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Innovation management: Innovations and processes

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ABSTRACT
Innovation management is a topic that has been increasingly addressed in the scientific and management literature over the past 35 years. To innovate is to invent, whether they are ideas, processes, services or technologies, but it can also be the way to organize a company. How should the innovation process be managed to achieve the expected results? The objective of this study is to show how the innovation process can be managed and to understand how to be motivated to achieve success, using the best techniques to increase the quality and efficiency of this process. When the environment changes, organizations cannot adapt. The hypothesis is that if it is understood how to incorporate the innovation process in an organization, through tools and routines, although it has risks and uncertainties, this can have an influence on success.

Keywords: Innovation Management, Invent, Organization, Idea.

INTRODUCTION

Innovation management is a topic that has been increasingly addressed in the scientific and management literature over the past 35 years. The reason for this interest is probably the realization that innovation is of fundamental importance for the survival of an organization. Whether it's businesses that need to compete for market share or profit, or public organizations that need to improve their services.

To innovate is to invent, whether they are ideas, processes, services or technologies, but it can also be the way to organize a company. How should the innovation process be managed to achieve the expected results? The need for innovation is imperative. But at the same time, innovation is not easy.

The objective of this study is to show how the innovation process can be managed and to understand how to be motivated to achieve success, using the best techniques to increase the quality and efficiency of this process. Innovation efforts, over time, have given rise to an excess of innovation projects, many of which have failed.

Hypothetically, even large companies that were once forerunners and creators of entire markets have not been able to remain competitive when changes have occurred. An organization is so engaged with (and simply used to) what they're good at (core competencies), that they get stuck in it. When the environment changes (e.g., changing consumer needs, changing regulations), organizations are unable to adapt. The hypothesis is that if it is understood how to incorporate the innovation process in an

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INNOVATIVE MANAGEMENT

CONCEPTS AND DEFINITIONS OF INNOVATION

Innovation is defined as the technical/technological invention, the introduction into the production process and/or sale of a new product, equipment or process (Larousse dictionary). According to the OECD Oslo Manual (2005, p.54), it is "the implementation of a new or significantly improved product (good or service) or new marketing method, or a new organizational method in business practices, workplace organization or external relations". Innovation can also be defined as a process or activity that requires investment (inputs) and, eventually, results in the production of results (DUTTA et al., 2005).

Innovative companies have certain specificities in terms of risk, information asymmetry, and financing. In fact, according to Holmstrom (1989), they present high risk due to uncertainty related to the expected future economic results and benefits of innovations. In addition, the intangible assets generated by R&D are characteristic and difficult to redistribute, which increases the risk borne by shareholders. In addition, innovation is a specific activity that reinforces the informational asymmetry between managers and shareholders (ABOODY and LEV, 2000). These companies are likely to face external financing difficulties (HALL, 2002, CASAMATTA, 2003 and SAVIGNAC, 2006).

The innovation process

The innovation process is defined as the development and selection of ideas for innovation and the transformation of these ideas into innovation (JACOBS and SNIJDERS, 2008). To emphasize the uncertain character of this innovation process, other authors use the innovation journey (VAN DER VEM, 1999). An innovation project is in this document used as the innovation process of a particular innovation. Andrew and Sirkin (2006) argue that the management of an innovation project is essentially like any other business project, although it has more risks and uncertainties.

The body of literature on the topic of innovation management is relatively young. Since almost half of the last century, innovation has become a topic of research. The first step in innovation management is to understand how the innovation process can be successfully influenced. This is pursued by empirical studies of successful companies and thus describing how they organize innovation (VAN DE VEN and POOLE, 1990; ROTHWELL et al. 1974; ANDREW et al., 2007).

Models of innovation processes

Models are simplified representations of reality. The variety among models on innovation

management is the result, on the one hand, of a small consensus on how an innovation process should look like, and on the other hand, of the cause of the purpose for which it was developed. For example, a descriptive model that includes a best practice in a set of technological manufacturing companies will be different from a prescriptive model on how to manage innovation in a police department (VAN DER VEM, 1999).

This section is not intended to include all existing models, but it does give a wide range of the variation that exists. The method used to search for sources is described below.

The models

It is interesting to analyze a number of characteristics when discussing the different models, to better understand the differences and similarities. Firstly, to underline the wide range of backgrounds this document covers, the source of the model is explained. Second, it is determined whether the model had empirical support, whether it was based on previous theoretical research, or both. In addition, the main type, novelty and sector of innovation is determined. The models are found in management books and scientific journals.

Through the help of scientific search engines in combination with the search plus the references of your studies, there are 12 templates included in various sources. This includes management literature, policy documents, as well as scientific manuals (Table 1). Three of the models were developed some time ago, but they were tested so influentially that leaving them out means a significant hiatus in this study (ROGERS, 1962; COOPER, 1986; ROTHWELL, 1994).

The other models are approximately all from the last decade and include private (e.g., Verloop, 2004; Andrew and Sirkin, 2006; Van der Ven et al., 1999) and public models (Mulgan and Albury, 2003) and authors that include both (TIDD and BESSANT, 2005; HANSEN and BIRKINSHAW, 2007; JACOBS and SNIJDER, 2008; NOOTEBOOM, 2001). Some more recent authors have based their models in some parts on earlier authors, but over time, more empirical studies have improved and modified the models considerably.

Notable authors such as Van der Ven and Poole, based their book Innovation Journey (1999) on an extensive empirical study (1990). Similarly, Rothwell (1994) based his work on earlier work by himself and colleagues from the seventies (1974). And Andrew et al. (2007) served as the main empirical support for the book by Andrews and Sirkin (2008).

Table 1 - Characteristics of the models

	Source	Mainly based on	Type of Innovation	Incremental vs. Radical	Type of organization	Size of the Organization
Rogers (1962)	Book; Free press					
Cooper and Kleinschmidt (1986)	Journal of Product Innovation Management	Recent theory and practice	Industrial Manufacturing Product Innovation	Both, but leaning towards the radical	Private	Quite large with its own R&D department and a distinctive top management
Rothwell (1994)	International Marketing Review	Pesquisa anterior	Goods	Not explicitly stated, but tendency towards radicalism	Private	Reasonably large
Van der Ven *et al.* (1999)	Book; Oxford University press	Large empirical study	Product, Process, Services	Not explicitly stated, but tendency towards radicalism	Private	Wide
Nooteboom (2001)	Book; Oxford University press	Theory	Product, Process, Services	Everyone	Private and public	Big and small
Mulgan e Albury (2003)	Role of the UK Strategic Unit	Pesquisa anterior + some case studies.	Services	Everyone	Public	Wide
Verloop (2004)	Livro; Elsevier	Experience	Product, Process	Radical	Private	Wide
Cormican and O Sullivan (2004)	Technovation	Model based on theory, verified in practice.	Product, Technology	Portfolio of different novelties	Private	Large multinationals
Tidd *et al.* (2005)	Book; Wiley and children	Empirical and theoretical research	Product, Process, Services	Both steady state and discontinuous innovation	Private and public	Big and small
Andrew and Sirkin (2006)	Livro; Harvard Business School Press	Experience and empirical research	Product, Process, Services	It's not very explicit, but leans more towards the radical	Private	Wide
Hansen e Birkinshaw (2007)	Article; Harvard Business Review	Based on the authors' empirical experience	Product, Process, Services	It's not very explicit, but leans more towards the radical	Private	Large multinationals
Jacobs e Snijders (2008)	Livro; Management Studies Foundation	Theoretical and empirical research	Product, Services	Emphasize that most innovations are incremental.	Private and public	Organizations large and small

Source: Verloop, 2004; Rothwell 1994; Jacobs e Snijders, 2008.

The type of innovation differs considerably between models. Most models of innovation processes

are mostly based on (1) radical products and processes (2) in the private sector (3) (COOPER and KLEINSCHMIDT, 1986; CORMICAN and THE SULLIVAN, 2004; VERLOOP 2004; ANDREW and SIRKIN, 2006). But, in modern economies where services are getting more important, other types of innovations (incremental and/or services) are also considered (Tidd and Bessant, 2005; Jacobs and Snilder, 2008), although with even less attention. In addition, innovation in the public sector remains underrepresented (MULGAN and ALBURY, 2003).

Table 2 - Phases, stages, components or main activities of the innovation process.

Rogers (1962)	**Cooper (1986)**	**Rothwell (1994) (3G)**	**Van der Ven *et al.* (1999)**	**Nooteboom (2001)**	**Mulgan e Albury (2003)**	**Verloop (2004)**	**Cormican and O Sullivan (2004)**	**Tidde Bessant (2005)**	**Andrew and Sirkin (2006)**	**Hansen A. Birkin-Show (2007)**	**Jacobs e Snijders (2008)**
Knowledge	Scope	Idea generation	Initiation period	New combinations	The generation of possibilities	Generation and crystallization of ideas	Analyze the environment and identify opportunities	Research	Idea generation	Idea generation	Variation
Persuasion							Generating innovation and research				
Decision	Construa o business case	Research design and development		Consolidation			Plan the project and select the sponsor	Select	Marketing		(Internal selection)
								Acquire			
	Development	Production prototype	Development period		The Bulge and Prototyping of Promising Ideas	Development and demonstration	Prioritize the project and assign teams	Perform	Accomplishment	Conversion of ideas	Accomplishment
	Testing and validation	Manufacturing									
		Marketing and sales									
Implantation	Launch	Marketing	Implantation / Termination			Invest and prepare for	Implement the product implem	Launch			(External) selection/ survival

			Period			launch	entation plan				
Confir mation				General ization							
				Differe ntiation	Replic ation and Scalin g			Supp ort		Dissem ination of ideas	Multiplic ation
				Recipro ta- tion							
					Analy sis and learni ng			Learn ing and innov ation			Learning

Source: Verloop, 2004; Rothwell 1994; Jacobs e Snijders, 2008.

So, what phases can be observed? Below the phases of the 12 models are summarized. This is done by including a phase if more than 2 authors consider it to be a phase, component, etc. The phases defined below will be used throughout the paper for clarity. However, it is noted that it is not the only way to define the phases. All models start with some form of idea generation or seeking ideas for innovation. Some authors emphasize the opening of possibilities (NOOTEBOOM, 2001; MULGAN and ALBURY 2003; JACOBS and SNIJDERS, 2008).

Van der Ven et al. (1999) argue that this is considered divergent behavior. The next step is for most authors to narrow down the options, make a decision, and select which projects are pursued and which are not pursued (ROGERS, 1962; NOOTEBOOM, 2001; TIDD and BESSANT, 2005; JACOBS and SNIJDERS, 2008). This selection should be based on the organizational strategy and the existing portfolio of projects to spread risks. At this point, it must be judged whether the innovation is potentially profitable enough (Andrews and Sirkin, 2006) or whether it will increase public value enough (MOORE, 1995).

The next step is to transform the (selected) idea into some tangible product, process, or service. This subprocess is described differently by almost all authors, but words such as development (Cooper and Kleinschmidt, 1986; Van der Ven et al., 1999 and Ver loop, 2004), prototyping (Mulgan and Albury, 2003), fabrication (Rothwell, 1994), and realization (Andrews and Sirkin, 2006; Jacobs and Snijder, 2008) are used.

For clarity, in this article, this is referred to as development and phase testing. Generally, innovation is tested at this stage, although some authors introduce an extra phase for this in their model. This is usually the phase where many more resources are assigned to the project. For Van der Ven et al. (1999), this is a convergent behavior.

The fourth overall step is one in which the newly developed product, process, or service will be implemented in the "real world." This phase is called the implementation/release. This entails client preparation and *marketing* activities. Most authors stop here with the innovation process. However, some authors (Rogers, 1962; Nooteboom, 2001; Mulgan and Albury, 2003; Tidd and Bessant, 2005 and Jacobs and Snijders, 2008) include a post-release phase. This implies the sustaining and supporting of innovation or even (re)innovation and expansion.

Finally, Mulgan and Albury (2003), Tidd and Bessant (2005), and Jacobs and Snijders (2008) include an explicit learning phase. Not only to learn about the innovation itself, but also about how the innovation process went. The obvious goal is not to make the same mistakes in a future project. Although most authors (and practitioners) recognize the importance of this phase, it is rarely done in a structured way (TIDD and BESSANT, 2005).

Key contextual factors

The variation in how these factors are described is greater than when considering the phases above. To illustrate this, they range from organizational characteristics to social factors, and from influencing factors to external factors. Furthermore, although some authors describe these factors extensively (Van der Ven et al., 1999; Tidd and Bessant, 2005), others treat them superficially (MULGAN and ALBURY, 2003).

Table 3 - Main contextual components, subroutines, Organizational influences, strategic elements.

Rothwell (1994) (3G)	**Rothwell (1994) (5G)**	**Van der Ven et al. (1999)**	**Mulgan e Albury (2003)**	**Cormican and O Sullivan (2004)**	**Tidd e Bessant (2005)**
Senior management commitment and visible support for innovation.	Time-based strategy (faster and more efficient product development).	Institutional arrangements to legitimize, regulate, and standardize a new technology;	Skills	Strategy	The strategic context for innovation
Long-term corporate strategy with associated technology strategy.	The development focus on quality and other non-price factors.		Resources	Leadership	The innovation of the organization
Long-term commitment to big projects (patient money).	Emphasis on flexibility and corporate responsiveness.	Public resources of basic scientific knowledge	Organizational methods	Culture and climate	The organization's links to its environment
Corporate flexibility and responsiveness to change.	The customer's focus at the forefront of strategy.	Market development, consumer education and demand	Leadership	Planning and selection	

High-level management acceptance.	Strategic integration with primary suppliers.	Proprietary research and development, manufacturing, production, and distribution activities by private enterprise companies to commercialize innovation for profit	Cultures	Structure and performance	
Culture of acceptance of innovation and entrepreneurship.	Strategies for horizontal technology collaboration.			Communication and collaboration	
	Electronic data processing strategies.				
	Full quality control policy.				

Source: (VERLOOP, 2004; ROTHWELL 1994; JACOBS e SNIJDERS, 2008).

The factors are analyzed and, as far as possible, summarized. The main components that are used are (Table 3): Strategy (Yellow); Culture (Green); Leadership (Red); Organizational structure (Blue); Resources/Abilities (Purple); (*Links* with) outside the organization (Light blue)

TOOLS AND ROUTINES

While some phases are actively called (e.g., research or launch), in general, the templates are quite abstract and descriptive. These activities, being of great importance to the innovation process, are sometimes referred to as key activities. Other authors use the word "routines" (Tidd and Bessant 2005; Jacobs and Snijders, 2008), because these activities must be institutionalized for the organization. By providing an overview of these management routines, the second research question is answered.

The routines

Not all models include this step of defining these routines. As you can see in table 3, the variation of routines and activities becomes extensive (more than 150 routines). As the authors list it is also more diverse than with the phases. For example, while Cooper and Kleinschmidt (1986) present a relatively short set of 13 routines, Cormican and Sullivan present an extensive checklist of 50 factors that need to be met. Under the different phases and contextual factors, there are several routines suggested by several authors and others by only one. There is a wide variety of activities and routines. To get a better overview, the colors are referring to the type of routine as described below. For more information on specific routines, it should be directed to the original sources, since it is outside the scope of this work.

For *idea* generation, four main types of routines return. These are (1) market studies, (2) technical

studies, (3) mobilizing ideas from within the organization to generate ideas (encouraging people to come up with ideas and share them, making cross-functional teams to augment interdisciplinary ideas), and (4) involving people from outside the organization (core users, creative people, society at large, other countries/companies).

The considerably less associated routines are associated with the *selection* phase. The main routines here are (1) to analyze the options in terms of market potential and feasibility. And then the choice is made based on the company's strategic direction and the portfolio of existing projects or products (2).

To *develop and test* there are many and diverse routines suggested. Examples of development (0) are cross-functional teamwork, finding the best people, creating incubation places for development, concurrent work, early user engagement, focus and commitment, and support and *design tools*. For test (0), the authors generally distinguish internal tests and external tests as main activities.

Implementation and launch (0) can be implemented using the following routines: it should be noted that this phase does not include many activities related to the innovation process; generally, it is more of a logistical task, the only routines suggested are market prospecting activities, production launch, focus and commitment, and *marketing* activities, pre-launch.

Post-launch *activities* (0) are only included in some templates. The models that include them suggest routines such as assigning ideas, evangelists, networking, engagement, and supporting a supporting infrastructure.

Finally, to implement *learning* (0), all authors who deal with this phase emphasize the need for real numbers, preferably in real time, in evaluations.

Routines that cannot be placed under a certain phase are related to contextual factors. However, there are several routines that could have been placed both in a phase and in a contextual factor. In these cases, they are only listed in the phase classification above. Most of the remaining routines are placed under the following contextual factors: Strategy (0) Culture

(0) Leadership (0) Organizational structure (0) (*Links* with) outside the organization (0) or Provision of resources (0).

Table 4 - An interesting understanding of the tools available

Idea generation	**Selection**	**Development and Testing**	**Implementation /Launch**	**Post-launch**	**Learning**
Distant days; Give people time to come up with new ideas.	SWOT Analysis to Determine Strategic Position	Operation tests: tests to verify the functionality/reliability of the product in actual working conditions.	A detailed financial analysis, involving an evaluation of return or profitability.	Designate "evangelistic ideas"	Value Analysis

Implementation of the quality function; Analyze how to offer customer value	Risk assessment matrix	Let users try the product and let them give feedback	Trade in literature, fairs and commercial advertising, but without special promotion or training for the sales force.	Organize places where professionals meet: "collaborative" in the health service or Head of speech (heads of school)	Debate
Review of competitors' products	Portfolio management	Rapid prototyping technologies and approaches	Use alpha, beta gamma product versions		Benchmarking
Invite artists or trend spotters	Payback period and/or breakeven analysis	Try different approaches	Apply a stage template		
Build cross-unit networks		Create refuges			
Role-playing					

Source: Verloop, 2004; Rothwell 1994; Jacobs e Snijders, 2008.

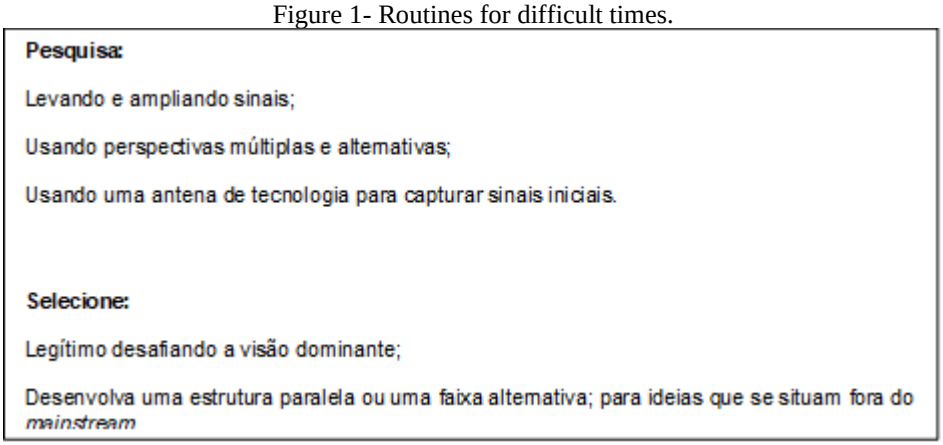
Innovation Management Tools

As seen, from a few relatively simple models, one ends up with a wide variety of routines that can help managers incorporate the innovation process into their organization. Tasks for managers have become more practical with each step (from model to phase and contextual factors to routines), but most routines are still very abstract (e.g., the routine of 'making a choice based on the strategic direction of the company and the portfolio of existing projects or products', or 'involving others'). *Brainstorming*, for example, can be an excellent tool for generating ideas and evaluating. Thus, conferences and other gatherings can be excellent places for generating ideas, but also for spreading innovation (post-launch). These tools are incorporated into the overview. An interesting (but rather random) selection of tools is listed in table 4 above.

CHARACTERISTICS OF INNOVATION

As seen earlier, there are some differences between the innovations. This raises the question of whether some routines and activities were more useful for specific innovations (VERLOOP, 2004). For example, are selection routines different for small organizations compared to large ones? Or are they different implementation routines in a rapidly changing environment compared to a more static environment? Subsequently, this session is about the actual use of routines and tools. To what extent should they be applied?

Figure 1- Routines for difficult times.



Source: Verloop, 2004; Rothwell 1994; Jacobs e Snijders, 2008.

Using Routines and Tools

While some authors argue that poor performance in one routine can be compensated for by the other (Jacobs and Snijders, 2008), most other authors stipulate that all routines need to be balanced and well maintained (TIDD and BESSANT 2005). An interesting contribution is how Prud'homme van Reine and Dankbaar (2009) emphasize that all routines (and especially culture) should not be seen as having a linear relationship to innovation success (i.e., more of the routine means more innovation).

METHODOLOGY

The methodology of this study is a literature review. This research from the point of view of its nature is classified as basic, where the study generates new and useful knowledge for the addition of science without a foreseen practical application. Where it involves truths and common interests (GIL, 2008). From the point of view of the way the problem is approached, it can be considered qualitative, where it is considered that there is an effective relationship between the real world and its subject, that is, an inseparable link between the objective and subjective world of the subject that cannot be explained in figures (GIL, 2008).

In the process of reviewing and analyzing the items of the theme as a database for the development process, the usual scientific research methods for this type of work were applied, using authors, the vast majority, from the last 10 years. Relevant information on the subject was also researched and collected on the internet, outlining the reflection as seen, as well as the bibliographic references cited in this study.

PRESENTATION AND ANALYSIS OF RESEARCH DATA

It should be noted that the bibliographic research of Innovation Management and relevant models of innovation processes has been extensive, but not very structured. With a high probability, it can be said that the most relevant literature has been reviewed, but a second survey or panel of experts should confirm

this. Secondly, a broad overview of models, routines and tools is created (JACOBS and SNIJDERS, 2008).

This overview has retained the authenticity of the authors' original terminology. This resulted in a very rich database, but it varied in terms of terminology. To take further steps with this overview, some general terminologies should be used for clarity. When this is done, the overlap and underlying differences become clearer. This will be a task for future research.

In the same vein, the overview is extensive, but not very easy to use. Some kind of database can make the information more accessible and therefore useful. The last point of discussion is the analysis of possible differences between sets of routines and tools when considering the various characteristics of innovations. Although some information has been acquired during the study of the literature, this part is still very thin. This is mainly the result of the lack of current research, but also because this study set out to create the overview and the secondary analyzed this third research question (JACOBS and SNIJDERS, 2008).

Further research can explore this terrain in more detail. What models of innovation process exist in the literature? What management routines and management tools can be extracted from the literature that stimulates the innovation process? What other implications for the practical use of innovation management routines and tools can be found in the literature? All questions were answered in the form of tables. In short, it was found that all the models had some kind of phases with some order in them. The main phases of synthesis are: idea generation, selection, development and prototyping, implementation/launch, post-launch and learning/evaluation.

Most sources have included contextual components in their innovation process model. These were: strategy, culture, leadership, organizational structure, resources/skills, and *links* outside the organization. In addition to the phases and contextual factors, more than 150 routines or activities have been distilled from the literature (JACOBS and SNIJDERS, 2008). At the same time, a certain overlap was found and, for each phase or context, some of the main themes were identified. Where routines were still quite abstract, management tools have been found adding to the database. These tools can be used at different stages and to satisfy different routines.

FINAL CONSIDERATIONS

The innovation models described in theory are becoming more elaborate over time, that is, firstly, the number of phases, including more and more post-launch activities. But also in terms of the kinds of innovations that are considered, the literature is becoming more complete, not just radical and technical innovations in the private sector, but also incremental and service innovations and innovations in the public sector.

With regard to the relationship between innovation characteristics and management routines and tools, the following can be said: the existing literature is not explicit about which management routines and tools should be used and in which situations. Finally, a discussion remains about the extent to which routines and tools should be implemented. How much of a routine is enough to stimulate innovation?

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