist of what must be considered when designing or intervening in an innovation-oriented organization.

CONCLUSION

The systematic review reported in this paper allowed to comparatively analyse many innovation management models and systems already proposed in the literature. The previous contributions analysed vary from very detailed and complete to simple sketches of elements and activities related to innovation. The publications that directly approached the problem of how innovation can be managed at the firm-level were analysed in order to highlight those that include a clearly defined innovation process, with sequentially and logically related activities, and those that propose elements that drive, facilitate, or support the innovation process.

The synthesis of the identified innovation management systems revealed, first, a generic, sequential four-step innovation process and, secondly, a set of the most common innovation drivers reported in relevant literature. The systematic literature review reported in this paper is a work-in-progress report, a first step to an empirical analysis that will support the development of a comprehensive typology of innovation management systems and models.

As the main outcome, a generic innovation model was proposed comprising four main steps (idea generation, idea evaluation, innovation development, innovation implementation) and eight innovation drivers (Strategy, Leadership, Culture, Structure, Knowledge Management, Communication, Human Resources, and Physical Resources).

The proposed innovation management system could be used as a starting point for organizations wishing to develop their own mechanisms for managing innovation. In particular, the proposed system includes the relationship with the national innovation system as another key innovation driver, although the literature reviewed mentioning this aspect was not numerous. This may be related to the fact that open innovation literature is relatively recent, compared to the other streams of research in innovation management. However, given the current global innovation scenario, the relationship with external agents of innovation cannot be left out.

The proposed system does not deal with particular tools and techniques that could be associated with specific innovation drivers or process steps. This is an interesting gap to be filled by future

research. Similarly, the specific interrelationships between innovation drivers and innovation process activities can be further investigated. The next stages of the ongoing research here reported will develop this knowledge, initially using a systematic literature but also resorting to empirical investigation.

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