

# Filling the Gap: Matching Consumer's Needs with Technological Evolution – A Systematic Literature Review

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#### **Abstract**

Addressing consumers' needs is an important task for companies, not only in the process of developing new products to fulfil them, but also in the process of searching for the right technology to use in those products. Creating products that consumers find attractive and innovative is the major goal of every company, with significant impacts on the company's competitiveness. Although being an essential process for the survival of the company, and even though there is no shortage of guidance available, too often companies fail in delivering products that consumers are willing to buy.

Successful innovative products arise from the correct articulation between the consumers' needs and the technology chosen. Though essential to the company, this relation is not yet fully understood and characterized. The main objective of this thesis is to identify points of connection between the process of identification of the consumers' needs and the process of search for the technology that provides the capability or capabilities to effectively respond to those needs.

A systematic literature review (SLR) was developed in order to establish a relation between the two previously mentioned drivers in the development of innovative and appealing products: the consumers' needs and the technology. Based on the SLR findings, a conceptual framework that helps systematizing that relationship is proposed.

**Keywords:** consumers' needs; technology scouting; new product development; job to be done

#### Resumo

A incorporação das necessidades dos consumidores no processo de desenvolvimento de novos produtos, e a articulação dessas necessidades com o processo de pesquisa das tecnologias adequadas para o desenvolvimento desses produtos, é uma tarefa importante para as empresas.

A criação de produtos que os consumidores consideram atrativos e inovadores é o objetivo principal de todas as empresas, com impactos significativos nas suas competitividades. Embora seja um processo essencial para a continuidade das empresas, e ainda que não faltem estudos que guiem e potenciem a criação de inovação, muitas vezes as empresas falham em conseguir desenvolver produtos que os consumidores queiram comprar.

Produtos inovadores com sucesso comercial surgem a partir da articulação correta entre as necessidades dos clientes e a tecnologia escolhida. No entanto, embora seja essencial para as empresas, essa articulação ainda não é totalmente compreendida e caracterizada na literatura. O objetivo principal desta dissertação é identificar pontos de ligação entre o processo de identificação das necessidades dos consumidores e o processo de pesquisa da tecnologia que permite à empresa ter as capacidades essenciais para responder a essas mesmas necessidades.

Foi desenvolvida uma revisão sistemática da literatura (SLR) a fim de, com base no conhecimento existente, desenvolver um entendimento sobre a relação entre os dois *drivers* mencionados anteriormente para o desenvolvimento de produtos inovadores e atrativos: as necessidades dos clientes e a tecnologia. Com base nas conclusões da SLR, depois de identificados os pontos que conduzem a esse entendimento, é proposta uma ferramenta concetual que ajuda a sistematizar a compreensão dessa relação.

**Palavras-chave:** necessidades dos consumidores; *technology scouting*; desenvolvimento de novos produtos; *job to be done* 

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#### 1. Introduction

Addressing consumers' needs is an important task for companies, not only in the process of developing new products to fulfil them, but also in the process of searching for the right technology to use in those products (Markham and Kingon, 2004). The process of identifying consumers' needs and communicating them to the different departments of the company is a process that should be carefully prepared and monitored, since different departments are involved in the process of developing new products.

The same applies to the search for new technologies, technological trends or technological partners. Successful innovative products arise from the correct articulation between the identification of consumers' needs and the choice of the right technology. Though essential to the company, that articulation is not yet fully understood and characterized, which has dire implications for companies.

The main objective of this work is to identify points of connection between the process of identification of the consumers' needs and the process of search for the technology that provides the capabilities to effectively respond to those same needs. After identifying those points, and based on the findings of a systematic literature review (SLR), a conceptual framework is proposed to systematize the understanding of the relation between consumers' needs and technology.

#### 2. Problem Definition

The development of products that consumers find attractive and innovative is the major goal of every company, since they have significant impact on the company's competitiveness (Lord, 2000; Sheikh, 2008)). Although being an essential process for the survival of the company, and even though there is no scarcity of guidance available, too often companies fail in delivering products that consumers are willing to buy (Lord, 2000). About 75% of all products developed by companies do not succeed commercially. According to Christensen and Raynor (2003) and Christensen *et. al.* (2007) this happens because companies fail at understanding the basic causal mechanism (what causes what and why) in the consumers' world, *i.e.*, the consumers' real needs.

Supporting this evidence are the findings of Leonard-Barton (1995), who conducted a study of 252 product development projects in 123 firms, and concluded that less than 20% of the project teams took into consideration what the consumers actually wanted or needed in order to generate product specifications. Leonard-Barton (1995) also concluded that the amount and detail of the market research performed for the failed projects was the same as for the successful ones. It appears that merely increasing emphasis on market research by itself does not lead to a better understanding of consumers' needs and to a higher probability of product success (Leonard-Barton 1995; Christensen and Raynor, 2003; Christensen *et. al.*, 2007).

In fact, executives have not yet realized that their companies are failing in capturing the consumers' needs, which is undermining the company's financial performance (Ballantine, 2004). In a study involving 270 companies conducted by Strategyn, 72% of the executives inquired said that their marketing departments where doing a great job in understanding what consumers want (Ulwick, 2003).

Although market studies are important for the product development and a useful tool at the disposal of companies, they can sometimes deceive decision makers and cause more harm than good (Ulwick, 2003; Christensen *et. al.*, 2007). If a market study defines market segments that are misaligned with the circumstances in which consumers base their purchases, then the product development will be also misaligned with the consumers' needs, resulting in a product with a higher probability of commercial failure and a waste of the company's resources (Griffin and Page, 1996; Christensen and Raynor, 2003; Ulwick, 2003).

On the other hand, if market studies are able to characterize the circumstances in which consumers base their purchases (the reason why consumers hire a product to get a job done), then the consumers' purchase causal mechanism will be defined, allowing the development of products with high commercial potential (Christensen and Raynor, 2003; Ulwick, 2003; Oestreicher, 2009). In fact, consumers are the main innovation driver for the development of new products through their constantly changing options and needs. However, the way consumers influence the new product development depends largely on the industry and on the company's skills and resources to properly

translate the consumers' needs into product features that are both functional and technologically appealing for the consumers (Ballantine, 2004).

Evidence shows that companies face a large variety of new-product definition challenges, requiring a different range of market information, the most important being the information derived from the consumers' database and the technological design underlying the product (Leonard-Barton 1995).

According to Anderson (1997), Carlson (2004) and Rohrbeck (2010) technology is the main source of competitive advantage for companies. To capture those advantages companies must have a strong peripheral vision of their technological environment, in order to pursuit and maintain a leading competitive advantage over their competitors. This involves the search for "weak signals" that are often the precursor of big industrial changes and dictate the success or failure of many lines of products, and, consequently, of companies that are capable of understanding those changes in their early stages (Day and Schoemaker, 2005).

In the search for the most suitable technology to be incorporated in new products, and therefore obtaining a leading competitive advantage, companies often deploy a vast array of methodologies, such as competitive intelligence, technology intelligence or technology foresight (Brenner, 1996; Reger, 2001; Birkinshaw and Monteiro, 2007; Vecchiato and Roveda, 2010; Rohrbeck, 2010). Even though all the methodologies above mentioned provide crucial information to the development of new products, the main role in selecting the right technologies for integration in innovative products is attributed to technology intelligence (Reger, 2001; Birkinshaw and Monteiro, 2007; Vecchiato and Roveda, 2010; Rohrbeck, 2010), especially through the deployment of technology scouting (Birkinshaw and Monteiro, 2007; Vecchiato and Roveda, 2010; Rohrbeck, 2010).

Technology scouting aims at identifying technologies with high potential at relevant areas for the company (Rohrbeck, 2010): finding technological threats and opportunities in a fast changing environment (Reger, 2001), searching for information about emerging trends in fields outside the company's environment (Vecchiato and Roveda, 2010), and looking for technological knowledge from external sources and then proceed with the

dissemination of the gathered information throughout the company in order to fully access the technology potential (Birkinshaw and Monteiro, 2007).

In order to take full advantage of technology scouting's outcomes, companies must provide the right directions through which the technology scouting process must be conducted (Rohrbeck, 2010; Birkinshaw and Monteiro, 2007). This includes the formulation of the right set of questions (Rohrbeck, 2010), as well as an internal assessment of the company's real needs, *i.e.*, its problems (Birkinshaw and Monteiro, 2007).

According to Rohrbeck (2010) and to Birkinshaw and Monteiro (2007) the main driver of technology scouting success is the understanding of the needs and problems of the company. One can argue that those needs and problems of the companies, the technological needs and problems, are strongly related to the needs and problems of its consumers, since the technology will be used to create products that solve consumers' needs and problems, and since consumers are the reason companies exist in first place (Masoomeh *et al.*, 2013).

The findings of Masoomeh *et al.* (2013) related with the causes of failure of product development (Christensen and Raynor, 2003; Ulwick, 2003; and Oestreicher, 2009) suggest a clear pattern: products and technology are dependent on consumers' needs.

Although this relation may seem obvious, it is not yet fully studied, with each of the several authors focusing on the study of only one of the components of the problem - the consumers' needs (Lord, 2000; Christensen and Raynor, 2003; Ulwick, 2003; Ballantine, 2004; Oestreicher, 2009) or the process of technology scouting (Brenner, 1996; Birkinshaw and Monteiro, 2007; Vecchiato and Roveda, 2010; Rohrbeck, 2010).

This work is focused on identifying the components of the job to be done (JTBD) framework and the technology scouting methodology, through the conduction of a systematic literature review. The aim of this work is to produce a new understanding of how these two components relate between each other during the new product development process, with the objective of bridging the technology and consumers' needs in order to improve the product development. The findings of this work provide guidelines for companies to correctly address the consumers' needs, and search for the

right technology to incorporate in the products to correctly answer those same consumer needs.

#### 2.1. Why do most companies fail at the development of new products?

Companies generate revenue by selling their services or products to clients. It is from this flow of revenue that shareholders' value is created (Christensen and Raynor, 2003, and Chirstensen *et al.*, 2007). This need for the creation of shareholders' value drives executives into the search of a sustainable and profitable growth for their companies, which will ultimately be reflected in more innovative and appealing products or services. The main difficulty is that too often this quest fails, leading to a waste of resources and time, and placing the company in a worst position than it was before (Christensen and Raynor, 2003).

Why does this happen? Why are some companies able to beat market expectations year after year, while others fail? Is it a matter of luck of the executive teams, or are there skills behind those results?

There is no shared answer to these questions, as it depends on whom they are asked to:

- Shareholders will say that the search for sustainable and profitable growth fails
  due to incompetence of the executive team and that the solution lies in
  consecutively trying different teams until finding the one that can properly
  implement a plan that ultimately leads to growth.
- Analysts will argue that achieving a sustainable and profitable growth is hard, unpredictable, and a matter of skill mastered by only a few executives with outstanding management skills.
- Executives will claim that failure in achieving sustainable and profitable growth
  dwells in a risk adverse policy undermining all the options that lead to growth.

  In fact many companies that experience long time growth trajectories evidence a
  high focus on risk.
- Overall pessimist people will argue that creating growth is risky and unpredictable, being a matter of odds. Many managers of financial instruments

used for creating new companies, such as venture capitals, assume this posture, putting in evidence that successful new growth cannot be predicted.

But what if neither of the above mentioned answers are in fact correct, and the true reason why some companies fail at achieving a sustainable and profitable growth, while others succeed, resides in the different angles both use to look at the information provided by the market?

Executives rely on information provided by marketers to manage the company and pursuit the best strategy for the company's success. This includes the decisions about the company's resource allocation process, of what products or services must be developed, and of how many resources should be spent on developing them (Christensen and Raynor, 2003; and Chirstensen *et al.*, 2007).

As previously explained, and as will be further detailed, information gathered by the marketers is usually segmented in a way that most of the times cannot be used to develop products that consumers want to buy, hence failing at delivering value to the shareholders and jeopardizing the company's future. This is what job to be done framework (JTBD) is about: understanding that consumers hire a product or service to get a job done, absorbing the information about what is the job, and translating it into fast selling products (Christensen and Raynor, 2003; and Chirstensen *et al.*, 2007).

#### 2.2. Understanding and absorbing the right information from the market

The information provided by the market serves as a beacon to guide managers' decisions. Market segmentation is widely accepted as one of the most fundamental and most important concepts in marketing (Kalafatis and Cheston, 1997; Danneels, 1996; Wind, 1978). An important issue lies in how companies incorporate market's information in the cycle of product development (Ulwick, 2003; Oestreicher, 2009). Marketers employ static segmentation schemes that are rigid and do not follow the changes in consumers behaviours. Besides static segmentation, marketers also collect and report information about the characteristics that consumers are looking for in the products and about competitors' offers for those same consumers. But some executives fail in understanding why those characteristics should be incorporated in the new

products and instead merely imitate the competitors' products specification (Christensen and Raynor, 2003, and Chirstensen *et al.*, 2007).

This segmented attribute based characterization scheme conducts companies to bet in undifferentiated one-size-fits-all products leading eventually to the commoditization of the product, compromising profit margins and market share, and ending in developing products that perform poorly in satisfying the job that consumers want to get done (Christensen and Raynor, 2003, and Chirstensen *et al.*, 2007).

The jobs that consumers are trying to get done or the outcomes that they are trying to achieve constitute a circumstance-based categorization of markets. Companies that target their products at the circumstances in which consumers find themselves, rather than at the characteristics of the consumers, will most probably launch successful products (Christensen and Raynor, 2003; Chirstensen *et al.*, 2007). Circumstance base categorization scheme, or the creation of job-based segmentation scheme, must involve the consumer's problem categorization through observation, with the objective of understanding and defining the causal mechanism of the consumer's purchase, the what-causes-what-and-why (Christensen and Raynor, 2003).

Companies that want to create disruptive products must synthesize insights from observing and questioning consumers to determine what consumers are trying to do. And then couple that information with strategies of fast development and feedback, in order to improve the probability that their products will converge quickly upon jobs that people want to get done (Christensen and Raynor, 2003; Chirstensen *et al.*, 2007).

## 2.3. How can a circumstance based categorization of market enhance innovation?

The use of a circumstance based categorization for market analysis can in fact create new areas of business for companies, since it leads to the identification of new jobs that consumers want to get done. New opportunities can rise in different types of innovation, depending on the strategic positioning of the company and the nature of the JBTD uncovered (Christensen and Raynor, 2003; Chirstensen *et al.*, 2007).

Innovations can be sustainable or disruptive (Christensen and Raynor, 2003; Chirstensen *et al.*, 2007). Management decisions for the development of new products based on the findings of JTBD change significantly depending on whether the company is following a sustainable or disruptive innovation strategy, and on its awareness and readiness to incorporate the JTBD information. Incumbent companies, following sustainable innovations, are slower to realize the potential of JTBD despite having the resources to do so. And even when JTBD is fully understood, the information is mostly used to incorporate sustainable innovations in new products (Christensen and Raynor, 2003; Chirstensen *et al.*, 2007).

Disruptive companies, on the other hand, generally are fast to react and to implement the findings of JTBD in new disruptive products, creating simple products, only with the necessary specifications to get their consumers' job done. Disruptors typically start with an up-market strategy, being their initial consumers either conquered from the lower-end markets of incumbents, or by appealing to non-consumers. Either way, the up-market strategy, with time and development of product's performance, eventually allows the disruptive companies to directly compete with the incumbent firms and threat their permanence (Christensen and Raynor, 2003).

As a consequence of the up-market strategy, disrupters have to create a value network, which involves distribution channels, brand creation and management, resource allocation processes, and the definition of organizational values. This is another reason why disrupting with existing technologies is simpler to new companies than to incumbent ones, since new companies are not tied to an existing value network and as they are creating it they can adjust it to better suit the JTBD of their consumers (Christensen and Raynor, 2003).

Summarizing, the information provided by the circumstance based categorization of market is a powerful fuel for disruption, which enhances innovation towards more successful products.

#### 2.4. Defining product architecture based on the types of innovation

The type of innovation, sustainable or disruptive, is responsible for the definition of the product architecture. Sustainable innovations tend to be used in modular products, while

disruptive innovations tend to result in integral products (Christensen and Raynor, 2003).

The reason why different types of innovation require different product architectures is related to the performance offered to consumers. For instance, with sustainable innovations incumbent firms can develop new products to consumers for whom the performance plateau of the existing products was already reached. This means that products need to have higher performance to satisfy high demanding consumers, even though some consumers from less demanding market segments will use only a fraction of that performance. This higher performance is the result of many years of product evolution, which leads to well established industry standards and modular interfaces among components that are subject to intellectual property rights (such as patents). This allows incumbent companies to outsource the production of such components to third party companies. Such decision eventually leads to a commoditization of the technology and to undifferentiated products. Commoditization also is responsible for the reduction of the value chain controlled by incumbent companies, and consequently, in lower profit margins over time (Christensen and Raynor, 2003).

On the other hand, and since disruptive companies focus on low-end market segments or new markets, they do not need to have such high performance to satisfy lower demanding consumers, being able to get the same job done with less expensive technologies. At the same time, these technologies have a huge potential for performance increase, since they are new and still being studied. Any increase in technology's performance is of great interest since it will allow the company to make its products interesting for consumers from higher demanding segments of the market. As a consequence, disruptive companies employ an integrated architecture in order to maintain the performance gains under their domain and collect the higher profit margins (Christensen and Raynor, 2003).

But disruptive innovators need to be aware, since even disruptive products with the increase in performance turn into sustainable innovations and lead to a cyclical process of commoditization and decommoditization in the offerings of the market (Christensen and Raynor, 2003).

#### 2.5. Gathering information about the company's environment

Business intelligence is a set of tools that allow the analysis of the external components to the company, in order to provide information that can be translated into business advantage. Depending on what is being analysed, business intelligence can be divided into competitive intelligence that focuses on existent and potential competitors, and in technological intelligence that focuses on the early identification of technology trends and changes in the technology bases of suppliers and consumers. From technology intelligence analysis rise opportunities and threats that could signal the future growth and survival of a business (Brenner, 1996).

Some authors study the process of identification, assessment and monitoring of the technological capabilities of competitors, as well as the identification of technological trends based on subtle signs, the technology foresight (Reger, 2001; Rohrbeck, 2010; Vecchiato and Roveda, 2010).

Technology intelligence and technology foresight are both concerned with the early identification of the "weak signals" related to the evolution of the technology trends (Brenner, 1996; Reger, 2001; Vecchiato and Roveda, 2010). These "weak signals" are often the precursor of big industry changes that can dictate the success or failure of many families of products. For this reason companies should be capable of detecting them in their early stages (Ansoff, 1976; Brenner, 1996; Day and Schoemaker, 2005).

Technology intelligence or technology foresight processes are described as having one (Reger, 2001; Vecchiato and Roveda, 2010) or two (Brenner, 1996; Rohrbeck, 2010) main components. The authors who consider only one component argue that in one single process it shall be possible to identify technological opportunities and threats, search for the external "weak signals", and communicate and disseminate the findings throughout the company's departments.

Whereas the authors that consider the division of the technology intelligence or technology foresight process into two components separate the broad search and identification of technological opportunities and threats for the company, from the identification of the "weak signals" and the communication and dissemination of the findings throughout the company's departments. The process of identifying the "weak signals" is designated by Reger (2001) and Rohrbeck (2010) as technology scouting.

There is no consensus about the definition, scope and objectives of the process of assessment of company's technological environment. In fact, Reger (2001), states the following:

"There is no commonly used term for technology foresight in companies. Expressions such as technology monitoring, technology watch, technology forecasting, technology scouting or technology evaluation show the broad variety of expressions/definitions and include different activities in each firm", in pp. 535.

In this work, the term technology foresight will be used to mention both technology intelligence and technology foresight activities. It will stand for the process of scanning the company's technological environment. And technology scouting will be used to the identification of the "weak signals" and the communication and dissemination of the findings throughout the company's departments.

Technology scouting's main goals are to identify technologies with high potential at relevant areas for the company (Rohrbeck, 2010), finding technological threats and opportunities in a fast changing environment (Reger, 2001), searching for information about emerging trends in fields outside the company's environment (Vecchiato and Roveda, 2010), and having the particular purpose of looking for technological knowledge from external sources. And then proceed with the dissemination of the gathered information to all the company in order to fully access the technology potential (Birkinshaw and Monteiro, 2007).

While the role of technology foresight in providing information to companies is quite agreed amongst many authors (Brenner, 1996; Ansoff, 1976; Day and Schoemaker, 2005), the process by which that information is accessed, treated and disseminated throughout the company has less consensus (Brenner, 1996; Reger, 2001; Birkinshaw and Monteiro, 2007; Vecchiato and Roveda, 2010; Rohrbeck, 2010).

Both Reger (2001) and Rohrbeck (2010) consider technology foresight as a way to improve the overall competiveness of the company through the collection of information about the continually changing technological environment surrounding the company. These two authors are the only ones that characterize extensively the technology scouting process employed by companies. Vecchiato and Roveda (2010)

and Birkinshaw and Monteiro (2007) also mentioned the process, although not as profoundly as the first authors.

In the following sections some considerations are made about the understanding of Reger (2001) about the technology foresight process and the beliefs about the process of technology scouting by Rohrbeck (2010).

#### 2.6. Reviewing different perspectives about Technology Intelligence

# A - Technology Foresight in Companies: From an Indicator to a Network and Process Perspective (Reger, 2001)

Companies must be prepared to deal with changes in the technological environment. These changes can be generated by technological discontinuities that companies must identify and adequately address in order to be faster than its competitors. The identification of those technological discontinuities can be conducted using technological foresight. According to Reger (2001) the technology foresight techniques employed by companies have four main elements:

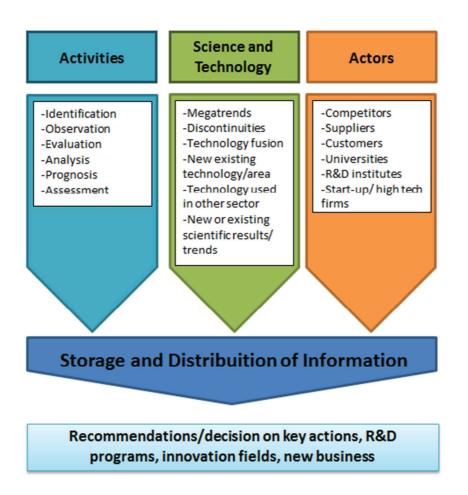
- Technology analysis consisting in the analysis the competitors' technological capabilities
- Technology monitoring exercise of compiling the available technologies
- Technology prognosis evaluation of technological trends
- Technology scanning search for new technologies outside the company's main areas of business.

These four elements allow companies to achieve the following objectives:

- Contribute to the competiveness of the company
- Promote company's contact with new sources of technologies
- Identify new technological trends;
- Incorporate new technologies in the development of new products or services
- Be prepared for technological discontinuities based on early identification of "weak signals".

The combination of the 4 elements with the objectives identified by Reger (2001) result in a theoretical framework for technology foresight (TF) based on 5 core elements, as identified in figure 1, namely:

- Activities
- Science and Technology
- Actors
- Storage and distribution of information
- Recommendations/decision



**Figure 1** – Core elements of the theoretical technology foresight framework proposed by Reger (based on Reger, 2001).

Based on the information provided by 47 multinational companies, Reger (2001) verified that the internal TF procedure employed by each firm changes significantly.

This variation is intrinsically related to the objectives, main areas of business, and organization of the companies analysed. Even though the procedure practiced in the different companies under study still had sufficient points in common that allowed the identification of the main phases of the TF framework, which are:

- 1) Determining information needs and selecting the search area
- 2) Selecting information sources
- 3) Selecting methods and tools
- 4) Collecting data
- 5) Filtering, analysing and interpreting the information
- 6) Preparing decisions
- 7) Implementing and carrying out the project or program

# B - Harnessing a network of experts for competitive advantage: technology scouting in the ICT industry (Rohrbeck, 2010)

The way companies deal with the discontinuous technological changes dictates their success or failure. Companies face two challenges: identifying, anticipating and assessing discontinuous change, and effectively use this information to plan and execute the appropriate actions.

As previously mentioned, incumbent companies are slower to react than disrupters when faced with discontinuous technological changes (disruptive innovations). Despite incumbents might be aware of this, it does not mean that they will be able to react adequately.

Rohrbeck (2010) addresses the importance of establishing a network of experts in the identification, anticipation, and assessment of discontinuous technological change and that this network supports the planning and execution of appropriate actions.

It has been noticed that the process of technology foresight requires the placing of a formal process and the selection of optimal methods depending on the task, size of the company and the context (*i.e.*, the industry clock speed and the level of complexity of the environment). Technology scouting provides the abilities of delivering state-of-theart products, monitoring technological capabilities of competitors, allocating R&D

budget to get the most promising technologies, mapping emerging technologies, and supporting make-or-buy decisions.

The mechanism by which companies implement the information provided by technology foresight is understood in less extension. The theory of dynamic capabilities suggests that companies facing disruptions in their environment need to adapt their strategic resources, namely their R&D capabilities. Therefore, technology foresight identifies capabilities needed to be acquired by the company and facilitates their acquisition or development.

Rohrbeck (2010) defines technology scouting as being an approach (developed internally by company staff or by external consultants) that allows gathering information about available technologies to be absorbed and used by the company. This search can be direct or indirect towards a specific area. In both cases the objective of technology scouting is the identification of technological opportunities in grey areas that otherwise would remain unidentified. Technology scouting deals with the identification of technologies with great potential for the company. The acquisition of technology falls in the domain of technology sourcing.

Rohrbeck (2010) argues that in order to fully take care of technology scouting's (TS) capabilities companies must define, prior to the initiation of the TS process, the right set of questions. This set of questions is crucial to guide the TS, independently of whether it is direct or indirect towards a specific technological area.

Summarizing, technology foresight sets the technological context where the company is acting, while technology scouting searches for new technologies and technological capabilities that might get the company better positioned in its technological context.

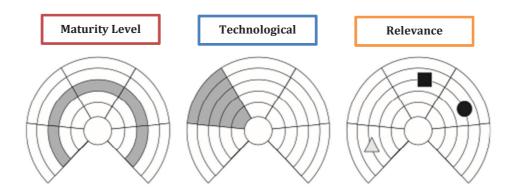
Rohrbeck (2010) describes the technology radar process as a possible approach for TS likely of being applied by companies. The technology radar process has 4 stages:

- Identification technologies are scouted through the company's contact network, accessing information sources in the industry and academia;
- Selection consists of 2 screening steps: I) the technology selection according to the degree of external novelty and newness; II) the assurance that the technology is not being assessed elsewhere in the company;

- Assessment ranking the technologies according to their market potential and technology realization potential;
- Dissemination dissemination of technology potential throughout the company structure.

Rohrbeck (2010) presents a radar screen visualization in order to provide convenient access to the most important scouting results and to promote the usage of the technologies by the different company's departments. This presentation is made along three dimensions, as represented in figure 2:

- Maturity level of the technology (basic research, applied research, product concept, market readiness, and market presence);
- Technological area structured along the company's value chain;
- The need for awareness (relevance), which has a three level rating scale (high, medium and low).



**Figure 2** - Radar screen visualization along its three dimensions (based on Rohrbeck, 2010).

Rohrbeck (2010) warns for the importance of the individual technology scouts in the TS process and of the contact network which consists of 4 major actors: 1) internal stakeholders, 2) the TF team; 3) the technology scouts; 4) the experts.

Between these actors 4 major relationships or exchange interfaces must exist, having the TF team in the centre managing them:

- 1) Internal stakeholders receive the technological information that should lead to action;
- 2) Technology scouts provide descriptions on emerging technologies in exchange for direct payment;
- 3) Experts from industry and academia provide information about their on-going research in exchange for contacts;
- 4) A fourth exchange interface is needed to allow for the scouting network to function and to stabilize the scouting network, making it succeed in the long run.

In what concerns the typology of the ideal scout, internal full-time employees have superior characteristics in the dissemination of information and are better suited to identify technologies with information of high relevance. External consultants are better at identifying technological developments in "white spaces", since they have larger networks and may have more in-depth expert knowledge. The internal technology scout has to be able not only to understand the technology, but also the needs of the company to become an expert in the innovation priorities of the company's business plans.

#### 2.7. Summary

The JTBD framework provides a broad understanding about the consumers' needs, with special focus on the clarification of the circumstances in which consumers base their purchases. This kind of information is of major importance for companies during the development of new products, because it allows refining the product specifications to meet the expectations of the consumers, maximizing the commercial potential of the product. To fulfil consumers' expectations companies must employ technology search methods to find the right technology and incorporate it in the new products.

Although the consumers' needs and the identification of the right technology are in fact joined together during the new product development process, there is a lack of both empirical and theoretical research focused on the identification of how both components are merged to develop products with commercial success. This constitutes a handicap

for the companies that struggle to develop products with commercial success, undermining their prospects of growth and limiting their financial performance.

The development of products that consumers find attractive and innovative is the main goal of every company. Although it may seem simple, this objective is far from being achieved for the vast majority of the companies, mainly due to companies' inabilities to properly relate the consumers' needs with the technology that will provide the products with the required capabilities to fulfil those same needs. This translates in frequent product failures, resulting in a waste of resources and time, and ultimately leading to financial underperformance. Even though quite common, this problem and specially the way its main components – the consumers' needs and the technology - relate to each other, is far under evaluated and understudied in literature.

#### 3. Bridging the Consumers' needs with the Technology

#### 3.1. Introduction and problem contextualization

A systematic literature review (SLR) was developed in order to establish a relation between the two previously mentioned drivers in the development of innovative and appealing products: the consumers' needs and the technology.

Various authors study how data extracted from sales registers, enquiries or other sources can be analysed in order to characterize the consumers' needs in a useful, but not harmful way for companies (Lord, 2000; Christensen and Raynor, 2003; Christensen *et. al.*, 2007). There is also research that focuses on studying how the technology is collected, treated and detained by companies so that they can introduce the technological advances in the development of new products (Brenner, 1996; Reger, 2001; Birkinshaw and Monteiro, 2007; Vecchiato and Roveda, 2010; Rohrbeck, 2010).

As exposed in the previous chapter the way in which the two drivers (consumers' needs and technology) relate to each other is far under evaluated and understudied in the literature. In fact, innovative companies, deliberately or not, must employ a methodology that glues the findings that yield from the understanding of the consumers' needs and from the capabilities of the existing technology in the development of new products. The lack of clear and systematic steps towards the implementation of such

managerial methodology undermines the efforts to avoid the main difficulties that many companies face after dedicating several resources to the development of new products, leading to a weak or non-existence consumer acceptance.

Based on this argument, and since, unfortunately the time available for the conclusion of this work did not allow for an empirical analysis of the procedures conducted by companies, a SLR was applied instead. In this SLR the main objective was to identify and develop a web of connections between these two main subjects. Hopefully, shedding some light to the research question, presented below, and laying the foundations to the development of a managerial tool, or methodology, able to support companies' activities plan during the new product development cycle.

#### 3.2. Systematic Literature Review Protocol

A SLR, differently from traditional literature reviews, uses a well-defined and structured method to conduct the review of the existent literature regarding a specific scientific topic (Khan et al., 2003; Tranfield et al., 2003; Cronin et al., 2008; Rosseau et al., 2008; Cooper et al., 2009). The literature review is called systematic if it is based on a clearly formulated research question, finds relevant studies, assesses their quality and reviews the evidence by use of an explicit methodology (Cronin et al., 2008; Cooper et al., 2009). It is a process to classify, evaluate and interpreter all available literature relevant to a particular research question, topic area, or phenomenon of interest with the objective of building a concise summary of the findings describing current knowledge and offering a rationale for conducting future research (Khan et al., 2003; Tranfield et al., 2003; Cronin et al., 2008; Rosseau et al., 2008; Cooper et al., 2009). The individual studies searched in the various scientific databases are called primary studies, being the SLR a form of secondary study (Khan et al., 2003; Tranfield et al., 2003; Rosseau et al., 2008). Having clear that the validation and the replication of the review, maintaining its original premises by other authors, is a major academic interest and a tool to assess its credibility, a SLR can be divided in 5 main steps – problem definition, data collection, data evaluation, summarize the evidence, and interpret the findings - in order to produce a specific review protocol (Khan et al., 2003; Tranfield et al., 2003; Cronin et al., 2008). In this SLR the 5 steps that make de review protocol are:

#### 1) Frame the research question (problem definition)

The systematization of the previously mentioned connections between the consumers' needs and the technology that allows fulfilling those same needs is very incipient, both from a theoretical and empirical perspective. This happens because there is a need for a clearer understanding of each of the themes under study, especially of the technology scouting, and because each company employs its own set of practices and tools that do not follow common patterns.

Looking for such systematization and to achieve a common language for the community worried with these questions, the research question this SLR is proposing to answer is the following:

"Is it possible to find and characterize relations between the consumers' needs and the methods of searching new technologies?"

#### 2) Identify relevant works (data collection)

The relevant works to answer the research question were collected using the Scopus and Web of Knowledge (WoK) databases. Search terms, based on the relevance identified in chapter 2 for each component, and that help define each of the work components - the job to be done framework and the technology scouting concept - was employed.

For the job to be done the terms used were:

- -Job to be done
- -Consumer needs
- -New-product definition
- -Market segmentation

Whereas for the technology scouting the search terms used were:

- -Technology scouting
- -Technology foresight
- -Technology intelligence

### -Technology radar

Having the terms of the search defined, 17 different search sets with two distinct search criteria, were defined to posterior introduction in both databases, with the objective of maximizing the pool of papers collected which cover the two main topics of the study. The search was restricted to the areas related with business and management, since the main objective of the SLR is to assess the connection of the consumers' needs and technology at the managerial and strategic level. The sets of terms searched are shown in Table 1.

**Table 1** – Search sets and criteria used in the Scopus and Web of Knowledge databases.

	Search Set	Internal Ref	
1	Job to be done AND technology scouting	JTBD_TS	
2	Job to be done AND technology foresight	JTBD_TF	
3	Job to be done AND technology intelligence	JTBD_TI	
4	Job to be done AND technology radar	JTBD_TR	
5	consumer needs AND technology scouting	CN_TS	
6	consumer needs AND technology foresight	CN_TF	
7	consumer needs AND technology intelligence	CN_TI	
8	consumer needs AND technology radar	CN_TR	
9	new product definition AND technology scouting NP		
10	new product definition AND technology foresight NI		
11	new product definition AND technology intelligence		
12	new product definition AND technology radar NP		
13	market segmentation AND technology scouting	MS_TS	
14	market segmentation AND technology foresight	MS_TF	
15	market segmentation AND technology intelligence	MS_TI	
16	market segmentation AND technology radar	MS_TR	
17	(Job to be done OR Consumer needs OR new-product definition OR Market segmentation) AND (Technology scouting OR Technology foresight OR technology intelligence OR technology radar)	ALL	

The 17 search sets returned about 244 results, 132 in Scopus database and 112 in WoK. From these 244 entries 24 were repeated, so were removed from the final pool, ending with 220 papers. Further details about the searched papers are presented in Appendix 1.

## 3) Assessing study quality (data evaluation)

The selection of the relevant papers is no easy task in a SLR, in part because of the number of studies that result from the initial search, and also because of the subjectivity that can arise during the selection, depending on who is selecting the studies (Khan *et* 

al., 2003; Tranfield et al., 2003; Cronin et al., 2008; Rosseau et al., 2008; Cooper et al., 2009). In this case the selection undertaken consisted of classifying the studies based on the analysis of the abstract and keywords, and then attributing them one of two possible categories. With this classification the selection becomes more clear and easier to replicate if necessary, adding clarity to the work. This step was performed both by the author of this work and by the supervisor to provide validity and reliability to the results. Results from both evaluations were confronted and the inconsistencies discussed until an agreement was achieved. The criterion used for the construction of the two categories is described with more detail in Appendix 2.

- a) With no relevance to the study All the general abstracts of conference proceedings. This type of abstracts are generally very vague, covering many fields leading to the dispersion of the search terms, and when they have important findings, the same work is latter published in a journal with more detail. It were also included is this category studies whose search terms are included in the title, abstract or in the keyword list, but after a deeper analysis of the content of the abstract one concludes that the terms do not add relevance to the SLR, meaning that, the search terms are being used in other subjects.
- **b)** With substantial interest to the study The papers included in this category by their relevance and subjects covered will constitute the primary studies to be used in the SLR.

About 30 studies where classified as having substantial interest to the work, from which 18 were collected from Scopus and 12 from WoK. Of this 30, 9 where inaccessible, meaning that unfortunately where not used, because they were published in proceedings of conferences that happened long ago, and the paper was not found or because they were in languages that the author of this work cannot read. The full article list is presented in Appendix 3.

# 4) Summarizing the evidence and 5) Interpreting the findings

The summary of the evidence provided by the SLR intends to expose all the relevant subjects found during the analysis of the papers selected based on the previous point 3. This summary also helps to list the main subjects that were found to link the JTBD with the TS. From these subjects an interpretation was developed, resulting in the conceptual framework presented in chapter 4. The summary and interpretation of the SLR findings was the base for the elaboration of the answer to the research question.

## 3.3. SLR Findings

Consumers determine the success of innovative products or services. The consumers, based on their choices, will decide which products will thrive and which will be a commercial failure. Consumers also have influence at the company's organizational level, since the orientation of the company towards the consumer will model its market positioning (Anaza and Rutherford, 2012).

Marketing techniques are broadly used by companies to understand consumers' needs and desires, providing information about the direction markets are heading (Masoomeh et al., 2013). But markets change, and according to Alahuhta *et al.*, (2008) and Masoomeh *et al.* (2013) these changes can be guided by two drivers: the consumers' preferences and the technological environment. In both cases, managers need information about each of them and about their evolutions to make the best decisions.

The behaviour and the needs of consumers are difficult to predict and often take unexpected turns. The traditional marketing tools used to characterise the consumers' behaviours are unable to explain these deviations (Alahuhta *et al.*, 2008). This is in line with the claim of Christensen and Raynor (2003) and Christensen *et al.* (2007), who argue that marketers employ static market segmentation schemes that are rigid and do not follow the changes in consumers' behaviours. Instead of those traditional marketing schemes and for a better acknowledgement of consumers' needs, managers should be informed by a circumstance based categorization, which is more suitable to be used in the process of understanding the consumer behaviour, as the job to be done framework.

Robinson (1996) argues that one of the most common reasons for commercial failure of new products is the technological displacement of companies. A new product with new technology is sometimes perceived to be immediately accepted by consumers independently of its utility. The problem is that markets will only accept new products if they are somehow useful to consumers. Many technologies incorporated in new products are misaligned with the human need they intend to meet, therefore failing commercially.

Von Hippel (2005) refers that in high-tech product development industries the consumers actively control the commercial success of products. The microchip industry is a good example. A semiconductor fabrication plant, or fab, must be customized attending to the microchip manufacturers' specification requirements. If the equipment of a fab provider, like Taiwan Semiconductor Manufacturing Company (TSMC) does not meet the requirements of Intel and Qualcomm, for example, its most important equipment consumers, then TSMC's products will certainly be a commercial failure

According to Von Hippel (2005) and Alahuhta *et al.* (2008) in high-end sectors, consumers' needs are often ahead of the company's capacity to provide the appropriate solution. This means that what drives the elaboration of solutions to be incorporated in new products or services are ideas and processes derived from the perception of consumers' needs.

These examples, where consumers' needs lead to the development of innovative and successful products, offer a distinctive perspective about the relation between consumers' needs and the development of products.

Paasi *et al.* (2009) argue that the influence of consumers in the product development varies according to the position of the company in the market. Incumbent companies generally have difficulty in developing new products or services that do not fit the company's current business strategies, whereas new companies, disruptors, are better in capturing the consumers' needs and in translating them into new products or new business areas.

Product development can also be driven by technology evolution, neglecting the consumers' needs and ignoring the opportunities determined by the evolution of business. Therefore a new product, service or process can be developed without a clear

idea yet if that product or service can fulfil a consumers' need. This can be attributed to inadequate perspective on consumers' needs, evidencing that the development of new products may also fail, due to under informed choices of technologies.

Both these market and technology failures could result from insufficient management effort to deal with uncertainty related to the new technology and business development (Paasi and Valkokari, 2010).

For Wilbers *et al.* (2010) the continuous search for global societal and technological trends, and the translation of these findings into strategies is made easier by the use of Standardised Technology Intelligence Products (STIP), that are nowadays widely available. Technology Intelligence (TI) is the information about the technological environment surrounding the company and the intended recipients. STIP allows for the interaction between the outcomes of TI experts and decision makers. From this interaction crucial information is passed to the company, desirably to all the departments with responsibility in developing the company's new products. Wilbers *et al.* (2010) explore the phase of search and selection of the information that TI tools provide, focusing particularly in criteria and methodological steps to fundament the information to be used in the resolution of a given problem. Although providing a new perspective about how information collected during the TI process, they do not consider how this information is passed to the product development department or how the initial problem was formulated.

Curko *et al.* (2007) make use of business intelligence tools to assess the consumers' needs in the banking sector, providing bankers with tools that help understanding the consumer's behaviour to gain a competitive advantage over the competitors. They propose analysing sufficiently large sets of data, searching for patterns in consumers' needs and behaviours. The information collected is crucial for the banking sector to maintain the consumers, since this sector is pressed by constant demands for new and innovative products and by regulatory requirements. While segmentation schemes are included in the determination of the consumers' needs, much in similarity with the work of Christensen and Raynor (2003) and Christensen *et al.* (2007), the process in which those needs are treated to produce new products is also not mentioned by Curko *et al.* (2007).

Proposition 1: The development of new products can be consumer driven or technology driven.

Proposition 1.a: When the development of new products is consumer driven, consumer's needs are ahead of the company's capability to deliver a product that satisfies those needs, and it is from the correct identification of consumers' needs that companies are able to develop successful products.

Proposition 1.b: When the development of products is driven by technology, too often the development of new products ignores the market needs, i.e, the consumers, which results in products with a high rate of commercial failure.

Paasi and Valkokari (2010) claim that products with commercial success must follow a well-structured new product development (NPD) cycle. However, even with a well-structured NPD cycle, most of the new products do not become a commercial success. This can be attributed to the failure in preparing and dealing with the uncertainty in the initial stages of the cycle. Providing some order and structure to the initial stages of NPD cycle can reduce this uncertainty, identifying and anticipating future problems, even though future uncertainty is never fully removed from the NPD cycle. Companies can only become more successful if they force the initial stages of NPD to become more manageable, yielding substantial improvements in the success rate of products.

Proposition 2: As the commercial success of a product is highly dependable on how companies manage the initial uncertainty associated with the new product development cycle (NPD), if uncertainty is managed through the initial stages of NPD there is a higher probability of success rate for the new products.

According to the innovation model proposed by Chesbrough (2003), during the elaboration of new solutions, companies must make an effective use of the different options of Intellectual Property rights, IP. As long as the IP fits the company's business model it provides the right tools to the development of innovative products and services with higher probability of commercial success. During the search for external sources of IP (such as a new patent for a new technology), and according to Chesbrough (2003), companies deploy a set of tools that aim to boost the competiveness of the company, promote the company's contact with new sources of technologies, identify new technological trends, and incorporate new technologies in the development of new

products or services. These objectives are the same that Reger (2001) identifies in its definition of the technology scouting activities.

However, even if the company is able to find IP aligned with its business model, this will, most probably, not be enough to ensure the commercial success of the products developed. The business model has many dimensions and the company's consumers base is a very important dimension to have in consideration. Based on most of the business model frameworks available, as the one from Osterwalder and Pigneur (2010), one can argue that the business model already incorporates consumers, and therefore the previous sentence does not make sense. But this is true only if the company is already employing circumstance based market categorization, as Christensen and Raynor (2003) and Christensen *et al.* (2007) suggested. The circumstance based market categorization allows companies to understand the causal mechanism of the consumers' purchase, *i.e.*, the job consumers want done, allowing the adjustment of the search for the IP with the right characteristics to fulfil the identified consumers' needs. Only in this way is there assurance that the developed products or services are successful.

Proposition 3: Simply finding Intellectual Property (IP) that is aligned with the company's business model does not ensures the development of innovative products and services with commercial success.

Proposition 3.a: The IP must be aligned with the company's consumer base needs.

Proposition 3.b: During the search for the right IP, companies employ a vast set of techniques, which are the same that technology scouting employs.

There is consistent evidence of the importance that the external environment has on the development of new products, particularly on the technological "weak signals". Alahuhta *et al.* (2008) observe that consumers share their needs freely, and it is of the company's utter interest to collect and analyse those needs in order to extract the maximum useful information. These authors also claim that the majority of the consumers' needs can be fulfilled using existing technology.

The Alahuhta's *et al.* (2008) study allows inferring two important aspects about the relation between consumers' needs and technology. The first evidences the need to listen to the company's external environment, through technology scouting techniques.

It should allow the company to identify "weak signals" related to the evolution of technological trends and to the existing technologies that can be used in the development of new products or services (Brenner, 1996; Reger, 2001; Vecchiato and Roveda, 2010). The second is that in the search for IP to be incorporated in the development of new products and services, although certainly unaware, companies employ several components of the Reger's (2001) and Rohrbeck's (2010) technology scouting methodology.

Masoomeh *et al.* (2013) suggest the use of a knowledge management system (KMS) to capture the changes in the company's external environment or within the organization. This KMS must have two important, although apparently concurrent characteristics: be reactive and proactive. By reactive Masoomeh *et al.* (2013) mean that the KMS must be able to track, respond and translate the changes in the external environment in a way that can be interpreted and incorporated in the managers' decision-making processes. On other hand, KMS, must be proactive, with the capability to accommodate the structural changes dictated by the changes in the consumers' needs, and still be reactive.

When carefully analysed, Alahuhta's et al., (2008) findings and the KMS proposed by Masoomeh et al. (2013) have many similarities with the technology scouting methodology proposed by Reger (2001) and Rohrbeck (2010). The activities proposed by the first authors aim at the improvement of overall competiveness over their competitors while searching in the company's external environment for technology capable of being incorporated in new products. These activities are in line with the technology scouting component's proposed by Reger (2001) and Rohrbeck (2010), such as, the technology monitoring, technology prognosis, technology scanning and technology radar. Both studies, Alahuhta's et al. (2008) and Masoomeh et al. (2013) mention the external environment importance for the company's activities, with particular focus on the development of successful new products. They also refer to the importance in transmitting the findings to managers who have decision responsibilities, and the struggle to adapt to an ever-changing market. This is in line with the argue of Reger (2001) that there is no common definition for technology scouting, and inadvertently companies use technology scouting in their activities of new product development.

Proposition 4: Companies need a system that captures the changes in the company's external environment and within the company, which ideally must be reactive and proactive.

Proposition 4.a: Such system must be able to communicate to the decision maker changes in the environment so proper decisions can be made.

Proposition 4.b: Companies broadly use technology scouting techniques, most of the time unaware or with different designations.

One important piece of the NPD is the interaction between the outcomes from the analysis of the consumers' needs and of the available technology. So far both components appear to be treated separately by authors. Christensen and Raynor (2003) and Christensen *et al.* (2007) study the consumers' needs through job to be done framework, and Reger (2001) and Rohrbeck (2010) analyse the technological component through a technology scouting perspective. Alahuhta's *et al.* (2008) and Masoomeh *et al.* (2013) provide some insights about the interaction between consumers' needs and technology.

The works of Zhang *et al.* (2007) and Longanezi *et al.* (2008) are the providers of the first clues, although with some differences, about how consumers' needs and technology can be merged to produce innovative and successful products.

Zhang *et al.* (2007) refer that the development of new products is one of the hardest tasks that managers have to deal with. Managers must have a vast amount of information at their disposal to make any decision. Information about the company, the consumers, the market and of the technology available. According to Zhang *et al.* (2007) managers, based in this vast amount of information, decide whether to develop new technologies, use the technologies available or search outside the company for new technologies. Independently of the manager's decision, whether to opt for the development of new or use the available technology, a systematized review of the specifications of the existing technology must always be made.

Zhang et al. (2007) use the Theory of Incentive Problem Solving – TRIZ – to gather information about the technological environment surrounding the company. TRIZ is used to assess the evolutionary potential (EP) of a certain technology based on its specifications. The tracking of the technology EP allows the definition of an

evolutionary potential mapping (EPM). This EPM helps the definition of technological patterns that are useful to identify the direction that a given technology has taken. The main defect of TRIZ is that it only analyses, compiles and reports the changes in direction of the technology, and does not provide any information why those changes happened. Changes in direction could have been caused by technological, market or legal imperatives. While TRIZ by itself is useful for identification of the unexplored potential of a technology and fails in responding to why the change in direction happened, the EPM allows the identification of new uses for the technology and promotes the development of new ideas based on those unexplored potential. Nevertheless, EPM clearly fails in providing guidance on how companies must use those potentials while developing new products for their consumers. These potentials, when crosscheck with the consumers' needs, provide clearer information about the type of technology that should be incorporated in the development of new products.

Proposition 5: As information is the key for development of new successful products, managers must have information about the company, the consumers, the market and of the technology available at their disposal to make decisions related to the NPD.

Proposition 5.a: The EPM methodology helps companies find the unexplored potential of a technology, by mapping it.

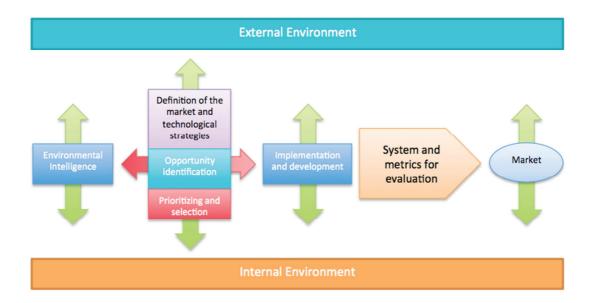
Proposition 5.b: This unexplored technological potential helps the company to assess in which areas companies are yet to be developed.

Proposition 5.c: While the EPM allows for the identification of new uses for the technology and promotes the development of new ideas based on those unexplored potential, it fails in providing guidance on how companies must use those potentials while developing new products for their consumers.

Longanezi *et al.* (2008) states that companies fail in delivering products that their consumers find attractive because the innovation model used is fairly inadequate to their structure. According to these authors, the implementation of an innovation system must follow three principles: the innovation base process should be broad enough to accommodate all the possible processes that the company employ in its activities; use management techniques capable of integrating the different areas and stages involved in

the innovation process; and, develop or adopt specific tools capable of assisting managers during the innovation decision process. An effective innovation process must be able to represent all the processes in place in the company, from the bottom to the top, promote a bi-directional flow of information (top-bottom, bottom-top), and consider the external company environment. Only in this way the innovative potential of the company can be fully explored.

The innovation process proposed by Longanezi *et al.* (2008) has 6 components that should be related with the company's internal and external environment as well as with the market where the company operates: company's environmental intelligence; definition of the market and technological strategies; opportunity identification; prioritizing and selection; implementation and development; and, system and metrics for evaluation of the process, as identified in figure 3.



**Figure 3** – The 6 components of the proposed innovation process by Longanezi *et al.* (2008).

The Longanezi's process provides new clues for the understanding of the relation between consumers' needs and technology during the innovation process of companies. This understanding arises from the relations that must be made in three of the sixth components proposed: the company's environmental intelligence; the definition of the market and technological strategies; and, opportunity identification. The analysis of the

company's environmental intelligence, as proposed by Longanezi *et al.* (2008), must employ a series of tools capable of gathering information from the technological environment, the market and the available resources at the company's disposal. In the process of compiling this information, companies must employ several tools related with technology scouting, for the assessment of the available technology, technology trends and technological capabilities. The market information can be collected using marketing tools, but, must be complemented with a comprehensive study of the consumers' needs, in order to relate this information with the technological conclusions and the company's resources. The definition of the market and technological strategies, and opportunity identification also require, at some level, the integration of consumers' needs with technology and managerial decisions. Only by having access to all the information available about consumers' needs and technology, are companies in conditions of controlling and comprehending in full detail the innovation process, which is essential to develop products with commercial success.

The construction of these three components inadvertently uses excerpts of the JTBD framework to characterize the consumer's needs and employs techniques of the technology scouting methodology. This makes the innovation process shed some light into how companies incorporate the information collected from markets in the development cycle of new products. The information about the consumers' needs and the technology must be integrated in the innovation process, otherwise the actions undertaken by the company to promote innovation in the development of new products will not meet the market demands (Rothwell, 1994 and Longanezi *et al.*, 2008).

One conclusion that can be drawn from the studies of Zhang *et al.* (2007) and Longanezi *et al.* (2008) is that consumers' needs and technology can be merged together to produce new products through the implementation of analyses tools, such as TRIZ and its evolutions, which explore the untapped use of a technology, and through the use of an appropriate and carefully thought innovation process, as the one proposed by Longanezi *et al.* (2008).

Proposition 6: The failure in delivering products that consumers find attractive can be attributed to the innovation process used by companies, and its inadequacy to the company's structure.

Proposition 6.a: For an innovation process to produce successful results, 3 different principles need to be followed: the innovation process should accommodate all the methods and activities of the company; management techniques must be used to integrate the different areas and stages involved in the innovation process; and, specific managerial tools must be developed for the innovation decision process.

Proposition 6.b: During the formulation of the company's environmental intelligence, the definition of the market and technological strategies; and, the opportunity identification innovation process's components, several tools related with the technology scouting, the identification of the consumer's needs and the evaluation of the available resources need to be used and aligned.

Proposition 6.c: The innovation process can be used to understand how companies incorporate the information collected from markets in the NPD cycle.

Proposition 6.d: TRIZ and Longanezi et al. (2008) innovation process can be merged together to produce new products that are appealing to consumers.

### 4. Conceptual Framework: The consumer-technology compatibility model

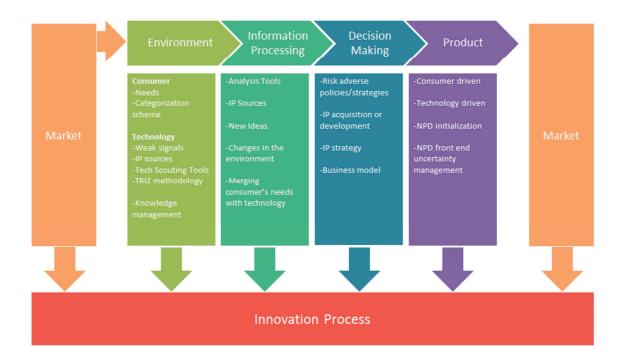
The analysis of the papers conducted to the elaboration of 16 propositions that highlight the most important findings of the SLR. These propositions guided the construction of a conceptual framework regarding the representation of how the consumers' needs and the technology selection are mixed together during the process of creating and developing new products.

From the 16 propositions, 4 main areas can be identified as particularly important in the development of successful new products: the external environment of the company, the information processing schemes, the decision making process, and the product development process. These correspond to the 4 elements of the consumer-technology compatibility model, the proposed conceptual framework: Environment, Information Processing, Decision Making, and Product (Figure 4).

The consumer-technology compatibility model must interact with markets, both at the beginning and end of the process, as well as with the innovation process already in

place in the company. At the beginning of the model, markets provide crucial information about the technological direction that the company must take, namely through consumers' needs or jobs to be done. On the other hand, at the final stages of the product development, the market reaction to the new product (the competitors' moves and the consumers' reactions to the product) must be carefully analysed so that the information it produces is incorporated in the process. Such information allows the correction of possible misleading conceptions about the product functionalities and the improvement of initial stages of the NPD process, where usually are located most of the problems with the development of the product.

The consumer-technology compatibility model must also interact and be coupled with the innovation process of the company. The objective is to provide the most important information for the innovation process, focusing on what is indeed more useful for the NPD cycle, which otherwise would be neglected or under evaluated, resulting in dire implications for the new product acceptance. This does not mean that there will be duplication of effort. By coupling the consumer-technology compatibility model with the innovation process the two procedures will complement each other. The consumer-technology compatibility model is focused in gathering and analysing information, so that decisions can be made and implemented by managers. Whereas, the innovation process incorporates actions related with the *de facto* development of the new products. It is from this synergy, from the access and treatment of relevant information and its inclusion in the process of developing new products that companies benefit. Those benefits extend to all departments, as the information and the decisions are spread along all the company structure and lead to the overall success of the company, the success of its new products.



**Figure 4** – Proposed consumer-technology compatibility model for the development of successful products.

#### 4.1. Environment

The function of the environment module is to collect, analyse and organize the vast amount of information collected from outside the company. The understanding about the environment surrounding the company must consider two main topics: consumers and technology.

In what regards the consumers topic it became clear that consumers' needs are a central point for the initial stages of the NPD cycle. The consumer involvement in the product development phase is directly related to the technological intensity of the sector, *i.e.*, in high-tech, high-performance products consumers play a much more active role in the product development than in lower tech sectors. This also means that consumers' needs must be characterized with higher detail and focus. Focus is essential to capture the maximum potential of the technology that provides the capability to construct a solution capable of responding to the consumers' real needs. This focalization can be achieved by implementing a circumstance based categorization scheme, as preconized in the job to be done framework, which allows for the identification of the causal mechanism that

drives the consumer in the demand for a new product. The understanding of this causal mechanism provides a much clearer image of how companies should develop their products to beat the competitors and please consumers.

The technological environment surrounding the company has to be scanned deploying technology scouting techniques so that the "weak signals" are signalized and the possible sources of IP are identified. "Weak signals" identification allows to understand which technological trends are developing and which are maturing in the industry. The identification of technological trends permits companies to search for an IP source aligned with the development of the trend chosen to be followed.

The deployment of tools capable of identifying the unexplored potential of a technology, such as TRIZ and its evolution, provides a new set of information. That information, when related with the technological trends and IP sources, and most importantly, with the consumers' needs, allows companies to elaborate an innovation development plan with the objective of creating technologies that will confer a competitive advantage over the competitors while satisfying consumers' needs with appealing products. This innovation development plan must fit with the innovation process already in place within the company's structure, so that the company's resources, capabilities and skills are fully explored, without the risk of having duplication of efforts or waste of resources.

A knowledge management tool helps to compile all the information collected. Such tool must be adaptive, *i.e.* must accommodate the market changes, and still be flexible enough to allow for the reporting of those changes, while having the capacity of relating the consumers' needs and with the technological environment surrounding the company.

#### 4.2. Information Processing

It is the responsibility of the information processing module to process the information collected and organized in the environment module in a useful and practical way to be used by the decision making process. The extensive amount of information must be scrutinized to exclude the irrelevant from the advantageous information for the company. This process of separation must be conducted prior to the systematization of

the information, avoiding the processing of information that will not be useful for the company.

The identification of the sources of IP, whether located outside the company or within its departments, must be detailed. It is important to list the advantages, risks, technological partners, resources and costs needed, as well as the time required to develop the technology or technological solution that will serve as the basis for new products development.

The information must be processed and grouped in such a way that facilitates the merging of the consumers' needs with the technology. This merging must evidence the jobs consumers want to accomplish with the capabilities of technology that help increase the productivity in performing those jobs.

This module must promote the development of new ideas that will be the base for new products. The development of new ideas must be integrated with the changes in the environment, namely with the consumers' needs and with the technological capabilities.

## 4.3. Decision Making

Risk management is very important during the initial stages of the product development (Paasi *et al.* 2009). Risk adverse decisions could undermine the development of promising products, hence the importance of the information processing module. Managers must have access to the most complete and correct information possible, so that they make informed decisions, with more accurate perceptions about the possible risks and costs those decisions might undertake to the company. Risks of the development of new products are also related with the IP strategy used by the company, which is also instructed by the information processing module. IP acquisition from external providers or IP partnerships is less risky than its complete development by the company. However, the advantages from the later choice could be significant, the higher the risk the higher the potential of return for the company.

The decision of which IP strategy to adopt and which technology to use in the development of new products must be aligned with the company's business model. The IP strategy, the technology and the way to develop it can be integrated in the existing

activities of the company (case of incremental innovation), or be integrated in a new department or activity (radical innovation). In either case, the IP must match company's core business strategy, activities, and resources, so that the success of the NPD cycle is maximized.

Besides being aligned with the company business model, the IP strategy must also be compatible with the innovation process of the company. The innovation process includes the relations between the different departments and the available resources allocated to each. Though not static, IP strategy must take into account the resource allocation of the company, because IP and its related technology are resource and knowledge intensive. Resources may or may not have to be reinforced, whether the company has or not the capability to deploy or absorb the technology.

#### 4.4. Products

The creation and development of new products has to be coordinated between several departments of the company that are involved in the NPD cycle. Several activities between those departments have to be initiated in order to trigger the product development. Initiation of the NPD process assumes that the front-end risks are quantified and framed in the company's risk policy.

NPD process can be consumer or technology driven, with distinct challenges in both cases, even though it always depends on both for the success of the product. It depends on the other modules of the consumer-technology compatibility model since they provide the information needed to choose the technological capabilities and the functionalities that shall define product specifications.

#### 5. Conclusions

"Is it possible to find and characterized relations between the consumer' needs and the methods of searching new technologies?"

The answer to the question is: yes, it is possible.

Although, possible to characterize, the relation between consumers' needs and technology selection still requires more attention by the scientific community. There is a

lack of empirical studies that provide understanding about how these two components interact in the corporation world.

In the literature it was found a lot of redundancy in the definitions of terms used especially for the characterization of the technology scouting processes. It also became clear that companies employ many tools that can be related with the technology scouting process in their activities of scanning the technological environment.

Consumers' needs, on the other hand, are more consensual, both in definition and in the process used for their characterization. The implementation of circumstance based segmentation schemes allows capturing the changes in the consumers' needs and the definition of the causal mechanism that drive consumers, even though they are highly mutable.

Concerning the relation among consumers' needs and technology scouting for the development of new successful products, it was impossible to find a clear, systematized and practical answer, scheme or methodology with that purpose. Nonetheless, some approaches where found, such as TRIZ and its evolution, that, when incorporated in a broader framework, can be used to combine the consumers' needs with the technology selection.

The conceptual framework proposed organizes the SLR findings into valuable guidance for accommodating the information about the consumers' needs and the information about the technology available. This conceptual framework explores the existing innovation process in the company, as well as the product development practices, while introducing 4 elements: the market and technological environment surrounding the company; its information processing schemes; its decision making processes; and the integration of the NPD cycle with the other three elements. These elements constitute the backbone of the relation that companies shall implement between their practices of consumers' needs and technology identification for the product creation and development.

This conceptual framework requires an in-depth adaption to the company's practices in order to validate and operationalize it. In this way the framework will potentiate the development of innovative products with commercial success.

### 6. Future work

The proposed conceptual framework is merely a theoretical proposal, resulting from a SLR, based on the analysis of the selected studies. This means that the next steps of the work must be the empirical validation of the conceptual framework and its adaptation to the operational realities of the companies in real world situations. Although being hard and complex to accomplish, mainly because of the secrecy involved in the product development process that has high commercial sensibility to the companies, this step is essential. Only after performing this crucial empirical test, will the conceptual framework move on to the next stage: becoming a working tool that companies can use in an everyday basis for minimizing the probability of failure in the development of new products.

Research about the understanding between the relations that exist in the innovation process and the consumer-technology compatibility model is also needed. With the indepth comprehension of such relation new insights for the innovation process or the consumer-technology compatibility model could emerge, benefiting even more the new product development cycle.

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## Glossary

- EP Evolutionary potential
- EPM Evolutionary potential mapping
- IP Intellectual Property rights
- JTBD Job to be done
- KMS Knowledge management system
- NPD New product development
- R&D Research and Development
- SLR Systematic literature review
- STIP Standardised Technology Intelligence Products
- TF Technology foresight
- TI Technology Intelligence
- TRIZ Theory of Incentive Problem Solving
- TS Technology scouting
- TSMC Taiwan Semiconductor Manufacturing Company
- WoK Web of Knowledge

Appendices



Appendix 1 – List of the Studies collected by Scopus and Wok

Internal REF	Title	Author	Note
Scopus_JTBD_TS	Scouting out the right path	Neubauer, B.	With no relevance to the study
Scopus_JTBD_TF	(2006) Proceedings of the European Conference on e-Government, ECEG, 471 p.	6th European Conference on eGovernment, ECEG 2006	With no relevance to the study
Scopus_CN_TF	Reducing the democratic deficit in institutional foresight programmes: A case for critical systems thinking in nanotechnology	Loveridge, D., Saritas, O.	With no relevance to the study
Scopus_CN_TF	On exploring consumers' technology foresight capabilities - An analysis of 4,000 mobile service ideas	Alahuhta, P.a , Abrahamsson, P.a , Nummiaho, A.b	With substantial interest to the study
Scopus_JTBD_TI	(2014) WIT Transactions on Information and Communication Technologies, 48  VOLUME 2, .	2013 International Conference of Information Technology and Industrial Engineering, ITIE 2013	With no relevance to the study
Scopus_JTBD_TI	(2014) WIT Transactions on Information and Communication Technologies, 48  VOLUME 1, .	2013 International Conference of Information Technology and Industrial Engineering, ITIE 2013	With no relevance to the study
Scopus_JTBD_TI	Crowd aided web search	Tseng, CH.	With no relevance to the study
Scopus_JTBD_TI	(2014) WIT Transactions on Information and Communication Technologies, 53, .	2013 International Conference on Advances in Intelligent Systems in Bioinformatics, Chem-Informatics, Business Intelligence, Social Media and Cybernetics, IntelSys 2013	With no relevance to the study
Scopus_JTBD_TI	Information framework for intelligent decision support system for home energy retrofits	Syal, M.a , Duah, D.a , Samuel, S.a b , Mazor, M.c , Mo, Y.a d , Cyr, T.a e	With no relevance to the study
Scopus_JTBD_TI	Technology transfer through OFDI: The case of Indonesian natural resource-based MNEs	Aminullah, E., Fizzanty, T., Kusnandar, K., Wijayanti, R.	With no relevance to the study
Scopus_JTBD_TI	Replica creation strategy based on quantum evolutionary algorithm in data gird	Ma, T.a, Yan, Q.b, Tian, W.c, Guan, D.d, Lee, S.d	With no relevance to the study
Scopus_JTBD_TI	Transforming IT Culture: How to Use Social Intelligence, Human Factors, and Collaboration to Create An It Department That Outperforms	Wander, F.	With no relevance to the study
Scopus_JTBD_TI	How organizational and employee-customer identification, and customer orientation affect job engagement	Anaza, N.A.a, Rutherford, B.b	With substantial interest to the study
Scopus_JTBD_TI	The University of California, Davis, collaborative model for biotechnology education and training	Kjelstrom, J.A.a , Mcdonald, K.b c , Hargadon, A.d e , Agatstein, W.e , Arnold, M.f	With no relevance to the study
Scopus_JTBD_TI	Basic architecture of the "semantically enriched e-working platform"	Kern, T.a , Petz, G.b	With no relevance to the study
Scopus_JTBD_TI	Cultural intelligence and engagement amongst India's IT professionals	Kodwani, A.D.	With no relevance to the study
Scopus_JTBD_TI	Research on dual-resource multi-objective flexible job shop scheduling under uncertainty	Lang, M., Li, H.	With no relevance to the study
Scopus_JTBD_TI	RETRACTED ARTICLE: The analysis of the training objectives of the vocational and technology institutes in the perspective of ISCED	Zhao, X.a b, Zhang, Y.a	With no relevance to the study
Scopus_JTBD_TI	A decomposition method to solve the large-scale scheduling problems based on cellular manufacturing technology	Niu, L.a , Han, X.b	With no relevance to the study
Scopus_JTBD_TI	MI-WDIS: Web data integration system for Market Intelligence	Yan, Z., Li, Q., Zhang, S., Peng, Z., Dong, Y., Ding, Y., Zhang, Y., Xu, X.	With no relevance to the study
Scopus_JTBD_TI	The boss as human shield.	Sutton, R.I.	With no relevance to the study
Scopus_JTBD_TI	Prospects for the textile and clothing industry in Thailand	Saheed, H.	With no relevance to the study
Scopus_JTBD_TI	An HR perspective: The global hunt for talent in the digital age	Dickson, D.R., Nusair, K.	With no relevance to the study
Scopus_JTBD_TI	Business intelligence - A helping hand for the strategic management	Ilie, A.G., Dumitriu, D., Colibasanu, O.A.	With substantial interest to the study
Scopus_JTBD_TI	UK defence chiefs give green light to job cuts at MoD headquarters	Ripley, T.	With no relevance to the study
Scopus_JTBD_TI	Role theory approaches for effectiveness of marketing-oriented boundary spanners comparative review, configural extension, and potential contributions	Singh, J., Saatcioglu, A.	With substantial interest to the study
Scopus_JTBD_TI	A study on the relation of the manpower' competency and the need of educating & training at the manufacturers in Taiwan	Wu, MT.a , Cheng, YS.b , Chen, GL.b	With no relevance to the study
Scopus_JTBD_TI	On optimising resource planning in BT plc with FOS	Owusu, G.a , Voudouris, C.b , Kern, M.a , Garyfalos, A.a , Anim-Ansah, G.a , Virginas, B.a	With substantial interest to the study
Scopus_JTBD_TI	Information overload: A cross-national investigation of influence factors and effects	Klausegger, C.a , Sinkovics, R.R.b , Zou, H.J.c	With no relevance to the study
Scopus_JTBD_TI	Textiles and apparel in Bulgaria: Prospects for the industry following EU accession	Tait, N.	With no relevance to the study

nternal REF	Title	Author	Note
Scopus_JTBD_TI	Competitiveness: Late but not too late	Augustine, N.R.a b c d	With no relevance to the study
Scopus_JTBD_TI	Work-life imbalance of IT workers in the internet age	Richardson, H.a , Bennetts, D.b	With no relevance to the study
Scopus_JTBD_TI	Knowledge management: More than a buzzword	Wijnhoven, F.	With no relevance to the study
Scopus_JTBD_TI	Modeling an intelligent continuous authentication system to protect financial information resources	Calderon, T.G., Chandra, A., Cheh, J.J.	With no relevance to the study
Scopus_JTBD_TI	Dynamic coalition in agent aware adhoc virtual P2P interconnect grid computing system - A3Pvigrid	Shankar, A., Sombattheera, C., Krishna, A., Ghose, A., Ogunbona, P.	With no relevance to the study
Scopus_JTBD_TI	The potential positive impact of E-government projects the flemish environmental legislation navigator: Conclusions of an inquiry about the use and the benefit of an online legal environmental expert system	Meyer, G.D.a , Lavrysen, L.b , Van Eetvelde, G.b	With no relevance to the study
Scopus_JTBD_TI	Turnover of information technology workers: Examining empirically the influence of attitudes, job characteristics, and external markets	Thatcher, J.B.a, Stepina, L.P.b, Boyle, R.J.c	With no relevance to the study
Scopus_JTBD_TI	Competitive pressure systems: Mapping and managing minimarket contact	D'Aveni, R.A.	With substantial interest to the study
Scopus_JTBD_TI	Therapeutic quality	Meade, R.	With no relevance to the study
Scopus_JTBD_TI	The implementation of information systems for workers: A structural equation model	Anderson, E.E.	With no relevance to the study
Scopus_JTBD_TI	e-Government as decision support system to improve public services provision	Mezzanzanica, M., Cesarini, M.	With no relevance to the study
Scopus_CN_TR	(2014) WIT Transactions on Information and Communication Technologies, 58 VOL I, .	2013 International Conference on Information and Communication Technology for education, ICTE 2013	With no relevance to the study
Scopus_CN_TR	Impact of subsurface drainage on improvement of crop production and farm income in north-west India	Datta, K.K.a , Tewari, L.b , Joshi, P.K.b	With no relevance to the study
Scopus_NPD_TR	Overview of remote sensing techniques in earthquake prediction	Alvan, H.V., Omar, H.B.	With no relevance to the study
Scopus_NPD_TR	Ethical issues in engineering education controlling innovation and technology	Bhattacharya, P.K.	With no relevance to the study
Scopus_NPD_TR	U.S. Army Corrosion Office's storage and quality requirements for military MEMS program	Zunino III, J.L., Skelton, D.R.	With no relevance to the study
Scopus_NPD_TR	Development of icing condition remote sensing systems and their implications for future flight operations	Reehorst, A.a , Politovich, M.K.b	With substantial interest to the study
Scopus_NPD_TR	(2003) AIAA\ICAS International Air and Space Symposium and Exposition: The Next 100 Years, .	AIAA\ICAS International Air and Space Symposium and Exposition: The Next 100  Years, 2003	With no relevance to the study
Scopus_NPD_TR	BEAWARE: Budget effective all weather accurate radar for Earth observation	Vincent, N., Souleres, E., Suinot, N.	With substantial interest to the study
Scopus_NPD_TF	Smart Grid: Fundamentals of Design and Analysis	Momoh, J.	With no relevance to the study
Scopus_NPD_TF	Elucidating the fuzzy front end experiences from the INNORISK project		With substantial interest to the study
Scopus_NPD_TI	(2014) WIT Transactions on Information and Communication Technologies, 52, .	2013 International Conference on Services Science and Services Information Technology, SSSIT 2013	With no relevance to the study
Scopus_NPD_TI	Upscaling the Technology Intelligence process	Wilbers, W.a b, Albert, T.b c, Walde, P.b	With substantial interest to the study
Scopus_NPD_TI	A reference model for innovation practice [Um modelo referencial para a prática da inovação]	Longanezi, T.a , Coutinho, P.b , Martins Bomtempo, J.V.c	With substantial interest to the study
Scopus_NPD_TI	Models of intelligent organizations functioning	Kliček, B., Gerić, S., Begičević, N.	With substantial interest to the study
Scopus_MS_TR	(2014) Advanced Materials Research, 846-847, .	2013 International Conference on Mechatronics and Semiconductor Materials, ICMSCM 2013	With no relevance to the study
Scopus_MS_TR	Novel approaches to helicopter obstacle warning	Seidel, C., Samuelis, C., Wegner, M., Münsterer, T., Rumpf, T., Schwartz, I.	With no relevance to the study
Scopus_JTBD_TR	(2014) Applied Mechanics and Materials, 551, .	2014 International Conference on Design, Manufacturing and Mechatronics, ICDMM 2014	With no relevance to the study
Scopus_JTBD_TR	(2014) Applied Mechanics and Materials, 443, .	3rd International Conference on Computer-Aided Design, Manufacturing, Modeling and Simulation, CDMMS 2013	With no relevance to the study
Scopus_JTBD_TR	Survey of the job market for college students majoring in sports performance	Wang, Y.	With no relevance to the study
Scopus_JTBD_TR	Parallel filter of progressive TIN densification for airborne LiDAR point cloud using multi-core CPU	Kang, X.a b , Liu, J.a , Lin, X.a	With no relevance to the study

Internal REF	Title	Author	Note
Scopus_JTBD_TR	Innovative sensor technologies for nondestructive imaging of concrete structures: Novel tools utilising radar and induction technologies	Korl, S., Wuersch, C., Zanona, J.	With no relevance to the study
Scopus_JTBD_TR	Cognitive process modelling of controllers in en route air traffic control	Inoue, S.a , Furuta, K.b , Nakata, K.c , Kanno, T.b , Aoyama, H.a , Brown, M.a	With no relevance to the study
Scopus_JTBD_TR	Real-time creation and dissemination of digital elevation mapping products using total sight™ flash lidar	Coppock, E.a , Nicks Jr., D.a , Nelson, R.a , Schultz, S.L.b	With no relevance to the study
Scopus_JTBD_TR	Stack-yard 3D measurement based on photogrammetry and projected contour aiding	Zhang, X.a b , Ou, J.a b , Yuan, Y.a b , Ma, Q.a b , Zhu, Z.a b , Yu, Q.a b	With no relevance to the study
Scopus_JTBD_TR	(2011) Applied Mechanics and Materials, 48-49, 1406 p.	Measuring Technology and Mechatronics Automation	With no relevance to the study
Scopus_JTBD_TR	(2010) 2nd International Workshop on Education Technology and Computer Science, ETCS 2010, 1, 2501 p.	2nd International Workshop on Education Technology and Computer Science, ETCS 2010	With no relevance to the study
Scopus_JTBD_TR	(2010) 2nd International Workshop on Education Technology and Computer Science, ETCS 2010, 3, 2501 p.	2nd International Workshop on Education Technology and Computer Science, ETCS 2010	With no relevance to the study
Scopus_JTBD_TR	(2010) 2nd International Workshop on Education Technology and Computer Science, ETCS 2010, 2, 2501 p.	2nd International Workshop on Education Technology and Computer Science, ETCS 2010	With no relevance to the study
Scopus_JTBD_TR	Field GPS vs. Remote sensing workflows for landform review: Selecting the right technology for the job	Calhoun, R., Evans, L., Shank, M., Richmond, M.	With no relevance to the study
Scopus_JTBD_TR	Incremental forming process for radar antenna manufacturing	Wei, H.a, She, J.b, Gao, L.a, Zhou, W.a	With no relevance to the study
Scopus_JTBD_TR	Quality assurance of LiDAR systems - Mission planning	Saylam, K.	With no relevance to the study
Scopus_JTBD_TR	Framework and design on wetland vegetation structural characteristics retrieval based on AOE-LiDAR	Xi, X., Jiang, X., Jia, Y., Li, X.	With no relevance to the study
Scopus_JTBD_TR	Development of a remote-modeling system of InSAR deformation and a case study of coseismic deformation	Zhang, GH., Ma, ZS., Li, WD., San, XJ.	With no relevance to the study
Scopus_JTBD_TR	An overview of small satellites in remote sensing	Kramer, H.J.a , Cracknell, A.P.b	With no relevance to the study
Scopus_JTBD_TR	Head start	Wilson, D.	With no relevance to the study
Scopus_JTBD_TR	Sony DDM Monitor: A case study in implementing technology change in ATC	Trueblood, J.	With substantial interest to the study
Scopus_JTBD_TR	Radar-based level measurement in urea synthesis or the elimination of radioactive sources in urea plants	Heijnen, L.	With substantial interest to the study
Scopus_JTBD_TR	Research on product technology evolutionary potential mapping system based on TRIZ	Zhang, J., Tan, R., Chen, Z., Zhang, H.	With substantial interest to the study
Scopus_JTBD_TR	Enhanced two level EBG antenna for a high F/D multibeam reflector antenna in Ka band: Design and characterization	Chantalat, R.a , Menudier, C.a , Troubat, M.a , Arnaud, E.a , Monediere, T.a , Thevenot, M.a , Jecko, B.a , Dumon, P.b	With no relevance to the study
Scopus_JTBD_TR	Boeing wins USDS billion border security job	Harrington, C.	With no relevance to the study
Scopus_JTBD_TR	Thales sees UK success as springboard for exports	Murphy, J.	With no relevance to the study
Scopus_JTBD_TR	AIRSAR automated web-based data processing and distribution system	Chu, A., Van Zyl, J., Kim, Y., Lou, Y., Imel, D., Tung, W., Chapman, B., Durden, S.	With no relevance to the study
Scopus_JTBD_TR	One ocean initiative and future generation vessels	Dehziri, A.M.	With no relevance to the study
Scopus_JTBD_TR	CEA Technologies to provide radar for Australia's Anzac frigates	Murphy, J.	With no relevance to the study
Scopus_JTBD_TR	DoD ready to close military technology centers	Schnelderman, R.	With no relevance to the study
Scopus_JTBD_TR	Not so fast	Kennedy, S.	With no relevance to the study
Scopus_JTBD_TR	An agent infrastructure for on-demand processing of remote-sensing archives	Yang, Y.a , Rana, O.F.a , Walker, D.W.a , Williams, R.b , Georgousopoulos, C.a , Caffaro, M.c , Aloisio, G.c	With no relevance to the study
Scopus_JTBD_TR	Style change	Fulghum, D.A., Wall, R.	With no relevance to the study
Scopus_JTBD_TR	(2004) Jane's Defence Industry, (AUG.), 2 p.	Online extra - Research - AMS moving well in 'nano' radar revolution	With substantial interest to the study
Scopus_JTBD_TR	Transforming the information super-highway into a business platform	Mosehle, B.	With no relevance to the study
Scopus_JTBD_TR	(2004) SAFE Journal, 32 (1), pp. 9-12.	Visual search and rescue a thing of the past	With no relevance to the study
Scopus_JTBD_TR	The mobile pipe locator crew: Evaluation of the PipeHawk radar, vacuum excavator and E-line locator for trouble locates	Peterson, A.a , Wiser, D.a , Minichelli, T.b , Hyde, S.b	With no relevance to the study
Scopus_JTBD_TR	(2003) Proceedings of the International Symposium on Test and Measurement, 2, 861 p.	ISTM/2003 5th International Symposium on Test and Measurement: Volume 2	

Internal REF	Title	Author	Note
Scopus_JTBD_TR	Biological effects on human health due to radiofrequency/microwave exposure: A synopsis of cohort studies	Breckenkamp, J., Berg, G., Blettner, M.	With no relevance to the study
Scopus_JTBD_TR	Getting the message	Wallich, P.	With no relevance to the study
Scopus_JTBD_TR	Development of the first Soviet three-coordinate L-band pulsed radar in Kharkov before WWII	Kostenko, A.A., Nosich, A.I., Tishchenko, I.A.	With no relevance to the study
Scopus_JTBD_TR	Amazonia biodiversity estimation using remote sensing and indigenous taxonomy	Fabbro, L.	With no relevance to the study
Scopus_JTBD_TR	Georadar technology and ist operational field [Georadartechnik und ihre Einsatzmoglichkeiten]	Formanski, T., Kathage, A.F.	With no relevance to the study
Scopus_JTBD_TR	Surveillance through non-metallic walls	Frazier, Lawrence M.	With no relevance to the study
Scopus_JTBD_TR	A brief history of electrical engineering education	Terman, F.E.	With no relevance to the study
Scopus_JTBD_TR	Radar surveillance through solid materials	Frazier, L.M.a b	With no relevance to the study
Scopus_JTBD_TR	Enhanced situational technologies applied to ship channels	Helgeson, M.A.a , Wacker, R.A.b	With no relevance to the study
Scopus_JTBD_TR	Surveillance through walls and other opaque materials	Frazier, Lawrence M.	With no relevance to the study
Scopus_JTBD_TR	Developments in airborne surveillance and control systems	Burnette, D., Hendrix, R.E., Kahlon, G., Michael, M., Queeney, P.J., Gretsch, W.R.	With no relevance to the study
Scopus_JTBD_TR	ON MANAGING R&D INVESTMENT.	JONES, GEORGE B.	With substantial interest to the study
Scopus_JTBD_TR	HIGH-FLYING MINI-SNIFFER RPV: MARS BOUND?	Reed, R.Dale	With no relevance to the study
Scopus_CN_TI	How e-servicescapes influnce consumers' purchase intentions	Mu, L.a , Cao, H.R.b , Zheng, Q.c , Cao, H.a	With no relevance to the study
Scopus_CN_TI	A research about the tracing technology and system designing of food-cold chain	Yu, X.a b	With no relevance to the study
Scopus_CN_TI	The research on the mass customization of tourism industry	Cheng, DT., Ye, N., Luo, LF.	With no relevance to the study
Scopus_CN_TI	Powering up the smart	Chiappinelli, C.	With no relevance to the study
Scopus_CN_TI	Anti-odour clothing: Bringing fresh appeal to the textile and apparel market		With no relevance to the study
Scopus_CN_TI	Decisions 2.0: The power of collective intelligence	Boimabeau, E.	With substantial interest to the study
Scopus_CN_TI	(2008) Textile Outlook International, (135), pp. 87-88.	New uses for wearable textile-based health monitoring technology	With no relevance to the study
Scopus_CN_TI	Grid-based data mining for market basket analysis in the retail sector	Singh, R.P.a, Turi, A.a b, Malerba, D.a	With no relevance to the study
Scopus_CN_TI	Microeconomic determinants of the duration of stay of tourists	Alegre, J., Llorenç, P.	With no relevance to the study
Scopus_CN_TI	Surf tribal behaviour: A sports marketing application	Moutinho, L.a , Dionísio, P.b , Leal, C.c	With no relevance to the study
Scopus_CN_TI	Current development and future analysis of mobile commerce	Bai, L.a , Yen, D.C.a , Chou, D.C.b , Li, E.Y.c	With no relevance to the study
Scopus_CN_TI	Can patients drive the future of health care?	Wyke, A.	With no relevance to the study
Scopus_MS_TI	RETRACTED ARTICLE: Improving item-based collaborative filtering recommendation system with tag	Song, H., Lu, P., Zhao, K.	With no relevance to the study
Scopus_MS_TI	Loyalty intelligence and price discrimination in a duopoly	Ouksel, A.M., Eruysal, F.	With substantial interest to the study
Scopus_MS_TI	(2008) MIPRO 2008 - 31st International Convention Proceedings: Digital Economy - 5th ALADIN, Information Systems Security, Business Intelligence Systems, Local Government and Student Papers, 5, .	31st International Convention Proceedings: Digital Economy 5th ALADIN, Information Systems Security, Business Intelligence Systems, Local Government and Student Papers	With no relevance to the study
WoK_JTBD_TF	EDUCATING THE NEW ENGINEER AND RETARGETING THE ENGINEERING CURRICULUM FOR THE FUTURE INDUSTRIAL LANDSCAPE	Blomgren, Henrik; Jerbrant, Anna	With no relevance to the study
WoK_JTBD_TI	The Design and Development of Intelligent University Program Ranking System Using JEE Frameworks	Al-Kubati, Muaamar; Aljunid, Syed Ahmad; Yusoff, Nor Eleena; Daud, Mohamad; Tajudin, Mohd Azrul Amir Muhamad; Hussin, Wan Ya Wan; Ibrahim, Zaidah	With no relevance to the study
WoK_JTBD_TI	Perceptions of neurosurgery: a survey of medical students and foundation doctors	Hill, Ciaran Scott; Dias, Lalani; Kitchen, Neil	With no relevance to the study
Wok_JTBD_TR	Tactical force protection	Stockel, E; Moneyhun, JC	With no relevance to the study
WoK_CN_TF	What place for livestock on a re-greening earth?	Janzen, H. H.	With no relevance to the study
WoK CN TF	Wood Technology Road Map - Austria	Teischinger, Alfred; Tiefenthaler, Brigitte	With substantial interest to the study

Internal REF	Title	Author	Note
WoK_CN_TR	System for controlling energy consumption in e.g. apartment, has air register including actuator coupled to processor, where actuator opens or closes air vents in room in response to sensed motion or room temperature	TRAN A B; TRAN A A; TRAN B Q	With no relevance to the study
WoK_CN_TR	A scheme for a high-power, low-cost transmitter for deep space applications	Scheffer, LK	With no relevance to the study
WoK_CN_TR	Spectral efficiency considerations in ultrawideband (UWB) radar and communications	Rao, C; Narayanan, RM	With no relevance to the study
WoK_CN_TR	Evolution of the SAW transducer for communication systems	Malocha, DC	With no relevance to the study
WoK_CN_TR	History of saw devices	Morgan, DP	With no relevance to the study
WoK_CN_TI	Method for custom-fitting service solution to consumer business requirements in cloud service marketplace, involves analyzing service knowledge representation item to determine whether custom-fit service solution is developed	AKOLKAR R P; CHEFALAS T E; LAREDO J A; SAILER A; SCHAFFA F A; SEGAL A; SILVA-LEPE I; PERNG C; TAO T	With substantial interest to the study
WoK_CN_TI	Knowledge-collector agents: Applying intelligent agents in marketing decisions with knowledge management approach	Moradi, Masoomeh; Aghaie, Abdollah; Hosseini, Monireh	With substantial interest to the study
WoK_CN_TI	Storm surge prediction with management information systems: A case study of estimating value and observations system	Chen, C. Y.; Chen, T. H.; Chen, Y. H.; Yu, S. E.; Chung, P. Y.	With no relevance to the study
WoK_CN_TI	A New NIR Camera for Gesture Control of Electronic Devices	Ionescu, Dan; Suse, Viorel; Gadea, Cristian; Solomon, Bogdan; Ionescu, Bogdan; Islam, Shahidul	With no relevance to the study
WoK_CN_TI	Intergraph Video & Images Exploitation Capabilities	Colla, Simone; Manesis, Charalampos	With no relevance to the study
WoK_CN_TI	How network operators can enhance Ambient Assisted Living applications through Next Generation Networks	Moreno, Pedro A.; Elena Hernando, M.; Hernandez, Alberto; Gonzalez, Francisco; de Poorter, Antoine; Gomez, Enrique J.	With no relevance to the study
WoK_CN_TI	Observe, Learn, and Adapt (OLA)-An Algorithm for Energy Management in Smart Homes Using Wireless Sensors and Artificial Intelligence	Qela, Blerim; Mouftah, Hussein T.	With no relevance to the study
WoK_CN_TI	Future internet and the agri-food sector: State-of-the-art in literature and research	Lehmann, Richard J.; Reiche, Robert; Schiefer, Gerhard	With no relevance to the study
WoK_CN_TI	Wireless Robotics: A History, an Overview, and the Need for Standardization Strategic Workshop Special Issue for the SW'11	Pruthi, Sanil	With no relevance to the study
WoK_CN_TI	Utilities Need Much Better Functional Safeguards - In a digital intelligence Smart Grid	Ling, Amy Poh Ai; Sugihara, Kokichi; Mukaidono, Masao	With no relevance to the study
WoK_CN_TI	Entrepreneurial Innovation: An Empirical Investigation in the Sri Lankan Rubber Industry	Ekanayake, Shyamalie; Abeysinghe, Dhammika	With substantial interest to the study
WoK_CN_TI	Phase change materials in non-volatile storage	Ielmini, Daniele; Lacaita, Andrea L.	With no relevance to the study
WoK_CN_TI	Exploring geographic disparities in broadband access and use in rural southern Illinois: Who's being left behind?	Oyana, Tonny J.	With no relevance to the study
WoK_CN_TI	An Advice System for Consumer's Law Disputes	Costa, Nuno; Carneiro, Davide; Novais, Paulo; Barbieri, Diovana; Andrade, Francisco	With no relevance to the study
WoK_CN_TI	Smart Grids - Intelligence for Sustainable Electrical Power Systems	Slootweg, J. G.; Cordova, C. E. P. Jordan; Portela, C. Montes; Morren, J.	With no relevance to the study
WoK_CN_TI	Intelligence by Design for The Entropic Grid	Negrete-Pincetic, Matias; Meyn, Sean	With no relevance to the study
WoK_CN_TI	An Overview of Smart Grid Technology in Bangladesh: Development and Opportunities	Ali, Tausif; Al Mansur, Ahmed; Bin Shams, Zubaeer; Ferdous, S. M.; Hoque, Md. Ashraful	With no relevance to the study
WoK_CN_TI	Emergent use of social media: a new age of opportunity for disaster resilience.	Keim, Mark E; Noji, Eric	With no relevance to the study
WoK_CN_TI	Competence and competitiveness with Exsys Corvid Expert System 5.2.1	Hauer, Ileana; Butuza, Antoaneta	With no relevance to the study
WoK_CN_TI	TOOLS 2.0 FOR THE DEVELOPMENT OF THE DIGITAL SOCIETY	Cabedo Gallen, Rosa	With no relevance to the study
WoK_CN_TI	Temperature and Light Control of Three phase Induction Motor Speed Drive by PIC	Barsoum, Nader	With no relevance to the study
WoK_CN_TI	Safetylert used in wireless communication and emergency services includes global positioning system (GPS) reverse geocoder having database software that can be embed within GPS remote unit or GPS wireless cell phone handset		With no relevance to the study
WoK_CN_TI	Intelligent Consumer-Centric Electronic Medical Record	Luo, Gang; Thomas, Selena B.; Tang, Chunqiang	With no relevance to the study
WoK CN TI	A Glimpse to Future Commercial Spy Satellite Systems	Bayir, Izzet	With no relevance to the study

Internal REF	Title	Author	Note
WoK_CN_TI	Control circuits simplification and computer programs design on bipedal robot	Pa, P. S.	With no relevance to the study
WoK_CN_TI	NANOTECHNOLOGIES AS IMPROVEMENT OF FASHION TEXTILE DESIGN	Laschuk, Tatiana; Nascimento, Jose; Oliveira, Fernando	With substantial interest to the study
WoK_CN_TI	Finland's Strategy and Implementation of Citizens' Access to Health Information	Ruotsalainen, Pekka; Iivari, Anna-Kaisa; Doupi, Persephone	With no relevance to the study
WoK_CN_TI	Is home health technology adequate for proactive self-care?	Horwitz, C. M.; Mueller, M.; Wiley, D.; Tentler, A.; Bocko, M.; Chen, L.; Leibovici, A.; Quinn, J.; Shar, A.; Pentland, A. P.	With no relevance to the study
WoK_CN_TI	Ontology-driven intelligent service for configuration support in networked organizations	Smirnov, Alexander; Shilov, Nikolay; Levashova, Tatiana; Sheremetov, Leonid; Contreras, Miguel	With substantial interest to the study
WoK_CN_TI	The Potential of Technology to Improve Quality of Life	Cooper, Rory A.; Cooper, Rosemarie	With no relevance to the study
WoK_CN_TI	Privacy versus national security: The impact of privacy law on the use of location technology for national security purposes	van Loenen, Bastiaan; Groetelaers, Danielle; Zevenbergen, Jaap; de Jong, Jitske	With no relevance to the study
WoK_CN_TI	Conclusions and key challenges	Mukherjee, Satyen	With no relevance to the study
WoK_CN_TI	Informatics for patient safety: a nursing research perspective.	Bakken, Suzanne	With no relevance to the study
WoK_CN_TI	Self-organizing trees and forests: A powerful tool in pattern clustering and recognition	Guan, Ling	With no relevance to the study
WoK_CN_TI	Enterprise telesales opportunity pipelines performance management	Chien, Trieu C.; Chowdhary, Pawan; Fu, Shiwa S.; Pinel, Florian; Yih, Jih-Shyr	With no relevance to the study
WoK_CN_TI	A scheme for a high-power, low-cost transmitter for deep space applications	Scheffer, LK	With no relevance to the study
WoK_CN_TI	Accomplishing the 'ecosystem' for convergent services offerings	Ross, T; Gilligan, K	With no relevance to the study
WoK_CN_TI	Evolution and trends in automotive electrical distribution systems	Torrisi, G; Notaro, J; Burlak, G; Mirowski, M	With no relevance to the study
WoK_CN_TI	Healthons: errorless healthcare with bionic hugs and no need for quality control.	Bushko, Renata G	With no relevance to the study
WoK_CN_TI	Smart clothes and associated wearable devices for biomedical ambulatory monitoring	Dittmar, A; Lymberis, A	With no relevance to the study
WoK_CN_TI	Automatic restoration system	Ohara, AT; Takiguchi, CS	With no relevance to the study
WoK_CN_TI	New concepts and technologies in home care and ambulatory monitoring.	Dittmar, A; Axisa, F; Delhomme, G; Gehin, C	With no relevance to the study
WoK_CN_TI	Personal relationships with an intelligent interactive telephone health behavior advisor system: a multimethod study using surveys and ethnographic interviews	Kaplan, B; Farzanfar, R; Friedman, RH	With no relevance to the study
WoK_CN_TI	Smart textiles: Wearable electronic systems	Park, S; Jayaraman, S	With substantial interest to the study
WoK_CN_TI	Consumer-SC: An E-gov portal for consumers rights protection in Brazil	Garcia, THB; Theiss, I; Zimath, P; Hoeschl, HC; Donatti, F; Loureiro, GM; Bueno, TCD	With no relevance to the study
WoK_CN_TI	Transmitting patient and device data via GSM-central management for decentral mobile medical devices.	Bachmor, T; Schochlin, J; Bolz, A	With substantial interest to the study
WoK_CN_TI	Functionally integrated systems on a chip: Technologies, architectures, CAD tools, and applications	McShane, EA; Shenai, K	With no relevance to the study
WoK_CN_TI	On business intelligence systems	Kim, W	With substantial interest to the study
WoK_CN_TI	Market-driven health care: Who wins, who loses in the transformation of America's largest service industry - Herzlinger,RE	Wyke, A	With no relevance to the study
WoK_CN_TI	SMT-TAB - A PROCESS PLANNING SYSTEM FOR PCB ASSEMBLY USING TAB AND SMT	SRIHARI, K; RAGHAVAN, S	With no relevance to the study
WoK_NPD_TF	Toward the What and How of Measuring R&D System Effectiveness	Meyers, Thomas; Hester, Patrick	With no relevance to the study
WoK_NPD_TR	Next generation ECDIS for commercial and military uses	Pillich, B; Schack, C	With no relevance to the study
WoK_NPD_TR	Implementing Commercial Off-the-Shelf (COTS) technologies into a Navy tactical display communication system	Gold, H; Suggs, C	With no relevance to the study
WoK_NPD_TR	SUPERCONDUCTORS IN THE FRENCH AEROSPATIAL SECTOR .4. CATIA AT DASSAULT AVIATION	PECHAUD, J	With no relevance to the study
WoK_NPD_TI	The Smart Grid-State-of-the-art and Future Trends	El-Hawary, Mohamed E.	With no relevance to the study
WoK_NPD_TI	A quality by design approach using artificial intelligence techniques to control the critical quality attributes of ramipril tablets manufactured by wet granulation	Aksu, Buket; Paradkar, Anant; de Matas, Marcel; Ozer, Ozgen; Guneri, Tamer; York, Peter	With no relevance to the study

Internal REF	Title	Author	Note
WoK_NPD_TI	An industrial approach to design compelling VR and AR experience	Richir, Simon; Fuchs, Philippe; Lourdeaux, Domitile; Buche, Cedric; Querrec, Ronan	With no relevance to the study
WoK_NPD_TI	Contextual Model Object Definition in Engineering	Horvath, Laszlo; Rudas, Imre J.	With no relevance to the study
WoK_NPD_TI	Coordinated and Recorded Human Interactions for Enhanced Intelligence in Product  Model	Horvath, Laszlo; Rudas, Imre J.	With no relevance to the study
WoK_NPD_TI	Closed-loop PLM for intelligent products in the era of the Internet of things	Kiritsis, Dimitris	With no relevance to the study
WoK_NPD_TI	Intelligence Capital for a Technology Development Centre	Olavarrieta Trevino, Gilberto; Carrillo Gamboa, Francisco Javier	With no relevance to the study
WoK_NPD_TI	Design-for-Manufacturing Features in Nanometer Processes - A Reverse Engineering Perspective	James, Dick	With no relevance to the study
WoK_NPD_TI	Tangible Light Interaction How light portrays the tangible action of things and spaces around us	Appleby, Richard; Overbeeke, Kees	With no relevance to the study
WoK_NPD_TI	Design-for-Manufacturing Features in Nanometer Logic Processes - A Reverse Engineering Perspective	James, Dick	With no relevance to the study
WoK_NPD_TI	Engineering optimisation by means of knowledge sharing and reuse	Kuhn, Olivier; Liese, Harald; Stjepandic, Josip	With no relevance to the study
WoK_NPD_TI	Mechatronics and smart structures: emerging engineering disciplines for the third millennium	Giurgiutiu, V; Bayoumi, AME; Nall, G	With no relevance to the study
WoK_NPD_TI	Leading the field: the role of the information professional in the next century	Marfleet, J; Kelly, C	With no relevance to the study
WoK_NPD_TI	AI planning's strong suit	Smith, SJJ; Nau, D; Throop, T	With no relevance to the study
WoK_NPD_TI	POTENTIALS OF ADVANCED CONCURRENT ENGINEERING METHODS	KRAUSE, FL; OCHS, B	With no relevance to the study
WoK_NPD_TI	ON THE ROLE OF CREATIVITY IN SCIENCES AND TECHNOLOGY	HELLER, KA	With no relevance to the study
WoK_MS_TI	Business intelligence and business process management in banking operations	Curko, Katarina; Bach, Mirjana Pejic; Radonic, Goran	With substantial interest to the study
WoK_MS_TI	Market research design on modeling propensity to purchase and market potential: Using GIS and data mining as the tools	Zhao, Lihua; Harris, Jennifer	With no relevance to the study
WoK_all	Manufacturing intelligence for semiconductor demand forecast based on technology diffusion and product life cycle	Chien, Chen-Fu; Chen, Yun-Ju; Peng, Jin-Tang	With no relevance to the study
WoK_all	A Call to Arms and a Blessing for 21st Century Information Technology: the Complexity Challenge	Magrassi, Paolo	With no relevance to the study
WoK_all	The Model and Algorithm of Customer Management in Automotive Marketing	Yang Bin; Zhong Yang; Zhou Chunguang; Huang Lan; Han Xiaosong; Liang Yanchun	With substantial interest to the study
WoK_all	Use of New Knowledge and Knowledge Management to Gain Competitive Advantage	Sheikh, Shahid A.	With substantial interest to the study
WoK_all	Automated promotion machine: Emerging IS for the retail industry in China	Chen, Yan; Tian, Jun; Kong, Xiangzhen	With no relevance to the study
WoK all	Technology foresight - The future for IT	Robinson, GW	With substantial interest to the study

## Appendix 2

The selection of the studies to be included in the SLR follows 6 criteria; primary marker, context sensitivity, sampling strategy, data quality, theoretical adequacy and generalizability. Each of these criteria is further detailed in this appendix, together with a list of questions to be answered for each of them.

a) Primary marker – the list of titles, abstracts and keywords of the collected studies is checked to evaluate if the terms and sets of terms used for the search lead to find papers that are somehow related to the main objective of this research.

## Questions to be answered:

- 1- Do the papers collected directly provide useful inputs for the development of this research?
- 2- Are the terms of search used to describe activities that are in line with this research's objectives?
- b) Context sensitivity It was used to assess the context in which the studies were conducted. The same key terms can be used for numerous research purposes. As we want to focus in characterizing the way consumers' needs and technology are merged together during the new product definition process, only the studies in this context where used.

### Questions to be answered:

3- Do the studies provide useful inputs to the new product development process, or are they used to provide inputs for other problems?

- 4- Are the key terms studied in such a way that can be used for the development of new relations between the consumers' needs and technology?
- c) Sampling strategy ideally the selected studies must provide a large diversity of environments in which the main concepts of this research were applied, providing enough material, both of theoretical and empirical, to answer the main research question with sufficient support and confidence.

### Question to be answered:

- 5- Do the studies offer diversity of research environments, providing a variety of elements to elaborate a thourough answer to the research question?
- d) Data quality the quality of the materials used in the studies is very important to the consistency and generalization of their findings. In the case of studies with a more theoretical component the number and variety of references must be taken into account when accepting the study. In what regards empirical studies particular attention was paid to the circumstances in which it was conducted.

### Question to be answered:

- 6- Is each study's materials broad enough, accommodating different environments that stimulate the development and connection of the main terms in the definitions of the consumers' needs and in the search for the right technology?
- 7- Is the data analysis of each study reliable?
- e) Theoretical adequacy the description of the methodology used in the elaboration of the studies is important for the better comprehension of the findings.

## Questions to be answered:

- 8- Is there a strong theoretical background supporting the studies?
- 9- Can that background be used for the elaboration of the answer to the research question?
- **f) Generalizability** the generalization of the findings inside the work context provides a larger pool of elements for elaborating the answer to the research question.

## Question to be answered:

10- Can the studies' findings be generalized in order to provide a solid knowledge base for the answer of the research question?

Appendix 3

# Studies Included in the SLR

Internal REF	Title	Author
Scopus_CN_TF	Alahuhta, P.a , Abrahamsson, P.a , Nummiaho, A.b	On exploring consumers' technology foresight capabilities - An analysis of 4,000 mobile service ideas
Scopus_JTBD_TI	Anaza, N.A.a , Rutherford, B.b	How organizational and employee-customer identification, and customer orientation affect job engagement
Scopus_JTBD_TI	Singh, J., Saatcioglu, A.	Role theory approaches for effectiveness of marketing-oriented boundary spanners comparative review, configural extension, and potential contributions
Scopus_JTBD_TI	D'Aveni, R.A.	Competitive pressure systems: Mapping and managing minimarket contact
Scopus_NPD_TR	Reehorst, A.a , Politovich, M.K.b	Development of icing condition remote sensing systems and their implications for future flight operations
Scopus_NPD_TF	Paasi, J., Valkokari, P.	Elucidating the fuzzy front end experiences from the INNORISK project
Scopus_NPD_TI	Wilbers, W.a b, Albert, T.b c, Walde, P.b	Upscaling the Technology Intelligence process
Scopus_NPD_TI	Longanezi, T.a , Coutinho, P.b , Martins Bomtempo, J.V.c	A reference model for innovation practice [Um modelo referencial para a prática da inovação]
Scopus_JTBD_TR	Zhang, J., Tan, R., Chen, Z., Zhang, H.	Research on product technology evolutionary potential mapping system based on TRIZ
Scopus_JTBD_TR	JONES, GEORGE B.	ON MANAGING R&D INVESTMENT.
Scopus_CN_TI	Boimabeau, E.	Decisions 2.0: The power of collective intelligence
Scopus_MS_TI	Ouksel, A.M., Eruysal, F.	Loyalty intelligence and price discrimination in a duopoly
WoK_CN_TF	Teischinger, Alfred; Tiefenthaler, Brigitte	Wood Technology Road Map - Austria
WoK_CN_TI	AKOLKAR R P; CHEFALAS T E; LAREDO J A; SAILER A; SCHAFFA F A; SEGAL A; SILVA-LEPE I;	Method for custom-fitting service solution to consumer business requirements in cloud service marketplace, involves analyzing service knowledge representation item to
WoK_CN_TI	Moradi, Masoomeh; Aghaie, Abdollah; Hosseini, Monireh	Knowledge-collector agents: Applying intelligent agents in marketing decisions with knowledge management approach
WoK_CN_TI	Laschuk, Tatiana; Nascimento, Jose; Oliveira, Fernando	NANOTECHNOLOGIES AS IMPROVEMENT OF FASHION TEXTILE DESIGN
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