

Technology Outlook as a tool for the management of innovation

La Vigilancia Tecnológica como una herramienta para la gestión de la innovación

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Abstract:

The purpose of this paper is to present a theoretical overview of innovation management and the tools that can aid in this endeavour. The paper adopts a user-oriented description, aiming at making SMEs familiar with the possibilities opened by innovation management tools in general and technology outlook in particular.

The goal of technology outlook is to search, interpret and evaluate information on technological developments in the areas of interest for the company. The process is divided into three general stages: observe, analyze and use. The paper explores all dimensions included in these stages together with the requirements for their implementation in the context of SMEs. In addition we also introduce the roles required for such a process to systematically work: observers, analysts and decision makers. These roles correspond to the previous three stages, so observers are involved during the first step, analysts are related to the second phase and decision makers to the final exploitation.

The paper closes by raising some concerns as to why innovation management tools in general and technology outlook in particular are underused in the context of SMEs. The author concludes that if SMEs are to increase their innovative potential, this challenge will be to a great extent dependent on their ability to introduce innovation management routines and tools aligned with their general strategies.

Keywords :

Innovation management, tools, technology outlook, SMEs.

Resumen:

El propósito de este artículo es presentar una visión teórica sobre la gestión de la innovación y las herramientas que pueden facilitar dicho empeño. El artículo adopta una visión práctica, con el objetivo de familiarizar a las PYMEs con las herramientas de gestión de la innovación en general y la vigilancia tecnológica en particular.

El objetivo de la vigilancia tecnológica es buscar, explorar y evaluar información existente sobre los avances tecnológicos en aquellas áreas de interés para la empresa. El proceso de vigilancia se divide en tres fases: observar, analizar y utilizar. El artículo examina las dimensiones incluidas en dichas fases además de establecer las condi-

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ciones para su aplicación en el contexto de las PYMEs. El artículo también analiza las funciones o roles necesarios para un uso sistemático de la vigilancia: observadores, analistas y decisores. Dichos roles corresponden directamente con las tres etapas anteriores. De este modo, los observadores están involucrados en la primera etapa, los analistas en la segunda y los decisores en la fase final.

El artículo concluye analizando algunas de las razones por las que las herramientas de gestión de la innovación en general y la vigilancia tecnológica en particular son infrautilizadas en las PYMEs. En este sentido, el autor concluye que si las PYMEs quieren incrementar su potencial de innovación, ello dependerá en gran medida de su capacidad para introducir ciertas rutinas para la gestión de la innovación así como de las herramientas asociadas a ellas, además de alinear a las anteriores con las estrategias empresariales.

Palabras clave:

Gestión de la innovación, herramientas, vigilancia tecnológica, PYMEs.

1. INTRODUCTION

Innovations are new creations of economic significance mainly carried out by firms. They can be new products or processes. New products may be material goods or intangible services. It is a matter of what is produced. New processes may be technological or organizational, so it is a matter of how the products are produced (Edquist et al., 2001). According to their character, they may be incremental or radical. The former case refers to the introduction of innovations by adaptation to (local, regional, national) demands, specificities or requirements, while the latter refers to the creation of something that did not exist before, that is, something that creates a technological discontinuity or introduces a new paradigm.

But how do we manage innovation? Is it possible at all to do so? This paper will try to shed some light on the management of innovation, clarifying certain terms usually used interchangeably either in managerial contexts or in research environments.

Innovation Management (IM) has been a growing field of study for the past four decades (Phaal et al., 2006). An increasing number of scholarly work has been carried out over the years contributing to the development of IM literature (Van de Ven, 1986; Currie, 1999; Libutti, 2000; Kärkkäinen et al., 2001; Tidd, 2001; Hidalgo and Albers, 2008). However, not many studies looking at firms as the main unit of analysis have been undertaken aiming at understanding the causes and benefits of the use of certain tools on firm performance (Mol and Birkinshaw, 2009).

This paper intends to present an overview of these tools through a thorough review of IM-related articles. The paper will combine a theoretical overview about IM with a more user-oriented description of the routines and tools available to firm managers for the daily practice of IM. In particular, we will focus on Technology Outlook processes, and how they can be exploited in Small and Medium Sized Enterprises (SMEs).

The remaining of the article is structured as follows. Section 2 will introduce the three (managerial) levels that need to be considered in the management of innovation activities, the strategic, the operational (routines) and the instrumental levels (tools). Section 3 will provide an overview of the most common IM tools described in the literature. Section 4 will then focus on the Technology Outlook as a potential IM tool, presenting its main characteristics, rationales, actors, phases, strengths and limitations. Section 5 concludes by opening the scope for discussion regarding IM.

2. THE THREE DIMENSIONS OF INNOVATION MANAGEMENT

Innovation management (IM) is a multidisciplinary topic as it involves disciplines such as science, engineering, economics, strategic management, sociology and psychology (García and Calantone, 2002; Phaal et al., 2006). Many firms (and managers) consider the management of innovation to be equivalent to the management of Research and Development (R&D) (Brady et al., 1997). Innovation is about creating products or processes that have a direct impact on the performance of the company, either in terms of increases in turnover (product innovations) or improvements in efficiency (process innovations). However, R&D is just one of the multiple determinants of innovation activities, but definitely not the only one (Edquist, 2005). Accordingly, if innovation is not only R&D, the management of innovation can not only refer to the management of R&D (Cetindamar et al., 2009).

Analogously, IM is not the same as technology management (Porter and Cunningham, 2005; Cetindamar et al., 2009). IM is about managing both 'hard' and 'soft' factors (Phaal et al., 2004). Technology, R&D, market commercialization are all 'hard' factors, those usually managers are aware of. However, innovation also implies the use of other 'soft' elements such as learning, development of skills, acquisition of capabilities or knowledge sharing, which are intangible in their character (Brady et al., 1997). Nevertheless, not all the factors to be managed are internal to the company. The management of innovation also implies taking into consideration other external aspects such as the customers' needs and their demands, the trajectory of the technologies the company is investing in, other organizations embedded in the innovation system the company may be interested in cooperating with, competitors, standards, regulations, etc. (Van de Ven, 1986; Tuominen et al., 1999; Tidd, 2001; Mol and Birkinshaw, 2009).

IM has thus to be understood as a core process of the organisation, which requires continuity in its application and which will eventually lead to a certain level of restructuring and reorganization (Leonard-Barton, 1988). The main purpose of IM is to introduce change in organizations in order to create new or exploit existing opportunities (Mol and Birkinshaw, 2009). Accordingly, managers should not expect returns on investment as soon as the company has started to use certain tools and to establish certain routines. It is a long term race whose key feature is about being systematic (Mogee, 1993; Burgelman et al., 2001; Hamel, 2006). IM is thus defined as the invention and implementation of a management practice, process, structure, or technique that intends to enhance firm performance (Birkinshaw et al., 2008, p. 825; Mol and Birkinshaw, 2009, p. 1269).

For an effective management of innovation we need to take into consideration the links the strategic level of the company has with its internal organization. In fact, a strategy is only of value if mechanisms for its implementation and renewal are in place (Gregory, 1995). In line with Skilbeck and Cruickshank (1997), Phaal et al. (2004) conclude that three levels are required in the management of innovation processes: the strategic, operational and instrumental levels. As we will see, the operational level will provide firms with the routines that can be established over time so that companies pursue their strategic goals (Cetindamar et al., 2009). In turn, the instrumental level provides a set of tools that aid companies in order to bring these routines into practice.

Following this, we will divide the remaining of this section into three sub-sections. The first will deal with the strategic dimension, where decisions about the organizational culture, the values and the objectives of the company are made. The second level will illustrate the five routines that need to be prompted in order to develop innovative products and/or processes. Finally, the third dimension will focus on the tools that companies could rely on in order to foster their innovative orientation.

2.1. The strategic level

Strategy is primarily concerned with the overall corporate goals of the company (Phaal et al., 2004). When formulating a strategy, every company tries to provide an answer to the following questions: What can we do and why? What do we want to do and why? What are we going to do and why? And finally, how are we going to do it?

Innovation more and more plays an important role in answering the previous questions. Accordingly, the corporate strategy should be aligned with the innovation strategy (or innovation-related goals) the company wants to pursue. Developing a strategy is complicated among other reasons due to the existence of changing customer needs, preferences, technologies and a changing environment. The strategic dimension of IM depends thus on both the internal and the external environment. The internal factors that have a direct influence on the setting-up of a corporate strategy are the availability of core competences in the firm— either technological (hard) or intellectual (soft), its organizational culture, the size of the firm, the mechanisms that support learning activities among the staff, the products they produce, the technologies required to produce them and the networks the company is involved in. On the other hand, the external factors the company needs to be aware of include among others the type of industry/sector the company belongs to (Pavitt, 1984), the national/regional innovation system the company is integrated in, the technological trajectory of the technologies the company is interested in, their relationships with customers and suppliers, the alliances with competitors, the institutional support, etc. Due to the mix of internal and external components, being systematic in the analysis of these factors becomes a key aspect when formulating a corporate strategy.

We can thus conclude that the key role strategic management plays in the management of innovation is in appropriately adapting, integrating and reconfiguring the internal and external organizational skills, resources and competences belonging to the firm, towards a changing environment (Cetindamar et al., 2009).

2.2. The operational level

From the previous description two of the main features of IM can be mentioned. On the one hand, managing innovation is about establishing and maintaining links between the strategy of the company and the resources it has. On the other, management implies the need to develop certain routines (Phaal et al., 2004, p. 5) since a firm's internal knowledge is incorporated into them. These routines contain and transmit the way in which tasks ought to be performed in the organization, guiding the innovation process (Nieto, 2003, p. 143).

The term activity is used interchangeably with process or routine, them being understood as the approach to achieving a managerial objective (Cetindamar et al., 2009, p. 238). In turn, Hamel (2006) defines a routine as that procedure firms adopt in order to apply a particular tool in a systematic way. The goal of the routines is to represent the processes hold within a company by which its core competences are being developed; in other words, reflect what is going on within companies (Cetindamar et al., 2009, p. 241)¹.

In general terms we can identify five routines as the determining factors for the successful management of innovation (Cotec, 1998; Tidd et al., 2001; Phaal et al., 2004): Scan, Focus, Resource, Implement and Learn. Scanning aims at detecting signals of change. Some of its activities imply scanning the external environment for technological, market, regulatory and other signals or collecting and filtering signals from competitors or potential partners on their strategies or technological developments. The second routine (focus)

¹ This activity approach has been recently introduced in the systems of innovation literature (Edquist, 2005).

aims at making the company be aware of its current technological base and the fit with the overall business strategy. In addition, it will set the basis for the diagnosis of the company's knowledge base so those areas in which further competences are required can be identified. By resourcing we mean all the possible combinations of new and existing knowledge in order to offer a solution to the problem the company is facing. This can imply the development of an innovation through in-house R&D activities, the use of technology transfer in order to absorb certain technology the company has identified as critical, provide the conditions for creativity, etc. The implementation routine requires having a close interaction between marketing-oriented and technical-related activities in order to bring an idea into a marketable product or service and to prepare the market (customers) for its final launching. This implies the company will not only have to release the product and make it available in the market, but also to protect its sustainability and to provide the necessary after-sales support. Finally, the learning routine aims to analyze the failures and successes had by the company as an input for their future innovation processes.

The previous five routines do not have to follow a particular order. Also, companies do not need to have all the routines in place in order to manage their innovation processes, despite recommended in order to have a comprehensive and systemic approach to it. This paper will focus on Technology Outlook, which is regarded as an IM tool valid for the scanning and focusing routines.

2.3. The instrumental level

Finally, the last level required to have an inclusive approach to the management of innovation is the instrumental. It is labeled as instrumental because in it, several tools are made available for their use. All the tools included in this level are somewhere in between the idea generation and the introduction of the concept/product/system in the market, i.e. between invention and innovation. These tools aim at bringing organizations into action, so they can develop their own competences, technologies, ideas and concepts and bring them into the market in the form of innovations. In addition, they will allow innovation to be a continuous process that can be sustained over time.

Many of these tools are structured into very well delimited stages or steps. The reason for these stages is simplicity. Obviously, a creative process can be as divergent as one may think of. However, too much freedom would lead to its fall (i.e. unexploited tool). By making IM tools instrumental (i.e. delimited into very simple stages) employees do not need to concentrate on the content of the task, since this will be mastered and their content easily processed in their subconscious memory (Van de Ven, 1986). Instead, the users of the tools will focus on the purpose of the task (e.g. idea generation, scenario analysis). Section 3 will provide a much more detailed description of the tools included in this instrumental level.

3. INNOVATION MANAGEMENT TOOLS

In the previous sections we have defined what we mean by innovation and the different types of innovations possible. Brady et al. (1997, p. 418) define a management tool as

a “document, framework, procedure, system of method that enables a company to achieve or clarify an objective”. But what about IM tools in particular? To what extent do they differ from general management tools? The literature in this regard is quite misleading. The definitions directly addressing what is meant by IM tools are in fact very similar, if not the same, as those only dealing with general management issues (Phaal et al., 2006; Hidalgo and Albers, 2008). A clear-cut definition of what IM tools constitute proves to be difficult, since tools, techniques, practices, methods, methodologies, systems and procedures are all terms that have been applied in similar contexts (Brady et al., 1997; Mol and Birkinshaw, 2009)².

A large number of tools have been developed during last couple of decades in order to understand the practical and conceptual issues associated with the management of innovation (Cotec, 1998; Tidd et al., 2001; Phaal et al., 2006)³. Some of these tools include diagnostic audit methodologies (Chiesa et al., 1996; Hallgren, 2009), creativity (De Bono, 1985; Kristensen, 2004), foresight (Chakravarti et al., 1998; Major et al., 2001), knowledge management (Nevo and Chan, 2007), intellectual capital (Rivette and Kline, 2000), the lead-user approach (Herstatt and Von Hippel, 1992; Urban and Von Hippel, 1988), technology outlook (Escorsa Castells and Maspons, 2001; Veugelers et al., 2010), project management, team-building or open innovation (Chesbrough, 2003; Dahlander and Gann, 2010). Each of these tools has a structure that allows them to be applied in different contexts, either in manufacturing or service companies, high or low-tech, big or small.

These tools have extensively been implemented in companies all around the world, from North (Finland - Nokia) to South (South Africa - COFISA) and East (Japan - Samsung) to West (Costa Rica - Cooperativa de Caficultores de Dota, Coopedota) (Palop and Vicente, 1999; Hietanen et al., 2011). In this regard, the European Commission (Brown, 1997) launched a project for the review of the existing practices concerning the application of innovation management tools. The study includes cases from around 20 European companies, illustrating the way they exploit those methodologies and the main results achieved. However, not many studies deal with the application of IM tools in SMEs (Lichtenthaler, 2004). This is the main reason why we focus on the adaptation of certain tools (in the particular case of this paper, Technology Outlook) for their use in SMEs.

A number of research programmes have resulted in the publication of practical guidelines supporting the application of IM tools (Brady, 1995; Phaal et al., 2006). In fact, several methods integrating IM tools have been developed during recent years from public and private organizations. To the best of our knowledge, the last of these initiatives is the one taken by the European Commission with the development of the IMP³ROVE catalogue. With this act, the Commission wanted to provide firms with a tool to benchmark their own innovation management processes against those in other companies⁴. Another of these publicly led examples is the TEMAGUIDE (Cotec, 1998) while CCI (Código Capial Innovación)⁵ or MIRAC (Modelo de Innovación de Restauración de Alta Cocina) are just a couple of the applications developed by private firms. In the particular case of CCI it consists of a method

² For a discussion about the differences between process, procedure, technique and tool, see Phaal et al. (2004, p. 4).

³ For a full list of IM tools and their associated methodologies, see Hidalgo and Albers (2008, p. 118).

⁴ <https://www.improve-innovation.eu/>

⁵ http://www.i3b.ibermatica.com/i3b/documentos/cci_resumen.pdf/download

developed in the Basque Country aiming at managing innovation in companies applied in non-food sector, while MIRAC is focused on the application of the CCI in the food sector.

We again need to highlight here that this set of tools are not meant to be mechanistic, nor do we mean to be prescriptive or applicable in all industrial contexts. As we will see in the next section, the application of all these tools requires some development and customization by the company (Phaal et al., 2006). In particular, this becomes true in SME environments, where the requirements of firms (even those operating within the same sector) differ substantially.

4. TECHNOLOGY OUTLOOK PROCESSES

Innovation has been for long categorized as an interactive process, being cooperation among agents one of its most determinant characteristics. In fact, there are few the cases in which innovations are developed without any type of cooperation. This interactive character applies not only to firms but also to public organizations. Due to the increasing technological complexity of goods and services companies need to rely on competences developed elsewhere. This makes them necessarily be aware of the technological advances and research-based applications developed by competitors and potential partners (Porter and Cunningham, 2005). One of the multiple tools that allows this task being carried out is the Technology Outlook (TO).

What can companies expect with the application of a TO process? First of all, the TO will allow them to select the various market and technological opportunities available and decide strategically to which respond to. This will imply the previous definition and selection of prioritized technologies, their analysis, assessment and the agreement on the resources to be devoted to each of them. In addition, the company will have to be aware of its current technological base, the fit of these technologies with the overall business strategy and the flow of signals coming from the environment and which could be captured by other IM tools (e.g. technology foresight).

The outlook filters, interprets and evaluates the gathered information so as to ease decision making processes about the future orientation of the company, and allow the firm to behave more efficiently by focusing on its core competences and technologies (Escorsa Castells et al., 2000). It is the need to make decisions in an uncertain environment which thus links the outlook with the corporate strategy. This is a field which is receiving increasing interest, not only among IM scholars and practitioners, but also among legislators. As a matter of fact, the norm UNE 166006-2006 was introduced by the Spanish National Accreditation Body (AENOR) in 2006 as an effort to make the management of R&D and innovation more systematic, and in particular to provide a more clear structure for those companies interested in the introduction of TO processes (i.e. UNE 166006-2006 EX)⁶. Similar experiences from other countries can also be found in France, one of the most proactive countries on the field⁷.

⁶ <http://www.aenor.es/aenor/normas/normas/fichanorma.asp?codigo=N0036140&tipo=N>

⁷ http://www.boutique.afnor.org/NEL5DetailNormeEnLigne.aspx?&nivCtx=NELZNELZ1A10A101A107&ts=5610196&CLE_ART=FA047502

This outlook can also be used for other purposes than merely the technological search. That way, we could also talk about competitive, commercial, legal or environmental outlook processes. Despite this paper will only focus on TO, the process outlined below could also be applied in other types of outlook.

Despite the obvious nature of these search activities not many companies have implemented processes that aid them in their outlook processes (Bucheli and Gonzalez, 2007). Most of the cases included in the literature refer to multinational companies in the high-tech sector (Lichtenthaler, 2004; Nosella et al., 2008), where the development of innovations are more of a radical character and where the pace of technological change is much higher than in their low-tech counterparts. However, not many examples of its application in SMEs are found (Dou and Dou, 1999). This is one of the goals of this paper.

The aim of this section is to develop a set of generic stages in which the TO process can be divided into. In addition, we also want to highlight the key roles required to make TO processes work in the company, as well as the sources required for it. The section will conclude offering the strengths and limitations of TO processes.

4.1. Activities

The TO process is basically a matter of managing different types of formal and informal, internal and external information sources. On the one hand, formal sources may include those from journals, books, sectoral magazines, patent databases, presentations at fairs, meetings, workshops or conferences among others. On the other hand, informal sources refer to those pieces of information collected through tittle-tattle, and that hence require verification so as to avoid the provision of misleading information. This includes daily and personal information from suppliers, customers, experts, labor unions or consulting companies.

One of the major requirements and challenges of TO processes (and IM tools in general) is to convert the gathered information into action (Porter and Cunningham, 2005). Information retrieval is not useful unless it is organized, analysed, evaluated and understood (Kärkkäinen et al., 2001) and provides the basis for firms' decision making procedures. This requires the development of a TO process which include all these stages. This paper intends to cover this gap by offering a general description of this TO process, which could be adopted by SMEs.

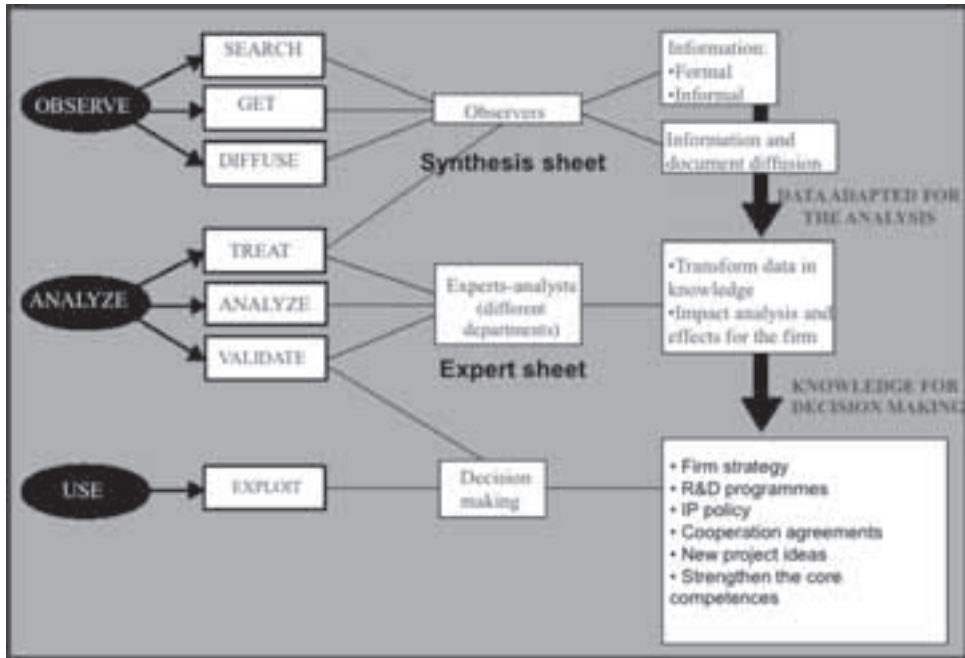
As the reader can note, the TO process (Figure 1) has been divided into three general stages: observe, analyze and use⁸. They will have a clear influence on the roles required to be incorporated into the TO process (observers, analysts and decision makers⁹), which will be the matter for discussion in the next sub-section.

⁸ A very similar approach is supported by Lichtenthaler (2004), while Porter and Cunningham (2005) distinguish among intelligence, analysis and design, and choice.

⁹ In this regard Porter and Cunningham (2005) talk about watchers, technology and business analysts, and finally planners and managers.

Figure 1

Organizing the Technology Outlook process within SMEs



A. *Observing*

The first step is also divided into three activities: search, get and diffuse. As discussed, the character of the information can be formal or informal. However, searching for information does not imply its direct acquisition. Data need to be filtered first, so that non-relevant or already known information is avoided. This is the reason why in this first stage the search activity is differentiated from that labeled as get.

The key role in this observation stage will be played by the network of observers, who will be in charge of the searching and detecting external signals in those technological fields of relevance to the company. In order to make the TO process not dependent on the observers, it is required that the information is diffused and shared within the organization¹⁰. Observers are usually required to have a broad knowledge of technologies and disciplines of interest for the company. Should they be too specific, the company would run the risk of missing many technological opportunities in related fields. It is a matter of the observers “feeling” what the future opportunities of a particular technology would be and how the company may be affected by them. This “feeling” is the driver that will make the

¹⁰ Note that during the last decade several software tools have been developed in order to make the search stages more continuous and systematic (Bucheli and Gonzalez, 2007, p. 119 – Table 2).

observers get the information that they find most relevant for the company. As said, this implies that not all the information that has been searched will also be obtained. The network of observers will have to make certain decisions (with their associated risk) as to which technologies to focus upon and which to dismiss. In order to minimize the future impact of this “missed information” we would suggest observers to use different sets of databases with bibliometric information, so the views from different sources can be compared (Gupta and Bhattacharya, 2004).

Once the information has been obtained, it is time for its internal diffusion. The rationale here is simple: the more the information diffused internally the better the chances not to miss a technological opportunity. However, it would not be practical for the observers to directly diffuse all the information they have retrieved. This would make the process very lengthy, when precisely the TO needs to be as flexible as possible. This diffusion can be done either personally (meetings and knowledge sharing among observers) or through more formal processes such as the internal computerized diffusion/sharing of the documents via internal repositories, databases or information management platforms. From our point of view, a practical way to carry out this diffusion is by using “synthesis sheets”. Their purpose and content will be detailed in few lines.

Due to the limited amount of resources, particularly in the context of SMEs, companies need to set their priorities as to the key technologies they are interested in this first searching stage. This (usually) involves the creation of some scanning teams or networks of observers, each focused on a particular technology. In the case of SMEs though, it is very often that this cannot be afforded due to the lack of skilled personnel and financial restraints. However, there are many public and private consultancy and service companies who are aware of this need and offer these services. Some examples¹¹ include the service company IALE, the ZAINTEK initiative promoted by the Department of Innovation and economic promotion in Bizkaia¹², or the services offered by most of the support centers for innovation, research and technology transfer (OTRIs in Spanish) implemented in Spanish public universities. Accordingly, this does not imply that all companies necessary need to carry out all the activities included in the model proposed in Figure 1. This will depend on the skill availability, the amount of resources that could be directed to technology outlook activities and the technology life cycle in which the company is embedded. Thus, despite we have proposed a general model, this will have to be adapted to the particularities of each company, as some of the search and get stages can easily be outsourced, which may be of particular relevance for SMEs.

B. Analyzing

The goal of this second stage is twofold. On the one hand, the process should transform the data collected by the network of observers (or external organizations in case the search has been outsourced) into useful knowledge. On the other, an assessment of the technolo-

¹¹ More examples of public organizations supporting the development of TO activities in Spain can be found in: http://www.fecyt.es/especiales/vigilancia_tecnologica/organismos.htm

¹² http://www.fundacionede.org/gestioninfo/docs/contenidos/_guiazaintek_.pdf

gies observed during the search stage should be made in order to estimate the potential impact they may have on the future performance of the company. This stage is also divided into three subcategories: treat, analyse and validate (see Fig. 1).

Due to the (usually) immense amount of information gathered by the network of observers during the first stage, it is not practical for the analysts/experts in charge of this second stage to start with the depth analysis of each of those sources of information. That would make the process impractical and long-lasting. In order to avoid this constraint, we recommend the use of the so called “synthesis sheets”. The synthesis sheet is the main output of the first search stage, and it is a responsibility of each observer to define it. The synthesis sheet usually details the person responsible for its writing (so the organization can identify the relevant actors when required), the technological area the observer belongs to, a short summary of the technology found, the description of its major technical issues, and a possible list of recommendations concerning its future applicability for the company. As said earlier, we believe the more the observers circulate the information found the better the chances for the company to detect future market and technological opportunities. Finally the sheet should also include the sources where the information was collected. For an example of the possible contents of this synthesis sheet, see Figure 2.

Figure 2

Example of synthesis sheet

SYNTHESIS SHEET		
Topic:	Code:	
Responsible:		
COMMENTS:		
1. Technical issues:		
2. Competence issues:		
POSSIBLE ACTIONS:		
Group members:	Recipients:	Sources of information:
		Source1:
		Source2:
		Economic sources:
		Legal sources:

Accordingly, the treatment of the information does not imply the usage of all files documented but the analysis of the synthesis sheets written by those observers in charge of the technology areas the company has focused upon. Since the sources of relevant information have already been included in the synthesis sheet, in case an analyst wants to know more

about the particularities of that specific technology, he/she can always go back to the original sources (which will also be at their disposal in the internal repositories or databases of the company) or directly communicate with the person in charge of that synthesis sheet. The main reason why we distinguish between treat and analysis is that while the treatment of the information and data gathered in the first stage can be done via repositories and databases, the analysis of this information (contained in the synthesis sheet) needs to be done by internal experts/analysts.

To close with the analysis stage, the validation step implies the definition of the proposal that will be made for the TO managers (or those in charge of the general management of the company in the case of SMEs) on the actions to be undertaken. In our experience, this is eased by the use of what we here call “expert sheets” (Figure 3). These expert sheets include all the information managers would need to know about the organization that developed the technology under study, together with the actions that the network of analysts has identified as potentially beneficial for the company.

Figure 3
Example of expert sheet

EXPERT SHEET		
Area:		
Specific activity/process/product:		
Company:		
Adress:		
Phone:	Fax:	e-mail:
Contact person:	Responsibility:	
Detected information:		
Date:		
Responsible person:		
Suggestions done/key actions to undertake:		

C. Using/Exploiting

Finally, the TO process will conclude with the exploitation of the expert sheets, which will set the basis for the decisions to be made by the company managers. Usually, these decisions imply that managers have to position themselves about such issues as the corporate strategy, the internal development vs. the external acquisition of R&D and technologies, intellectual property, cooperation agreements, the need to strengthen the core competences of the company on particular technological fields or the development of new project ideas.

All these decisions will be included in a “TO report” which will contain all synthesis and expert reports, together with all relevant information gathered during the TO process.

One of the key questions on the TO process relates to its periodicity. How often should the TO cycle be run? We don’t have a clear answer for it, as it depends on the speed of technological change, which is industry specific (Pavitt, 1984). The experience in the application of this TO process tells us that the information retrieval is not constant. In some of the companies where this TO process has been implemented, the periodicity was three months, so every year all relevant stakeholders had four TO reports. Sometimes many technological findings were gathered while in other periods none were found, so the significance of the TO report also differed among periods. This periodicity is thus an issue that needs to be addressed by every single company. Still, the fact of defining the frequency of the TO cycle should not exclude that when a key potential technology which requires a fast decision is identified, the TO process is developed in a much flexible way, not to miss opportunities due to the wrong timing.

4.2. Roles

Figure 1 drew the general TO process. On it we identified three major roles to be taken into consideration: the network of observers, the network of analysts and decision makers. This is aligned with the findings of Tomala and Sénéchal (2004, p. 282) who also distinguish between “product sponsors”, “expert advisors” and “decision makers” when discussing the roles of the internal staff in the adoption of innovation processes.

The main function played by the network of observers is to search, collect and diffuse information. We need to emphasize here that this network of observers should (potentially) include all employees and related stakeholders of the company. The more “agents” involved in this continuous search, the less the chances to miss a piece of information that could imply a breakthrough the company should be aware of. The philosophy behind is that everyone in the firm should act as an observer (Porter and Cunningham, 2005). However, as pointed out in the previous section, we also believe, particularly in an SME context, this role may be the one more likely to be outsourced to external organizations.

The network of analysts is oriented towards the treatment, analysis and validation of the information gathered in the previous step (search) by the network of observers, and which has been translated into the synthesis sheet. That is, they translate information into potential impacts which will be presented to the managers in expert sheets. This implies the assessment of value of the technologies identified according to their potential impact for the firm. Since the role of the analysts is firm specific, outsourcing their function could be a bit more problematic. It could be the case that SMEs could decide to subcontract this function to the clusters they are grouped in¹³. However, we still believe that commissioning this function may also imply losing influence on the strategic view of the company, as the main role of the analysts is to translate the opportunities observed into operative targets.

¹³ A possible example of a cluster grouping machine tool manufacturers is AFM (Asociación de Fabricantes de Máquina Herramienta).

Finally, decision makers have the less structured role, implying an important share of verbal communication with the other actors in the process. We already have claimed for a wide approach towards decision making procedures. We believe that every single person within the organization can have the potential to detect the key technologies setting the future of the company. Accordingly, we advocate for open decision making processes where consensus is reached among the actors involved. We believe decision making processes should still be kept open (i.e. aiming at reaching a consensus among involved stakeholders) regardless the stages of the TO that are outsourced.

Last but not least, we also need to point at the need for another crucial role: the “dynamizer”. The relevance of this role has also been observed by other scholars (Kärkkäinen et al., 2001; Lichtenhaler, 2004; Kapiér and Nilsson, 2006; Nosella et al., 2008). The main role of the dynamizer is to create a collective orientation towards information sharing, gaining the commitment and implication of observers and analysts. Small companies in traditional sectors undergo a great resistance to change, and the introduction of any type of IM tools within them usually leads to an opposition by the staff members. Accordingly, we consider that in order to make the TO process from the very beginning, setting a dynamizer who has certain responsibility and charm within the company is a must. He/she will require good public and human relations as well as communication skills, besides having certain respect within the organization.

4.3. Strengths and limitations

One of the characteristics of TO is its adequacy to different organizational contexts. For example, some organizations may be interested in using the TO as an input for their corporate strategy, whereas other companies may be more oriented to use the same activity for more practical purposes (e.g. benchmarking particular competitors or potential research centers to collaborate with), without so much integration with the general strategy of the company. In fact, we could talk about many different degrees of implementation of TO, going from unsystematic, reactive and basic levels to systematic, proactive and advanced ones (Nosella et al., 2008, p. 324). In other words, TO is a very flexible and adjustable IM tool. Another great benefit companies can get with TO processes is the promotion of internal learning. Since the process allows observers, analysts and decision makers to detect a broad range of technological fields to explore (possibilities and threats), it can set the ground for the generation of new ideas/concepts/technologies or for the development of technological solutions to perceived problems (either societal or firm/sector specific).

On the negative side, we need to emphasize that in order to successfully develop and implement TO processes, some factors will be required such as the commitment of top management, the alignment of corporate and innovation strategies¹⁴, having competent people, flexibility, patience and devotion. However, this is the case for all IM tools, due to the resistance to change, as previously discussed.

¹⁴ The technological areas than have been given priority should be also aligned with the strategic goals of the company.

One of the risks of TO is the probability of companies missing technological opportunities due to their radical character at the moment they have been identified. In order to make TO become effective, companies need to assess the key technologies they are interested in and limit the scope of the TO. Lichtenthaler (2004, p. 339) shows how many technologies, even if they found acceptance among top-managers, were often not pushed through due to the degree of radicalness involved. This clearly exemplifies how the commitment from managing bodies is a must when we come to the successful implementation of IM tools in companies, particularly in the case of SMEs, where innovation culture is not usually rooted at their core. However, this could also be due to the lack of competences or the ability of the observers and analysts, who were not able to assess the future relevance of a technology. Accordingly the TO process has the limit of being subjective to a certain extent, or at least dependent on the information captured by the observers. This is the reason why we adopted the rationale of making as many members of the organization as possible participate in the search stages. Some other weaknesses include the potentially unlimited amounts of information that can be collected during the observe stage, what can make the process become very time consuming, particularly for the network of observers and analysts.

Other hazards include the difficulty to create incentives for participation with the consequent danger of TO becoming a routinized instrument. The application (or not) of incentives is a company specific issue. This is the reason why the role of the dynamizer was introduced in the previous sub-section. He/she should precisely be the one involving and motivating the staff, particularly at the first cycles of the TO, showing the benefits for company with the application of this tool.

As noticed, the list of threats and risks is much larger than the potential benefits. This does not by any means imply that there are no advantages in the application of this type of IM tools. However, we also want to make firms aware (particularly SMEs) of the fact that no IM tool will solve all their innovation related problems, which is in many cases the expectation companies have. IM tools should be thus understood as a support, but not as a magic recipe to be applied in any context and under every situation.

5. CONCLUSIONS AND DISCUSSION

Some scholars argue that the business community has not been served by IM literature, mostly due to a tunnel vision in which every discipline focuses on its own contribution instead of searching for cross-disciplinarity (Currie, 1999). In addition, IM literature has mostly focused on the theoretical discussion rather than on the practice (implementation) of these tools. In this paper we have precisely aimed to offer the reader a user-oriented perspective in which the theoretical foundations of the TO (as one of the tools for IM) were not at the core of the paper, but their implementation, particularly, in the case of SMEs.

As we have seen TO is an individual but also a team tool that requires an appropriate internal organization in order to make the most effective and systematic use of the information sources used by the company (Libutti, 2000). Some of the reasons SMEs pose not to implement TO processes are the costs involved and the competences required for it. Is it possible at all to solve them? As we have seen, one of the key stages in the TO process is the information search. In fact, not all SMEs have access to formal sources of information

such as patent databases or journals of scientific literature, nor do they have the required competences to understand the language used in them. However, there are many service companies (public and private) who offer these services to local SMEs at an affordable price. As to the need for many actors (observers, analysts, animators and decision makers) we acknowledge that in the context of SMEs it is usually the same individuals who are involved in all activities, from management to production, from purchasing to sales. That is the reason why we talked about roles instead of using the terms actors, which could be more prone to be related to individual people. The roles we have introduced should thus be understood as such, as roles required to make the TO process work.

TO is a participatory process which requires strong commitment and continuous and coordinated communication. This has been illustrated by the participatory decision making processes we referred to, and which take place prior to the decision to invest/acquire/license/develop a particular technology. TO is thus a multi-level organization sub-system in which the parallel involvement and communication among the actors is at the core of the process.

For those companies interested in the application of TO processes, we could summarize the particularities of this IM tool, by the following seven questions (Cotec, 1999): (i) Which is the main goal of the TO?; (ii) What to search? Which information to focus upon?; (iii) Where to find it?; (iv) How to treat and organize the information?; (v) To whom to communicate the information?; (vi) How to encourage the involvement of all staff?; and (vii) Which and how many resources to devote? We believe that by providing answers to these seven questions, companies may have an idea about the requirements needed to implement such a process.

We have seen that there are multiple tools that can assist managers in the challenge of managing innovation in the companies. However, this does not mean that IM can be simply understood as the use of some techniques included in a toolbox. Managing innovation is much more complex than that, and it implies the commitment from the managers, the alienation of corporate and innovation strategies and the consideration of both internal and external factors to the company. Tools are just an aid in order to face this challenging task.

Needless to say is that the tools need to be used in a continuous manner and not leap-frogging. Innovation must be a continuous process within the company (the same as manufacturing or the provision of services to customers), otherwise when we notice that innovations (product or process) are needed, then it will be too late to start using these IM tools.

IM tools need time to be established within the company. Firms have constraints and are change adverse, so employees, and particularly managers, will need time to adapt to them. The implementation of IM tools will imply the change in organizational routines and the adaptation of certain rationales, such as communication, interaction, learning and change, and managers in particular need to be aware of these structural changes prior to the application of the tools in the company. We cannot assume though that all IM tools are applicable to all firms and that it will automatically lead to competitive advantages. From our point of view, IM tools provide the guidelines, stages or the process that could be followed to make them applicable to SMEs. They should not be understood as being prescriptive and normative. We thus claim for the adaptation of IM tools to the particularities of each firm and to the local environment in which the company is rooted.

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