Access a world of innovation

applying external orientation to improve product and service development at SES

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Access a world of innovation:

Applying external orientation to improve Product and Service Development at SES

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Executive Summary

Introduction

Innovation in product and services is often the most important factor for competitive success, yet many organizations experience trouble to effectively innovate. This is also the case at SES, the world's second largest satellite operator, as managers experienced insufficient innovative output from the activities that were performed. Therefore, improvement of the product and service development activities has been chosen as the topic of the Master Thesis.

Innovation within an organization is influenced by both the internal situation and the external environment. In order to change knowledge and ideas into products and services, well-functioning processes need to be installed. However, to initiate sufficient innovation projects and have a fit with the market, companies need to look beyond organizational borders. Introduction of External Orientation and externally oriented practices for Idea Generation and Open Innovation can greatly improve the performance of NPD processes and economic performance in the market.

SES was founded as Société Européenne des Satellites in 1985 and its headquarters is situated in Betzdorf, Luxembourg. The company launched its TV-broadcasting satellite, Astra 1A, in 1988 and has been growing organically and through acquisitions to become a worldwide provider of satellite connectivity. SES delivers the connectivity to TV broadcasters, Telco's and IP industry (Data connectivity for enterprises), governments and institutions and provides services to smaller players in the satellite industry.

Due to a major reorganization within SES, some existing practices for innovation were terminated and others were redeveloped. Yet the question how to improve innovative performance remained. In the new structure, several departments have their own responsibility over innovation projects. A Product Innovation Meeting (PIM) is held quarterly to align projects and practices and discuss future projects. This has led to the following question, which was the starting point of the research:

"How can PIM organize innovation activities to improve the efficiency and effectiveness of the innovation process and consequently the innovative performance of the company?"

Analysis

During the research towards a solution, the regulative cycle by van Aken, Berends and van der Bij (2007) was applied. This involves stating the problem, followed by an in-depth analysis to discover the causes of the problem. Based on those findings a new or redesign is developed and proposed, which can then be implemented and evaluated by the organization.

The analysis of the underlying causes involved describing the environment in which SES operates and investigating the internal situation. SES is one of the few big players in the satellite communication market, which can therefore be described as an oligopoly. Although there is competitive threat within the market, the biggest threat is the development of substitute products such as fibre optics, which can take of a large share of the customers in time or put pressure on the prices of SES. Secondly, in western economies, the market has achieved a saturated status, limiting the growth opportunities for satellite television. It is thus necessary for SES to innovation in their products and service to ensure revenues in the future and to create growth in western economies.

Internal investigation on available documentation and through interviews has provided insights into several root causes of insufficient innovative output. The bullets underneath show the root causes, which are modelled in figure 1:

- Too internally focussed in development;
- Ineffective process execution, due to bureaucracy and gates without teeth;
- Management commitment and strategy to innovation.

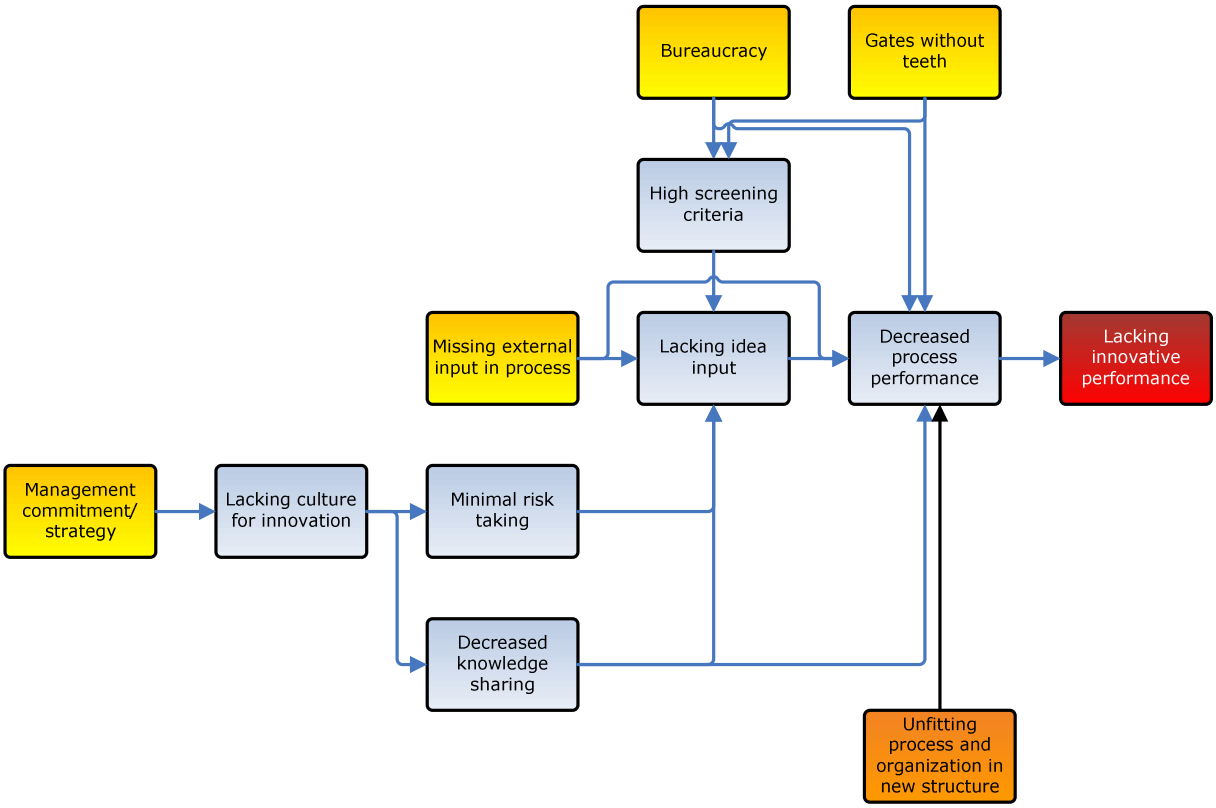

Figure 1: Root causes

These causes have also led to an extended problem statement:

"At SES, the mostly internal focus on P&S Development as well as formerly ineffective process execution and lack culture for innovation, prevented the company from initiating and realizing a sufficient amount of business-relevant innovations. Thus innovation did not add significant business performance."

Furthermore, in the context of the OneSES reorganisation, there is no coherent approach and best practices to innovation in place yet. The question shall thus be more generically about: Looking to external best practices and recent research findings. How could SES shape its approach to innovation management, what concepts and tools that have not been applied at SES, could be introduced?

Design

With the root causes in mind, a design is created that would fit in the organizational context. This included that there were functional requirements and limitations to the design, as it had to be realistically applicable and in line with company demands. Therefore, a set of topics was selected and agreed on with both the company and university supervisor. The design would focus on how the company could introduce external orientation throughout the development of new products and

services. This included the introduction of idea generation and open innovation. Finally, a critical review of the existing NPD process was necessary to see how this could be improved, as a faulty process would not benefit much from external orientation. The design can be conceptualized as in figure 2.

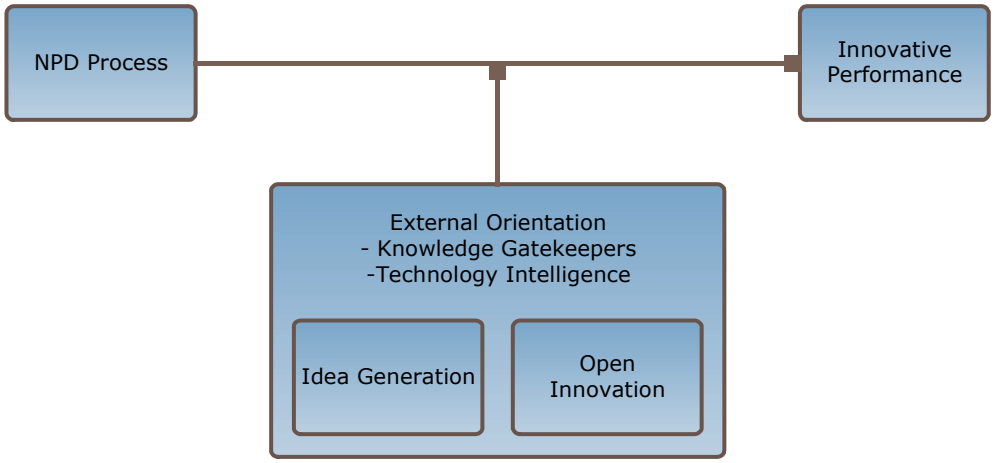

Figure 2: Conceptual framework of the solution design

External Orientation

To introduce external orientation PIM should use its influence to create the role of knowledge gatekeepers within the departments that are represented in PIM. Gatekeepers are employees that have a specific technical background, so that they can recognize interesting external knowledge, understand this, and translate it so that it becomes useful for others in the organization. In order to make gatekeeping effective within SES, PIM managers should identify who technology specialists are within the organization and give them explicit (part-time) responsibilities to act as knowledge gatekeepers. In order to share the knowledge throughout the organization, periodically planned presentations should be arranged, where those involved with innovation are involved about the latest development in technologies. The PIM meeting would be suitable presentation moment.

The following step to introduce external orientation in technologies is to install Technology Intelligence. Technology intelligence consists of (an) employee(s) who searches gaps in the existing knowledge base, coordinates the search activities from gatekeepers, initiates formal searching activities and communicates the findings to top management in order to support them in (strategic) decision-making.

Idea Generation

Within SES the former New Service Introduction (NSI) team had the responsibility to collect ideas internally and evaluate them for projects. This role has now been taken over by individual departments and PIM. In the past, internal oriented idea generation produced less and less ideas, but external sources were hardly addressed. To access more ideas, SES should extend the existing Voice of the Customer study (which is a superficial survey with a large sample, performed by the commercial departments) with in-depth studies at a limited amount of customers. Cooperation between PIM and the commercial departments should result into the creation of cross-functional customer visit teams, which perform in-depth interviews with customers to discover their latent needs. Furthermore, PIM can apply open innovation for idea generation by soliciting for ideas at

suppliers, partners or by addressing existing communities or open innovation networks (e.g. ninesigma.com)

Open Innovation

Implementing open innovation within project execution allows the organization to innovate into products and services, whilst not having all the innovative capabilities internally. It allows SES to specialize in certain elements of the development and accessing other elements at external sources, thus also mitigating the risks involved with developing all the necessary capabilities internally. To stimulate an open innovation mindset within SES, managers within PIM can start by setting targets for the external elements in developments. Setting these targets can be accompanied by providing project leaders with the possible network connections, as the managers within PIM are well connected within the industry.

Eventually SES needs to build a network of innovators, SMEs, entrepreneurs, researchers, business partners, suppliers, universities and customers to cooperate with during development. Building such a network is capital and resources intensive as it contains active expansion and maintenance to make open innovation work for the company. First of all, it should investigate which open innovation networks already exist in the industry and thus can be accessed without building it oneself. However, searching opportunities or building a network might not be a suitable task for the managers within PIM, as they already have full schedules. Instead an open innovation team or specialist(s) can be installed who:

- Maintain and build the networks;
- Search for external opportunities to use internally created IP or ideas (and vice versa);
- Scan SMEs and start-ups for new products or services that can be absorbed;
- Help project teams with soliciting for externally created solutions;
- Route information and requests that come in from external partners;
- Look for further extension of open innovation practices.

If these forms of open innovation work for SES, they can consider more radical implementation of open innovation. Many organizations that create a network to bring player together also perform this via physical colocation. As SES' HQ is currently located in Betzdorf, away from other technological players, chances of cross-fertilization are limited. SES should look for existing technology parks that are of interest to the business, and consider moving its development activities physically to such (a) location(s).

Development process

Without a well-functioning development, improvement through external orientation will be limited. In NSI a stage-gate process for product development was created, but this process was bureaucratic, not functioning effectively and thus not popular. With the change towards PIM an opportunity to evaluate this process and improve it is presented. To make the process more effective and efficient, PIM should introduce:

- Rules of engagement for the teams and decision-makers;
- Selection of project gatekeepers that fit to the risk in project;
- A flexible and scalable process that fits to the risk in projects;
- Scorecards to rate ideas and projects, instead of decisions on personal criteria.

Implementation

After creating a design for SES, changes should be implemented and shaped so that they work within the company. Although implementation is performed by the organization itself, a plan to gradually introduce the concepts from the design is created. This plan includes low hanging fruits, which are less capital or resource intensive and where introduction through PIM can start immediately. After implementing these changes a period of settling and testing is necessary before it can be evaluated. Then after evaluation, PIM and SES can continue with more intensive changes to further implement external orientation.

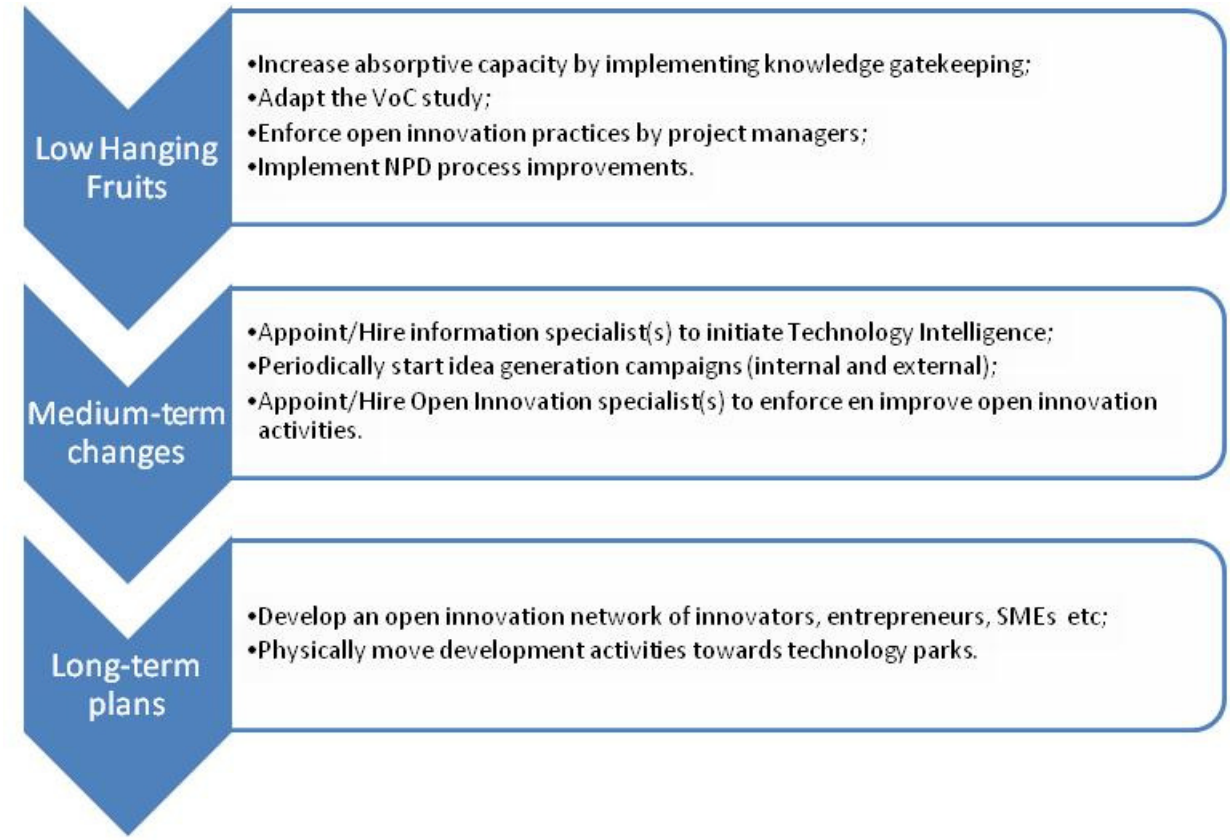

Figure 3: implementation plan

Conclusions and Discussion

In this thesis a structural way to introduce external orientation throughout development and thereby improve the innovative output for products and services is presented. Although PIM is a platform for communication between departments, it can have significant influence within the organization as all vice presidents that have innovation responsibilities are attending there. It is therefore that PIM has an important role in the introduction of the design concepts and it can apply pressure to implement these changes in the departments themselves.

However, there are some limitations to the research. The most important one being that little to no change was possible in the organizational structure, as this was introduced very recently. This introduced limitations to the directions the design could take, and it forced the research to find solutions to improve on the basis that was present already. However, to make significant change in the innovative performance, SES should reconsider the creation of dedicated R&D, which is not present at the moment. Having dedicated R&D will also improve the effects that external orientation has on the performance.

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List of abbreviations

BD	Business Development (department)
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
EC	Executive Committee
G&I	Governments and Institutions (department)
I.I.	Innovation Initiative
IP	Intellectual Property
NPD	New Product Development
NSD	New Service Development
NSI	New Service Introduction
OPEX	Operational Expenditure
PDM	Product Development and Management (department)
PIM	Product Innovation Meeting
Prod. Div.	Product Diversification (department)
P&S	Products and Services
RBD	Regional Business Development (department)
R&D	Research and Development
Telco	Telecommunications company
T.I.	Technology Intelligence
VoC	Voice-of-the-Customer
VoD	Video on Demand
VP	Vice President

Preface

The Thesis is part of the graduation for the Master Innovation Management at the faculty Industrial Engineering & Innovation Sciences of the University of Technology in Eindhoven. This document is the result of an internship and research at SES situated in Betzdorf, Luxembourg and describes the research that has been performed to get towards my recommendation to improve innovative performance in products and services.

While the core product of SES allowed the company to have a secure stream of revenues for many years, changes in the external environment force the organization to introduce innovations and extend their offerings. However, from its nature as an infrastructure and service provider, R&D intensity is low and there is a different approach to innovation compared to goods manufacturers. This created a great opportunity to research how innovation can be organized in such situations and apply the knowledge and skills that were gathered during the Master program to improve the effectiveness of innovation activities that are exercised.

I would like to take the opportunity to thank those people that helped me during the Thesis research. First of all, without the support and cooperation of my colleagues at SES this thesis research would not have been possible. I would like to express special thanks to Guy Harles, who has been my supervisor within SES, for guiding me through the company, placing critical notes to my work and providing me with the necessary information. Furthermore, I would like to thank Sybren de Vries for the first introduction within SES, thereby making the internship possible, and helping me to get around in Luxembourg.

My time at the University has been experience to never forget. First of all I would like to thank Jimme Keizer for his patience, advice and criticism throughout the graduation trajectory. Although his experience has taught him that an internship abroad can cause difficulties to keep research of track, he supported my choice to do so and kept focus in the research whilst the organizational context around the thesis was constantly changing. I would also like to show my appreciation to Hans Berends, who has provided me his critical and accurate view on the concept documents and pushed me to further improve the last few details.

Finally, I would like to thank those who helped me to get the most out of my student life and to finally get to this result. Dispuut BRUT has been there for the necessary leisure, support and personal development and has been an invaluable experience throughout my student life. Yet, most thanks go to my family who have always been there for me and (although it required some patience) motivated, advised and supported me throughout the Master program and Thesis.

Pieter Hoogeboom

Tilburg, December 2011

1. Introduction

The development of new products and services is for many organizations the most important factor for competitive success. Depending on the industry, new products (introduced in the last 5 years) can be responsible for at least a third of the revenues (Schilling, 2008). Not only can innovation be a source of competitive advantage, for many it is necessary to protect their position and stay alive (Cooper, 2000). However many organization also experience trouble innovating effectively. At SES, the world's second largest satellite operator, managers experienced problems with the effectiveness of their products and service introduction activities too, leading to insufficient innovative performance. This case was chosen as topic for the Master thesis.

Organizations need to have their internal processes arranged so that they can innovate effectively and efficiently. Internal mechanisms need to be in place to come up with new ideas and turn them into the next product or service. Over the years, many scholars and business have been developing processes and practice to make innovation work for them, a famous one being Stage-Gate by Cooper (1994). This is a stepwise process to gradually reduce risk during the process from idea to launch, while expenditures increase with every step of the process. The method is implemented at many companies, but also many experience problems making it effective and/or efficient. Half of the organizations experiencing troubles with new product development blame this on a poorly developed process (FAZ, 2009).

Not only internal processes influence the effectiveness of product development. Organizations rely much more on information from external sources to initiate and steer their innovations. Examples of such sources are customers, suppliers, partners, universities and competition. They build contacts with the external environment and rely on absorptive capacity (Cohen and Levinthal, 1990) to explore technologies, idea, needs, etc., assimilate them within the organization and exploit the benefits of the newly acquired knowledge. Recently external orientation has become even more influential on innovation, as organizations are realizing that they can't have all knowledge and capabilities internally in order to stay at the leading edge of innovation. They look to the external environment and actively solicit for ideas, solutions, processes etc. to realize innovations without having all of the necessary innovative capabilities or spending all the resources and time to develop the capabilities. This approach to innovation has been termed Open Innovation (Chesbrough, 2003). Not only do companies need a structured approach to continuous innovation, using sources and resources in the external environment can give them the competitive edge.

The purpose of this research is to create a solution design that can be implemented by SES to improve the innovative performance in products and services (P&S) of the company. The thesis describes the several aspects of the research, starting with a company and problem description in the next two sections. The environment in which SES is situated and how it influences decisions in the company is described in chapter 2. In chapter 3 an internal analyses, based on documents, experience and interviews, is made to discover root causes of the problems that occur with respect to innovation. Chapter 4 describes the design of the solution, which consist of a study of available scientific literature and interviews at innovative companies to build a solution that fits at SES. Chapter 5 entails a validation of the recommendations that are made and finally chapter 6 will be the conclusion and further recommendations.

1.1. Company description

Worldwide SES is the second largest satellite operator and is a leading provider of satellite services, offering broadcasting and broadband solution for companies. The company was founded in 1985 as Société Européenne des Satellites (thus SES in short) in Luxembourg and launched its first satellite in 1988, the Astra 1A. With the acquisition of AMERICON from General Electric, SES renamed its European activities SES ASTRA became part of SES Global, the strategic management company that owns market-leading satellite operators across the world.

Figure 1: Satellite ASTRA 4B (to be launched in Q4)

Together the SES companies, SES ASTRA and SES WORLD SKIES (a merger between SES AMERICON and the later acquired NEW SKIES), and their participations covered 99% of the world population with a fleet of more than 40 satellites and are the world's leading television distribution platform. A third organization, Called SES ENGINEERING, was the operations and procurement organisation for the entire SES group. They perform telemetry, tracking and control functions; provide the network and payload operations on the transponders on every satellite; provide connectivity for broadcasters and other satellite users and handle all spacecraft, launch vehicle and infrastructure procurement.

Very recent, SES Global's CEO Romain Bausch announced a major reorganization within the company to streamline its operational activities and reduce overlap in supporting functions. This meant that the two operational and the engineering company were merged into one, under the name SES. With this reorganization the internal structure of the company and its processes and procedures had to be redesigned. The new organizational chart is shown in Figure 2, although this picture only shows level 1 (Executive Committee) and lever 2 (departments) functions. On the 1st of May a new structure for the entire organization was in place, merging the three companies into one organization compiled of four vertical groups: Commercial, Development, Engineering & Operations and Financial. The CEO group contains the staff functions, such as HR, Legal, Communication and Audit. After this change, a period of adjustment was planned, so that all employees could settle in their new roles and new procedures could be built. The reorganization was finally made public on the 1ste of September with the unveiling of the "SES" brand, but improvement of the reorganization is planned to last until the beginning of 2012.

The company offers capacity on their satellite infrastructure and several services to make this capacity more accessible and attractive to their customers. These main customers and services of SES are:

- **Broadcasters;** offering Direct-to-Home services, broadcasters can reach over 53 million household covering Europe, sub-Saharan Africa and parts of the middle-east (old SES ASTRA); and the Americas and emerging countries around the world (old SES WORLD SKIES). Other services are transmission to cable networks, ground services to get content ready for broadcast, permanent inter-broadcaster transmission links, temporary backhaul capacity for

special events, etc. In total SES reaches over 245 million TV-households and broadcasts over 6000 channels worldwide.

- **Telecommunicators and IP industry;** providing companies with one or two-way connection for access to internet; video conferencing and other data communication, enabling machine-to-machine data transfer to monitor and control processes in areas with limited communication infrastructure and offering commercial broadband internet is available for connectivity in remote locations where no DSL or cable network is available.
- **Governments and institutions;** being politically neutral SES delivers systems to security, defence, civil and industry projects, e.g. military communication and rapid emergency response. SES US Government Solutions provides worldwide communication solutions for US government missions.
- **Satellite industry;** using their experience in satellite communication SES offers consultancy services and engineering expertise to broadcasters, satellite operators & manufacturers, etc. via TechCom services.

Figure 2: Organizational chart SES (removed due to sensitivity)

1.2. Problem Statement

Within the context of SES ASTRA, before the reorganization, innovation in services is organized via the New Service Introduction (NSI) board, which consists of high level managers that have part time responsibility to guide project managers where necessary and perform decision making around these projects. The board consists of managers from existing departments and operates between the organizational structures. For confidentiality reasons, the exact consistency of the board is not published.

When NSI was initiated huge amounts of ideas were proposed as it was the first time that employees had a drop off point for their thoughts. The success of the program steadily declined as people thought of the process as bureaucratic and unnecessary. Resulting was a decrease of innovative performance, which consecutively led to a need for revision of the approach (from: NSI meeting minutes). The activities of the student should take place in the confines of the NSI team and should focus on all aspects of NSI to increase its innovative performance. However, in the new structure, NSI became redundant, thus top management decided to replace a centralized innovation process by decentralized activities within departments and install a quarterly review of all projects and practices, called Product Innovation Meetings. This has altered the position of the research, making the question at hand:

"How can PIM organize innovation activities to improve the efficiency and effectiveness of the innovation process and consequently the innovative performance of the company?"

2. Situational Description

In the introduction we briefly introduced the company, SES, where the thesis research was performed. The description involved a brief history, an overview of the products and a description of the company structure. In this section a more in depth description of the research situation is provided. This includes a description of the industry SES is active in, the position SES has in this environment and a threats analysis.

2.1. Competitive environment

From the core activities SES can be seen as an infrastructure provider which uses satellite technology to transmit data and signals around the world. Worldwide there are several satellite operators that provide similar services. After Intelsat, SES is the second biggest, followed by Eutelsat which focuses its activities mainly on Europe. Although there are some small, regional players competing with the big companies, the market form can be described as an oligopoly (Wikipedia). The four biggest operators (those previously mentioned plus Telesat) own about 65% of the globally available transponder capacity.

In the original business model of a satellite operator, the company demands payment from media broadcaster for the amount of transponders that they use on their satellites. With analogue channels, which TV broadcaster are moving away from, one transponder equals one channel. With digital channels, each transponder can process up to 8 channels, depending on the quality of the transmission (SD, HD or 3D). The value of a transponder is determined by its footprint and reach; meaning the area it's covering and the amount of households which a dish aimed at the satellite, respectively. Other influences on the price are the reliability and of course the demand and supply.

The business model and pricing mechanism for satellite capacity sales to broadcasters still covers the biggest part of SES' revenues, but other sources of income are growing (Source: financial statement 2010). For instance, satellites can also be used for transmission of data (internet) or military purposes. These services differ from traditional broadcasting, for instance through occasional use or hosting payload for government programs on the new satellites. Also, SES has started to develop different types of services around the classical capacity sales to 'dress up' the offering, such as Astra Platform Service (APS) and Astra Broadband Services (ABBS). These services, such as play out services or remote internet access, are not only used to make capacity more attractive, but also are sources of income on itself. The services however, work via a different business model and pricing mechanism.

2.2. Value Disciplines

In their research, Treacy and Wiersema (1993) argue that there are three generic value disciplines from which companies can choose theirs (Figure 3). These disciplines are Operational Excellence, Product Leadership and Customer Intimacy. Operational excellence means that companies offer good products at a competitive price, without much hassle or inconvenience. Product leadership can be obtained when a company relies heavily on R&D, product development and risk taking to deliver state-of-the-art products. Customer intimacy means tailoring solutions to the demand of a single customer; not trying to make just a sale, but building a relationship with this customer. The general notion is that companies can't do all of this and should focus on what they are good at (Treacy and Wiersema, 1995). This doesn't mean that companies should only focus on one, but choose one to excel at and be OK in the others.

When applying the classification of Treacy and Wiersema on SES, a less clear situation appears. SES doesn't focus on one discipline, but adapts it to the kind of market they target. Looking at the broadcasters as customers, SES' approach can be described as a customer intimacy one. Companies can get as much service and support as they want, customizing the service package to the amount the customer needs, and the front office is currently being expanded to be as close to the customer as possible. [redacted][1]. Thus, SES has different approaches for different markets, depending on their expertise and situation in the market, but try to bind customers to the company as long as possible to secure capacity utilisation on their satellites.

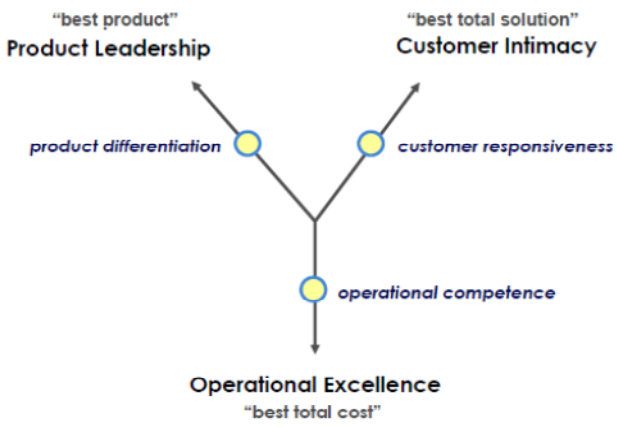

Figure 2: Value disciplines (Treacy and Wierseman, 1993)

2.3. Threats analysis

When looking at the five forces model (Porter, 1980), threats for the future of the company can be analysed. A student already analysed the threats to SES in North-America (Appendix 1), which is a saturated market for satellite television. In a sense, the results have some overlap with those in the telecom industry (Investopidia, n.d.):

First, the *threat of new entrants* is relatively low as there are high entry barriers into the market. Not only are investment costs into satellite development and launch very high, operators need to acquire rights to locate their satellites at a certain geographical location and need to acquire spectrum rights (which means the right to broadcast a certain range of

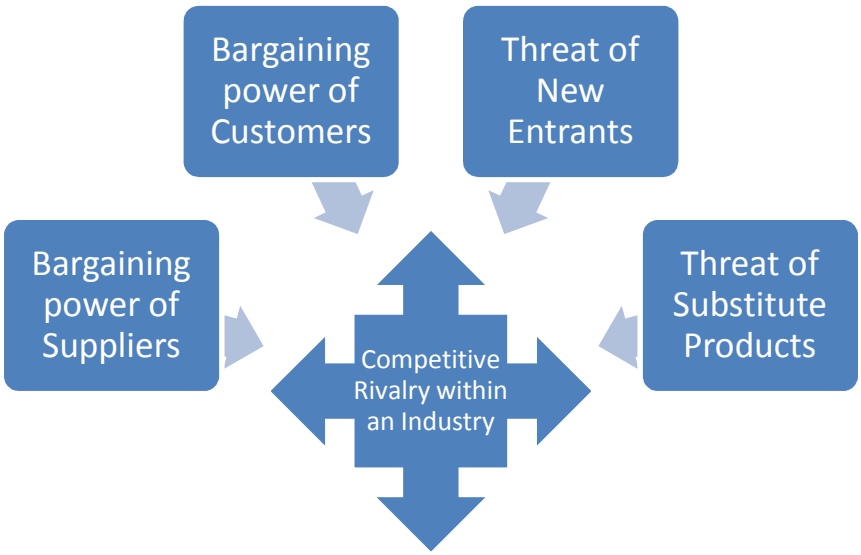

Figure 3: Five Forces model (Porter, 1980)

[1] Sensitive information on company specific market approaches has been masked

frequencies over an area), which is finite. In mature markets these rights have already been divided over the big players, giving start-ups little room to obtain them.

Power of suppliers does look quite high, as there are limited numbers of satellite manufacturers or launcher organisations. However, as the number of satellite operators are also limited and development contracts are sparse, manufacturers must win development contracts from operators, thus weakening their position. There is however a different type of stakeholder which has significant power: governments. As governments and governmental organizations own rights on spectrum and coordinates in space, and the supply of frequencies and coordinates is finite, satellite operators have to win these rights through bidding. This is especially of interest when moving into new markets.

Power of Buyers is relatively low; as satellite is still the most cost effective way for a full coverage (globally or regional) and ideally suited for broadcasting, TV channels and broadcasters are bound to a limited amount of operators. Furthermore, switching costs are high as large pay-tv broadcasters (e.g. Sky, Canal+) would need to re-aim all of their customers' satellite dishes. Contracts are often very long term, ranging from 5 years to 10 years.

The *intensity of competitive rivalry* varies, threat of new entrants is low as regulation is high and switching between operators is difficult. On top of that, opposite of what satellite technology as a space and rocket science might suggest, technological innovation is relatively slow. The reason for this is the risk averseness of satellite operators in general. Once in space, a satellite has very limited options for repair if failure occurs. And as development and launch of a satellite costs hundreds of millions, operators will only use proven technology, that what has been used or rigorously tested and proven to work for the full lifetime in space. Furthermore, SES has positioned itself as being the best in class on broadcasting quality and reliability. Although this requires much investing and back up capacity in case of failure, their position is quite secure and it allows them to asked higher prices for bandwidth. Finally, technology is often available to all operators, as satellite manufacturers can't afford to make development exclusively for one operator. Also, the use of patents and other protection mechanisms by operators is relatively low. Thus, in markets that are mature, competition from other satellite operators is limited. In new markets, such as Africa, the Middle East and Asia, competition is quite strong. Not only do various operators try to win broadcasting contracts, several countries want to initiate (or have already initiated) their own satellite programs. As the countries own the spectrum rights, rights to land video distribution and licenses for broadband terminals in these regions, entry into the market is difficult.

While the threat of current and future competition in the satellite industry is limited, *threat of substitute products and services* is rising. Satellite is still the most suited communication mechanism for broadcasting (1=n), technologies such as cable and DSL are better for unicasting (1=1). An example of unicasting is internet connectivity where every household has an individual IP-address and only receives information that is meant for that address. Unicasting however, is not very suited for mass distributions of content as every network connection requires computing resources (Wikipedia). Thus, not only does satellite have a better and more cost efficient reach (remote locations do not need a cable or antenna close), it requires less bandwidth to broadcast TV signals to all households. Thus, in the current situation, threat of substitution is still quite low, but this may change over time.

There are a couple of developments that do threaten the dominant position of satellite in TV broadcasting. First, development in the use of fibre optics has reached a critical point where newly built homes and apartment blocks are ready for fibre optics or already connected to it, instead of satellite TV. This doesn't directly threaten current reach, but it does allow broadcasters to put pressure on pricing as reach of fibre optics is growing. Second, Video on Demand (VoD), interactive TV and Smart TV are becoming more popular for end-users and broadcasters. An example of Smart TV is Google TV which allows users to watch regular TV, but also watch YouTube videos, use applications (apps), browse the web or social networks on the television. These services require a two-way connection and contain several elements of unicasting, two areas where satellite is weaker at than terrestrial, cable, DSL or fibre optics. A solution to this is to seek partnerships with Telco's, who want to move into this area too. With such a partnership the best of both worlds gets combined, creating "Hybrid TV". This move has its drawback though. When teaming up with Telco's it means that SES is allowing them to move into their reach of households. As capacity and speed of land based networks is increasing on a faster pace than satellite and compression technology for broadcasting is improving, unicasting technologies are getting better suited for TV. This might speed up replacement of satellite operators by the Telco's once speed is high enough to offer similar quality. Also, other technologies are able to offer triple play (i.e. TV, internet and telephone), while satellite can't. Therefore current customers are forming partnerships with DSL and cable providers to be able to offer those services. Thus, the biggest threats for the future of SES aren't coming from inside the satellite industry, but from advancements in other communication technologies.

3. Internal Analysis

Although a problem has been stated by the organization, a more in-depth study is necessary to determine what the actual problem is and what the root causes are. This step of the research can be called the diagnosis phase, which is one of the five phases that are proposed by van Aken, Berends and van der Bij (2007) to approach business problems. In this chapter we will discuss what type of innovations are developed, how this is organized and we will end with a diagnosis where problems might occur.

3.1. Research Methodology

This section is dedicated to the structure that is used during the Master Thesis. It involves the steps that are taken during the internal research at SES and how the problem is discovered and consecutively solved. For the entire thesis 5,5 months are reserved, starting with the request for the Master Thesis via the research proposal that was approved on the 21st of June.

The case of SES can be approached as an individual problem that appears within a specific environment. The aim for this research is to apply state-of-the-art theory for the development of a solution for a business case, not to develop theory. For the design of this solution, the methodology for Business Problem-Solving by van Aken, et al. (2007) is particularly suited. In this approach, researchers (or students) apply the regulative cycle (Van Strien, 1997) to define the problem, analyse the situation and diagnose the causes, design a plan of action, implement the changes and finally learn and evaluate the changes (and the process). As this process (Figure 5) is a cycle it can consist of multiple iterations if the expected results aren't reach in the first round.

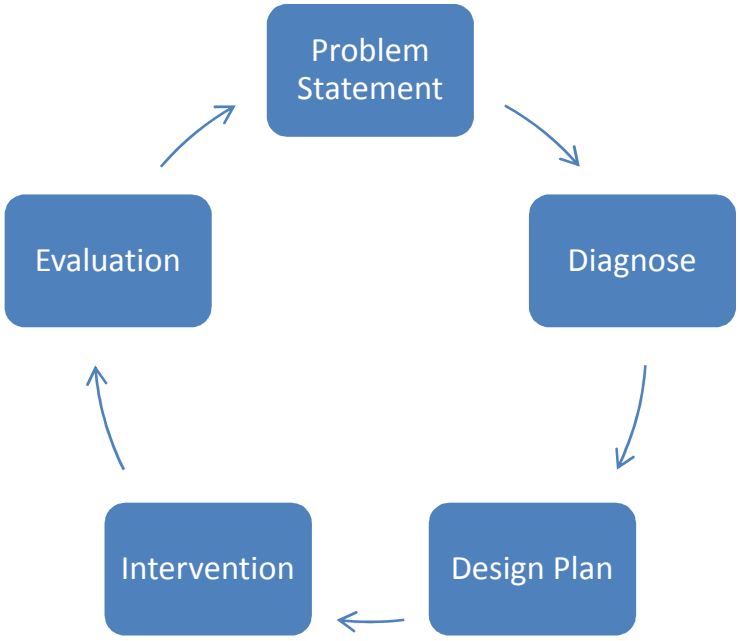

Figure 4: the regulative cycle (Van Aken et al., 2007)

There was an initial problem statement formulated in the introduction. In chapter 2 a start with the diagnosis of the problem was made by analysing the competitive environment and innovation at SES. This is followed by an in-depth investigation (chapter 3) into root causes of decreases innovative performance in P&S via internal interviews and documentation research. This research leads to a revised problem statement that included a number of root causes which will be the focus in following chapters.

The step after the internal analysis will be the solution design that consists of a redesign of a business system or organizational unit, based on the input from previous steps; a change plan that introduces the redesign and an organizational support structure for the solution and the change plan (van Aken et al., 2007). During this phase state-of-the-art scientific research will be used to develop a solution and mitigates the causes of lacking innovative performance within SES. The use of literature prevents from "reinventing the wheel", but the use of theory must be comprehensive, critical and creative. Thus, not only copying theory into particular cases, but also having a structured approach to gather, select and adapt or build upon theories. For further justification of the proposed solution that is adapted from literature, innovative firms are interviewed on their approaches to mitigate the causes for lacking innovative performance. Due to time restrictions, consecutive phases (intervention and evaluation) will be outside the scope of this research and can be taken over by the company. To facilitate the intervention within the organization, an implementation plan is presented.

3.2. Innovation at SES

Although we argued that the satellite industry is risk averse in the sense that they do not want to launch technologies that haven't been tested enough, innovation is occurring. These innovations can have different natures or backgrounds. In this section we will discuss the innovations that have been introduced by SES and what kind of innovations these are. We will also discuss what innovations will be necessary in the future.

3.2.1. Radical or Incremental

ASTRA 1A, the first satellite that has been launched by SES in 1988, was also a major innovation as being the first medium powered satellite that allowed smaller dishes to receive TV signals. Ever since SES has introduced a number of significant innovations in the satellite industry, such as colocation of satellites at a single coordinate, duo-LNB and more recently ASTRA2Connect. Other important developments where SES was of great influence were the development of a digital broadcasting standard (DVB-S and S2) and aligning the TV industry (TV producers, manufacturers, broadcasters, and network operators) for a standard in high definition TV. All of these innovation have different backgrounds; some are technology related, others process innovations, then there are service innovation which use satellite technology and there are marketing innovation.

The produced innovations that were mentioned in the previous paragraph happened over the entire lifetime of SES. The types of innovation have changed during this lifetime and are quite different nowadays when compared to those in the beginning. In the space segment, innovations have shifted from radical ones in the initial years to incremental improvements nowadays. The radicalness of an innovation depends on its newness, which can be new to the world, new to an industry or market, new to the firm or new to a business unit. The bigger the newness, the more radial it is considered (Schilling, 2008). Incremental innovations do not need to be particularly new to anyone, but can be a minor change or improvement and involve only minor change in the organization. Radical innovation often requires new processes, manufacturing or marketing approaches. Also, the amount of risk involved with radical innovation is often bigger than with incremental innovation as new knowledge, producers and customers are involved and more uncertainty and ambiguity is present. At SES, innovations in communication technology can be considered incremental since they are often slight improvements in quality, reliability or efficiency.

3.2.2. Products or Services

Innovation in products is necessary for organisations to gain a competitive advantage or keep their position in the market, but with declining margins on manufactured goods, more manufacturers develop services around their goods (Jacob and Ulaga, 2008; Paton and McLaughlin, 2008; Gebauer, 2008). Although SES can't be described as a manufacturer of goods, development of services is important next to their core product, satellite transponder capacity in space. A service differs from a product on a number of dimensions (Nijsen et al., 2006; Fitzsimmons and Fitzsimmons, 2000; Johne and Storey, 1998). Services are:

- Intangible; they can't be inventoried, difficult to patent, hard to display or communicate and pricing is difficult.
- Heterogeneous; delivery and satisfaction depend on employee and customer actions, quality depends on uncontrollable factors.
- Simultaneous in production and consumption; customers participate in production, mass production is difficult, customers affect each other.
- Perishable; difficult to match supply with demand, services can't be resold or returned.

Another difference between products and services is that development of services doesn't rely as much on R&D activities as with product development. Although improvements are on-going on space and ground technology, SES has also focused its attention on service innovation. While big TV networks or broadcaster might have the ability to uplink their broadcast to satellites themselves – thus needing only the capacity on a satellite – smaller channels might not have the facilities or experience to their signal into space and everything that comes with it. SES offers a wide range of services to make broadcasting easier. SES has extended its services beyond broadcasting and is looking for further ways to use and 'dress up' its capacity in the space. In some cases, it is absolutely necessary to develop service themselves in order to sell a new product. An example of this is the creation of ASTRA Broadband Services that operates the broadband access system ASTRA2Connect.

When looking at the development of services at SES, we can see that there are more radical innovations compared to the core product, but they do not happen very frequent. An example of a radical service innovation by SES was ASTRA2Connect, which is a data connectivity service for remote locations without installing big and expensive VSAT-terminals. This enables people and companies that are situated in rural locations to have affordable broadband internet connections. Offering such a service also required the development of new delivery processes. Although innovation in the core technology of satellite broadcasting is incremental and on a slow pace throughout the industry, the satellite operators try to find new, sometime radical services to use this capacity.

3.2.3. Open or Closed Innovation

When it comes to development of new product and services itself, SES has three choices. First, they can decide to do all development themselves. However, without the availability of a dedicated R&D department and priority for operational activities, resources for development are limited. The two other options that can be utilized are development in partnership or outsourcing of development (and exploitation) entirely, in which the latter is the most preferred. An example of outsourcing is the development of set top boxes. In these cases SES can have a request for features that should be implemented in future set top boxes, essential for satellite television, where the producers of these devices can then decide if they will invest in development. An example of partnership development

are the done by consortiums as the HbbTV, where several companies throughout the value chain cooperate to make industry standard for smartTV.

In 2003 Henry Chesbrough introduced the concept of Open Innovation. Compared with the classical form of closed innovation, where organizations rely on internal sources to execute all activities in the idea-to-launch chain, open innovation makes company barriers permeable (Figure 6). Ideas, knowledge, projects, etc. are allowed to flow in and out of the innovation funnel of the company. As innovation is one of the main drivers for competitive advantage, companies want to expand their innovative efforts, but most of them are not eager to invest more to increase their innovative capability. The latter is also strongly present at SES. The idea behind open innovation is that a company can't have all the knowledge and resources for development internally, that knowledge has become more mobile and that companies can access knowledge outside their company borders to increase development speed. As ideas, knowledge and capabilities can flow into and out of the innovation funnel at any point of progress, open innovation can be applied throughout the entire development cycle. Thus, not only can open innovation improve project performance, it also allows thinking outside the box as more creative minds are reached.

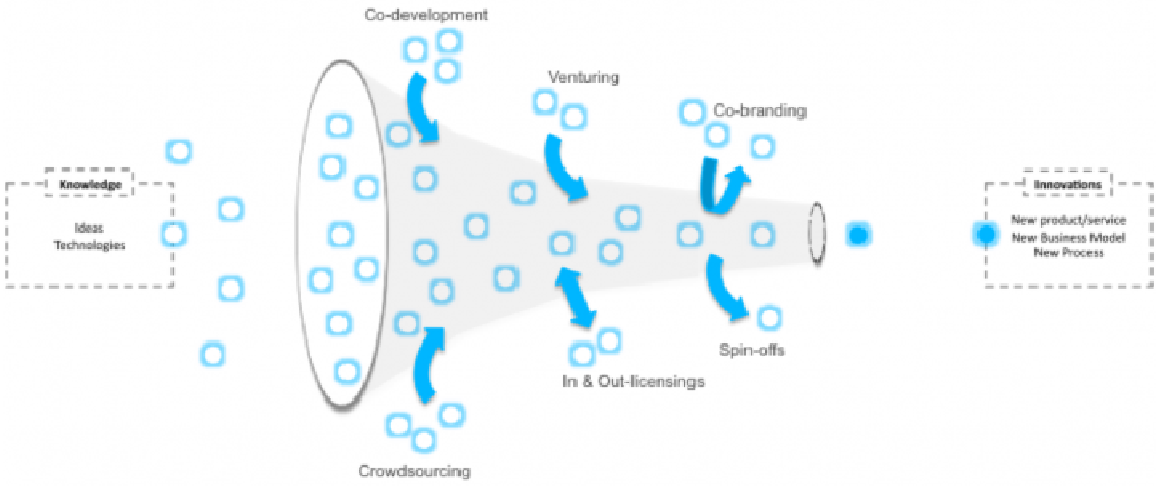

Figure 6: The idea-to-launch process with open innovation (Source: Cooper, 2008)

At SES however, closed innovation seems to be the main approach to development. In initial phases, such as ideation, only internal sources for ideas are addressed. During product or service design, SES does use contact with the outside environment, but do not do this in an open innovation way. SES sets specification for a new product that they would like to use for an innovation and then outsource development and the rights to private companies. In or out licensing of technologies for own benefits or venturing is hardly ever executed, nor are spin offs created from unapplied projects. There is an exception of the O3b network, which was an externally initiated innovation, but has been adopted by SES as the main investor. In the following stages of production and sales, open innovation has little influence. As a service oriented company production doesn't occur, but also development and manufacturing for the capacity in space is completely outsourced. We can conclude that innovation is internally oriented and that there is opportunity to introduce open innovation.

3.3. Organization of Innovation

In the previous sections we discussed the competitive environment in which SES is active, what types of innovations are developed and where opportunities lie. In this section we will address how

innovation is structured within SES, thus looking at how this is allocated within the organization and what the goals of the initiative that have been introduced are.

As mentioned in the introduction, “New Service Introduction” (NSI) collected the ideas and managed the development of the projects. [redacted]

[redacted][2]

After the introduction of NSI, ideas from employees flooded into the program, forcing the board to choose where to spend their resources. Also, board members had the responsibility to support project managers and idea bringers in their activities when necessary, but as NSI is a responsibility of managers on top of their daily activities little time for support was available. Low idea acceptance and little support from managers gave employees the idea that NSI was an administrative and bureaucratic process, instead of a helpful initiative to stimulate innovation. A second generation included an NSI team of lower seniority employees that was available for support and the organization of gate/board meetings. This second generation was only just under way when a major reorganization of all SES’ companies was announced.

With the introduction of the new organizational structure, the role of NSI was adopted by several departments and NSI was changed into Product Innovation Meetings, which are held quarterly and is a platform for information sharing on projects and practices. [redacted]

[2] Information on organizational structures has been masked

[redacted]

3.4. Internal Situation Analysis

Many authors have evaluated what organizational determinants for innovation are. In the meta-analysis by Damanpour (1991), the author discovered that determinants such as specialization, functional differentiation, professionalism, managerial attitude toward change, technical knowledge resources, administrative intensity, resource slack and external and internal communication are positively related to innovation. Centralization has a negative relationship and formalization, managerial tenure and vertical differentiation have no significant influence on innovation. In this research paper, innovation was defined as *"the adoption of an internally generated or purchased device, system, policy, program, process, product or service that is new to the organization"*.

Other research focused on more specific topics as determinants for innovation. For instance, Valencia, Valle and Jiménez (2010) researched how organizational culture influenced the development of products and services. Tidd (2001) involved the environment influences organizational structure and management of product innovation. Other researchers analysed what characteristics innovative companies have on topics as flexibility, informal internal communication and collaboration with external entities (Medina, Lavado and Cabrera, 2005). Based on several researches on measurements for innovative performance, Adams, Bessant and Phelps (2006) developed a framework that allows managers to evaluate their innovation activities. Throughout this approach managers can discover how innovative their company nominally is, and whether or not

[3] Information on organizational structures has been masked

innovation is embedded in the organization; thereby discovering where possible areas of improvements can lie. In their measurement, the authors identify seven topics that influence the innovative capabilities:

- Input,
- Knowledge management,
- Innovation strategy,
- Organizational structure and culture,
- Portfolio management,
- Project management,
- Commercialization.

The framework combined with previously mentioned literature about determinants of innovation has been used to develop a questionnaire that, consequently, has been used for internal interviews. With these interviews the current strengths and weaknesses within the context of SES were evaluated. Interviews have been conducted with several managers that are responsible for innovation in products and services, business models and space related technology development. The approach for these interviews was semi-structured; as questionnaire with high level, open-end questions was used as a guideline for the interview, with follow-up questions emerging from the dialogue between the interviewer and interviewee (DiCicco-Bloom and Crabtree, 2006). For the interview several senior managers and VPs were interviewed; however names and functions are kept out of the thesis as this is sensitive information.

From the interviews multiple conclusions about innovation in products and services can be formulated. When evaluating the results of the interviews, opinions about several strengths and weaknesses recur throughout multiple departments. Discussing of the elements in the framework by Adams et al. (2006) and description of other findings during these interviews is done in the next section. In that section the findings of the internal interviews are summarized into statements. The extended internal conclusions can be found in appendix 2.

3.4.1. Internal Analysis Conclusions

After revising all the interviews and available documentation on the intranet servers, an aggregated view on the strength and weakness in innovation on SES can be formulated. This situation was explained in detail in the previous section, from which conclusions for improvement areas in this will be drawn in this section. During the interviews both overlapping and contradicting views appeared. Areas of contradiction were investigated further using available internal documentation and informal conversations with various employees. When summarizing, some areas of determinants of innovation are well arranged within SES, others less. When comparing the determinants of innovation to each other, the following areas can be considered as suited for innovation[4]:

- On the Input factor, highly educated employees and the potential availability of financial resources improves the potential for success.

[redacted]

[4] Information on internal conclusions is considered sensitive and thus masked.

[redacted]

- Commercial departments have the skills to sell products, however there should be a change in sales targets to stimulate new product and service sales.

Other determinants would suggest that the there is room to further improve development activities. These determinants are identified as causes for limited innovative performance in P&S and therefore areas for improvement. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Dimensions such as organizational structure and innovation strategy are currently undergoing change and initial implementation. The changes in structure have been initiated too recent to judge about effectiveness and influence on innovative performance. Although the execution of the innovation strategy has room for improvement, little can be said about the content and direction of the strategy change. If the newly introduced innovation strategy will change the type of strategy from an overall defensive/reactive one to a more prospecting/analysing one is still unclear. For this reason the organizational structure and strategy are left out of scope.

3.5. Problem Diagnosis

In the previous chapters the research demands from the company was stated and an analysis of the situation was performed. Then, a more in-depth analysis of the problem was performed, concerning internal documentation and interviews that were performed with employees within the organization that were involved with NSI and innovation in P&S or innovation at SES Engineering. In this phase of the research the causes of decreasing performance were to be determined.

A revision of the problem statement, scope, assumptions and challenges can be formulated. First, the scope is to be specified. With the current structure and the “Innovation Initiative” in mind the scope of the problem solving will be the development of commercial innovations, thus the product and services that SES and its subsidiaries will sell or use to increase bandwidth sales. Innovation in space technology will be out-of-scope in this thesis, but this does not mean that some of the findings are not applicable in the innovation initiative.

[redacted]

[redacted][5]

The argument of opponents against innovation, that customers do not require innovation, shows many similarities with the research on disruptive innovations by Christensen (1997). There can be several reasons why large customers do not want SES to put much effort into innovation. First, as SES has been a supplier with the highest reliability and quality, customer's preference for SES' investment behaviour would be to invest primarily into these targets, not into innovative products and services. Second, large customers of SES have innovation departments dedicated to develop new services for their customers. Therefore, the need of new services by SES is low and might even be considered competition to the customer's services. However, if SES does not invest into (disruptive) innovations, their position may be threatened by upcoming technologies and businesses. The threat of substitution might not be imminent as satellite is and will remain the most best performing infrastructure for television broadcasting, but broadcasters aren't bound to use satellite capacity. [redacted]

Within the organization an amount of challenges arise. Traditionally the company has been an infrastructure provider with the addition of services to increase sales. As with most service companies, there is no R&D department that has the purpose of developing new technologies. It is therefore a challenge to organize activities within the current situation so that innovation can take place. A second challenge is to decide on what type of innovation the focus should be on. The company has a focus on the innovation in its services, but requires technological developments and product to be able to launch the services. These developments are nearly always pushed to suppliers or partners, reducing the risk in the products for SES. This brings two disadvantages: (1) the products that are developed are also available for competitors, reducing the advantage that SES gets from their new services; (2) the suppliers or partners might not find the targeted market for a product big enough to justify the development costs, thus not accepting the proposed product ideas and leaving SES with an unsolved problem. Therefore, there is a constant struggle between investing in product development and avoiding risk.

[5] Confidential financial information has been masked

3.5.1. Problem Statement

From the interviews, internal documents and experiences within the company, a number of root causes for the underperformance in innovation in P&S at SES can be identified. There are that have room for improvement to get the most out of their resources and efforts for innovation. [redacted] The causes for underperformance have been traced down to their roots, which are pictured in Figure 7. With this knowledge the problem statement can be defined:

"At SES, the mostly internal focus on P&S Development as well as formerly ineffective process execution and lack culture for innovation, prevented the company from initiating and realizing a sufficient amount of business-relevant innovations. Thus innovation did not add significant business performance."

Furthermore, in the context of the OneSES reorganisation, there is no coherent approach and best practices to innovation in place yet. The question shall thus be more generically about: Looking to external best practices and recent research findings. How could SES shape its approach to innovation management, what concepts and tools that have not been applied at SES, could be introduced?

To summarize, in the next chapters of this research we will focus on looking for potential solutions for four issues that have been found to hamper innovative performance within SES:

- Too internally focussed in development;
- Ineffective process execution, due to bureaucracy and gates without teeth;
- Management commitment and strategy to innovation.

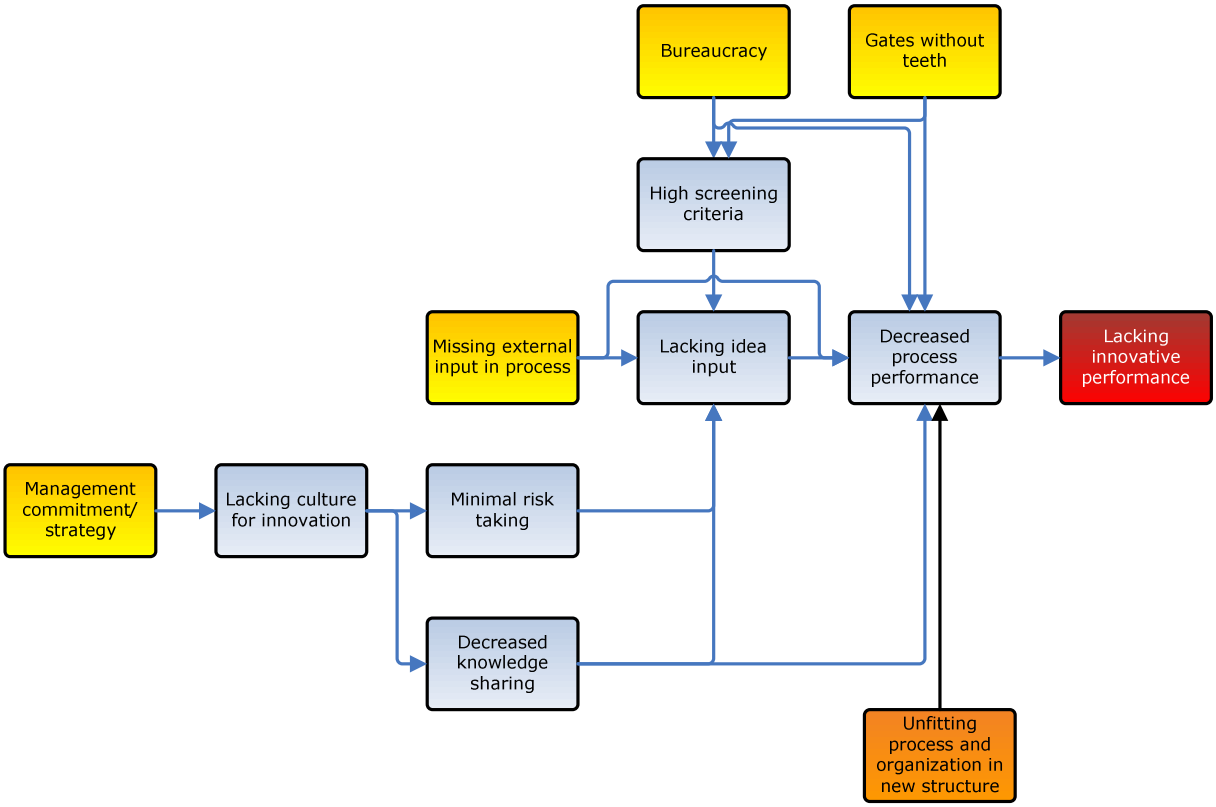

Figure 5: Impact model of root causes

3.6. Design Objective

In the problem statement in section 3.5.1 the problem was captured in one sentence. We will use this statement to formulate a research question for the following chapters in this research, thus:

"How should SES organize its innovation activities within the scope of Product and Service innovation and in the context of the restructured organization to increase innovative performance of the company? "

In the problem statement, the main problem was traced back to a number of root causes that negatively influence the innovative performance in P&S development. These root causes are thus the basis for the following chapters in the research. To tackle these problems in the roots individually a number of sub questions have been created:

- What activities can SES perform to increase its external orientation in innovation projects?
- How can SES continuously feed their innovation funnel with new ideas for products and/or services?
- How can SES increase innovative output, with the current innovative capabilities and resources?
- How should the development of a new product or service at SES be organized and executed?

In these questions a hierarchy of importance is visible. First of all, SES should focus on improving its **external orientation** on technological developments and knowledge creation. Within SES an opportunity to implement more external orientation has been identified. Applying more external orientation brings more information and knowledge from external sources into the development

process; thus allows decision makers, project managers and team members to make better informed decisions and perform their tasks more effectively. External orientation includes a number or sources and types of information that can be gathered (from) and shared within the company. In theory this will lead to improved process and product performance (Todorova and Durisin, 2007). Together with both the supervisor from SES and the university supervisor, it was determined that applying external orientation would be a functional requirement of the thesis.

A second functional requirement is the focus on **idea generation** within the thesis. Not only was a part of the original assignment from the company to review idea collection/generation, internal documents and interviews have also shown that the number of ideas from internal sources were decreasing fast since the introduction of NSI. In combination with external orientation, idea generation provides input into the development process and having more and more valuable ideas will positively influence the innovative output and sales of new products (Cooper and Edgett, 2008).

Part of the assignment was to improve the effectiveness and efficiency of the process. High tech companies are experiencing more and more trouble to keep up with innovation in their industry and are experiencing that they invest more in R&D while returns of innovation are levelling (Huston and Sakkab, 2006). Instead of investing massively into innovative capabilities they are opening up their organization to let ideas, knowledge, technologies and even full solutions or product flow into and out of the development process. This innovation paradigm, also known as **Open Innovation** (Chesbrough, 2003), had been introduced briefly in chapter 3 as a potential area for improvement at SES. As SES hasn't got all innovative capabilities in-house to keep at the leading edge of innovation and SES' top management is reluctant to invest greatly into the development of the capabilities, applying Open Innovation allows SES to access a world of innovation without the high internal investments into R&D. Again, in agreement with both supervisors Open Innovation is a theoretical area that should be investigated for the thesis.

The previous paragraphs included several theoretical areas that can be researched for SES' solutions design; however these will not improve innovative performance if there is an ineffective **process for New Product Development** and if there is no management support. Management will have the responsibility to implement and enforce the findings in this thesis, in order to make the design work for the organization. Thus, a final functional requirement is that there is a sound process and management structure to implement the external orientation, etc.. In the internal research, it was also discovered that the culture within SES does not promote innovative behaviour. Although this is also important for successful implementation and change is necessary, this is a different research topic in itself and therefore outside the scope of this research.

4. Design

In chapter 3 an internal analysis via interviews and internal documents has led to a number of conclusions about factors that hinder innovative performance. Three factors: too internally focused in development, having a bureaucratic and flawed execution of the process, and not enforcing a culture for innovation were found as causes that reduced the effectiveness of innovative attempts. Within these factors a distinction can be made between the cultural and social aspects of innovation and the management and execution of innovative projects. As the two are different topics in literature on innovation, one direction will be chosen to search for a fitting solution for SES. Having the original problem statement in mind, the focus is on management and execution of innovation within SES. A recommendation for future research will be how top management could trigger a culture for innovation.

In this chapter, a fitting design for SES to approach innovation in P&S in a more effective and efficient way will be formulated. In the search for this solution three different sources for knowledge and information are used:

- A literature study in the field of idea generation, new product/service development, open innovation and other relevant topics.
- A best practice research via external interviews to search for approaches that are tested in practice and that can be applied at SES.
- Internal documents and experiences with innovation at SES to make a fitting proposal.

To design a solution that fits in the context of SES, several functional requirements were developed. These prevent the research from losing focus and guarantee that the solution design will realistically applicable. The functional requirements to the thesis research are:

- In agreement with both the university and company supervisors, the main objective of the thesis is to introduce external orientation in the innovation process.
- The organizational structure of SES has just been installed, thus little can be said about its effectiveness. As the structure is newly developed for SES, changing it will be unrealistic.
- Within SES no dedicated R&D department is available. Initiating an R&D department is not in line with the Executive Committee's (EC) vision, thus not a direction for the solution. The solution design has to fit in the current structure and procedures.
- PIM is a new platform for innovation discussions still partially under development. As PIM focuses on product and service innovation, the solution design needs to be applicable for/in PIM.
- As PIM is a platform for discussion and information exchange on projects and practices, there is no budget available for project execution. Although all VPs have individual responsibilities over innovation projects, PIMs can only enforce discussion on new ideas and innovation practices.

The structure of the solution design will be based on the design objectives that were stated in section 3.6. First, external orientation will be addressed, followed by idea generation techniques and open innovations practices. Finally, the development process and execution will be discussed. This theory will be used to design an integrated solution at the end of the chapter. The integrated solution will

thus be based on functional restrictions/requirements and empirical findings of past practices at SES, practical findings for external interviews and scientific literature.

4.1. External Interviews

For the external interviews practical example were sought to discover how innovative companies organize their innovation processes. The goal of the case studies was to find out:

- What sources for ideas and knowledge are addressed during the process;
- How knowledge management and sharing is performed;
- What idea generation techniques are practised;
- How open innovation is practiced within the organization;
- Determine what processes are used;
- How this is embedded within the organization;
- How top management decision making around technology and strategy is executed.

The case studies were performed via semi-structured interviews with high level managers and experienced project managers. The interviews were performed at four companies in various technological sectors, (i.e. chemical, automotive/communication, sensory equipment and printing machinery). Within the mixture of companies, both product and service development, open and closed innovation, and radical and incremental innovation were represented. The approach of the interview allowed the interviewer to stimulate a dialogue on the topic of innovation, whilst steering it with pre-determined questions. Personal or organizational details have been removed from the interviews; instead interview results were numbered. Transcripts of the interviews can be found in appendix 4. After the findings from the external interviews, theory will be addressed that to build a solutions for SES.

4.1.1. Findings from the External Interviews

From the external interviews conducted with innovative companies in a variety of industries, a couple of interesting findings can be drawn. The interviews were all performed at the product and service development department or organizations that have B2B customers either internally, thus other departments that use the developed half-products, or externally. The interviews varied in the industry they were active in and their place in the value chain. In this section we will summarize the most important findings from the interviews.

External Orientation and Knowledge Management

Technology scanning at conferences, workshops or even on the internet or shops can trigger new product development within companies. Often people within companies have a partial function as knowledge gatekeeper, they scout for technologies at various places and inform management or innovation boards of the technologies that are interesting for future products. In some cases, employees are full-time dedicated to scouting of regulation and law-making, but this is strongly dependent on the situation of the company.

Other types of information that are important during development are regulatory and customer information. These sources are very important as analyses on the subjects will determine if it is feasible or attractive to start/continue development and they influence the ‘shape’ of the product in the end. In some cases regulatory issues even determine the development process itself, as a series of steps need to be undertaken to comply with, for instance, safety regulations or ISO-standards.

Big companies that are close to the end-user perform market studies and user analysis to learn what their next products should be. The results of these studies are often shared with their supplier companies to trigger their next development. Having close contact with (big) customers can therefore provide new product ideas without great investments into market studies. Thus, experiences when working with customers can trigger ideas in the company or act as a direct input of ideas.

All of the interviewed companies tried IT-tools for knowledge management and sharing, but had meagre results. Tools are implemented to increase the easiness of sharing and retrieving of knowledge throughout the company, but in reality using personal networks to send and request information is the fastest and most efficient way to share and acquire knowledge. Formal meetings or presentations at the start of a project or at the call of innovation board or top management are an often used method to share important knowledge with the employees that need to be informed.

Idea generation

The interviewed organizations access a vast amount of sources to gather ideas and start new product development. Although much literature focuses on internal sources for ideas (thus employees and managers), in reality external sources deliver or trigger a large share of the ideas. In 3 of the cases, customers have proven a very important source for new ideas. In the fourth case, internal customers created demand for new half-products. In service development, having continuous close contact with big customers directly delivers service ideas that are applicable at that customer. These specific ideas develop via iterations with the customer and may form the basis for future standardized services.

Open innovation practices are less used as an idea generation tool as these practices more often result in input into the process along the development and not as an initiator. This is in line with the findings of Cooper and Edgett (2008) on ideation methods, where open innovation activities are neither the most favourable methods nor the most effective ones. In some cases, when engaging in open innovation activities, ideas for new products do spawn, but this is not regular practice.

Open innovation

Although open innovation practices aren't that popular for ideation methods, they are used as input throughout the rest of the development process. Knowledge from universities and private research institutes can support companies whilst searching for solutions for their product. Online communities (ninesigma.com), crowd sourcing or event organizing has proven useful to access bigger think-tanks for problem solving.

To support open innovation practices such as in-licensing of technology or more capital intensive approached as minority shares and acquisitions, employees use their personal and business networks to scout for technologies and small high-tech firms that could supplement the current developments and offerings. Finding businesses or a technology that supplement current offerings or fulfils needs can then be introduced at any moment into the development cycle, not just in the beginning of process.

Companies that are leading in their industry attempt to create networks of openness and trust via their open innovation programs (outside the organization itself). Examples of such networks are the High Tech Campus, Eindhoven or Chemelot, Maastricht (both in the Netherlands) or Connect & Develop from P&G. These initiatives involves giving start-ups, SMEs and spin offs the opportunity to

enter the network and facilitating this process. An important characteristic of such an approach is that the initiators need to be politically neutral, thus being open to anyone who wants to situate his business there. Smaller organizations can use networks set up by others or access open innovation networks such as ninesigma.com.

These approaches allow technologies, projects or even entire start-ups to flow into and out of the development funnel at different stages of innovation. Implementing an open view on innovation does however involve developing an IP strategy to ensure that no technologies get stolen or that patents from others are violated. Trust between the all parties that are involved is necessary, without trust cooperation and partnerships will not reach their full potential.

Processes and Organization for Innovation

Within all of the studied companies, Stage-Gating was implemented for development of new products. This does make sense as research has shown that the majority of the companies that have a formalized development process use Stage-Gate (Cooper, 1994). The process was applied for both incremental improvements and radical innovations, with flexible decision criteria to make the process efficient for the type of innovation. Every company modified their Stage-Gate process slightly to fit with the environment that they operate in. In some of the cases, parallel to the development process a intellectual property rights process was initiated (filing of the idea) in order to protect the project, prevent others to engage in similar products or to gain income from out-licensing technologies.

Every company had a different structure for the organization of innovation activities. However, there were some commonalities discovered. First, radical and incremental innovation responsibilities were allocated at different places within the organization. Market or business units that are already present within the company and that have a specific product category or market focus have the responsibility over incremental innovations. This often means getting better performance from products or adjusting it to altered circumstances. Radical innovation, however, cannot be placed within the confines of existing business and are therefore hard to allocate. For this purpose, special departments or boards that perform development and have responsibility for decision making are installed. These boards were either allocated within R&D or above it.

Flexibility is an important characteristic of the innovation steering board, as fast and effective decision making is required. When ideas enter the innovation board, an initial decision to further investigate the idea is made quickly by this board and allocation of the project is performed in case the idea fits one of the existing departments or units. Having a large board with opinions from various backgrounds slows this process down. Therefore decision on ideas are performed at a small group of high seniority managers and in consecutive stages, only those who are considered expert at the decision is at hand are invited for the gate meeting. The board should involve cross-functional (part time) members, so that members for decision making can be selected if they are concerned with or experts on a topic. This can also involve the use of external consultants if knowledge is lacking within the organization.

Portfolio management is an important criteria in decision making and strategic plans, as management or decision boards decide about the mixture of projects; balance between incremental and radical innovations, long- and short-term projects, explorative and exploitative learning etc. Every company has its own approach for selecting the projects. Most of them also appear in the

innovation portfolio management research by Cooper, Edgett and Kleinschmidt (2001). Such approaches include graphs that display potential against fit with current capabilities and scoring card methods.

4.2. External orientation

In their research in 1978, Miles and Snow first identified for types of organizations in their innovative activities: Reactors, Defenders, Analysers and Prospectors. In the first two cases, companies are focused on internal operation and are passive towards the external environment. Both Prospectors and Analysers seek opportunities and ideas externally, where the first has better internal operations and the latter is even further focused on being at the leading end. Initial research was focused on larger organizations, but this has also been confirmed in case of SMEs (Zhang, Macpherson and Jones, 2006). In the internal interviews it became clear that SES mostly adopts a defensive approach on their innovation and external orientation (for customers and technology) is missing or not applied effectively, which is in line with literature. To move from a defensive innovation strategy towards a leading position in innovation, a stronger external orientation is required.

The use of external information requires the development of skills that allow the company to explore, acquire, store and exploit that knowledge in innovative products and services or via IP rights. In literature absorptive capacity was first introduced by Cohen and Levinthal (1990) and was based on the argument that most innovations results of borrowing knowledge and technology instead of invention. The initial definition of absorptive capacity was *"ability to recognize the value of new information, assimilate it, and apply it to commercial ends"*. The process of absorptive capacity has been refined over the years, becoming the model that is shown in Figure 8.

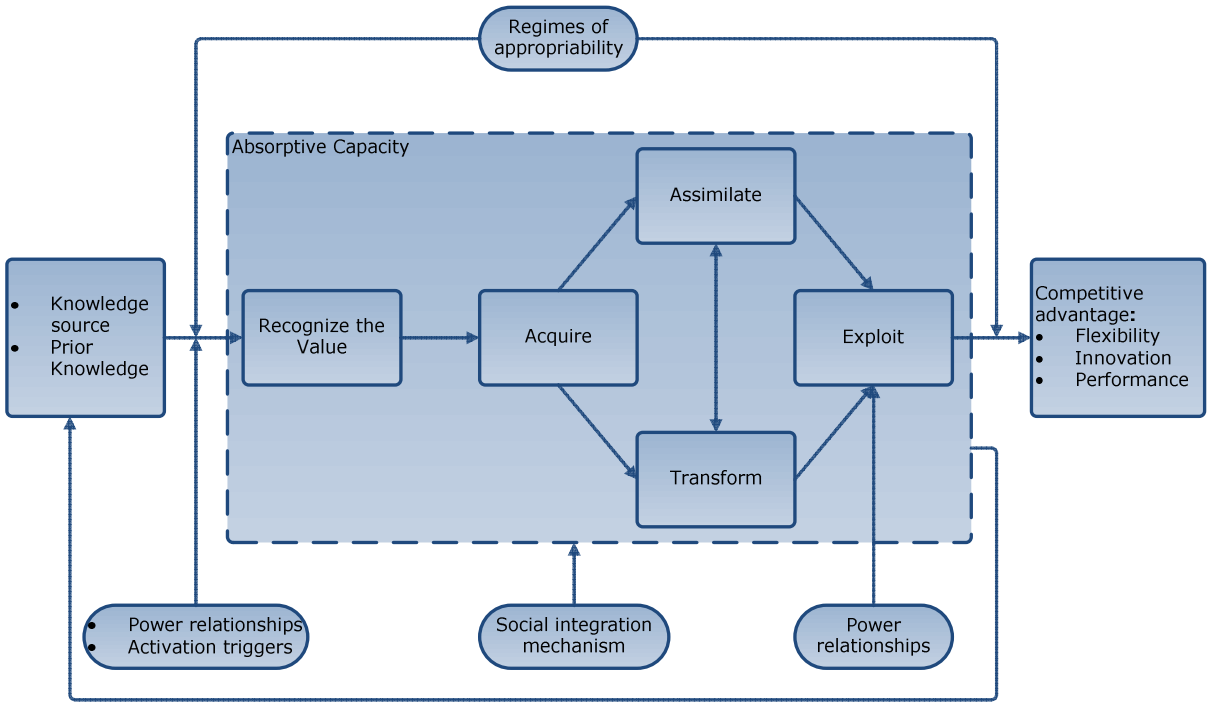

Figure 6: Absorptive Capacity model (Todorova and Durisin, 2007)

Organizations are often not able to recognize the true value of information, as they are bound by rigid capabilities, embedded knowledge base and path-dependent management. It is important that

the organization is open for new knowledge and not biased by organizational constraints (Todorova and Durisin, 2007). The acquisition of knowledge simply refers to the activities and intensity to actually acquire the knowledge, but this is useless if the potential of external knowledge is overlooked.

Assimilation and transformation of knowledge are two alternative processes of learning and creating new cognitive structures. They involve changing new knowledge and combining it with existing knowledge, or even changing existing cognitive structures (Todorova and Durisin, 2007). The latter is a result of transformation and is necessary in competence-destroying change. When knowledge is successfully assimilated and/or transformed so that it can be adopted into the organizations knowledge structures, then it is ready for exploitation. This last phase is the step where organizations translate the knowledge into new products, processes or services. This phase is thus where the actual development begins, starting with an idea gained from the knowledge and information in preceding phases.

Absorptive capacity is often defined as a set of dynamic capabilities, i.e. processes and routines that an organization has developed to make skills and resources work together and stimulate social interaction. Companies have developed social integration mechanisms that build connectedness and shared meanings. These systems have a double-edged effect: having strong ties internally allow complex knowledge to be assimilated, transformed or transferred, but might also hamper the inflow of new knowledge. Weak internal ties are more effective in case of search processes and simple knowledge (Hanssen, 1999).

Powerful actors are those people who can influence the use of external information in an organization, to achieve his preferred outcome. Internal power relationships are those that influence the use of knowledge via resource allocation. Managers can stimulate the use of external knowledge, yet rigid power systems can also hamper innovation. External relationships can be with customers and other stakeholders. Steering resource allocation and new product development processes to comply with current customer needs may cause failure to see emerging technologies. On the other hand, customers can be a source of new ideas, knowledge and skill (Todorova and Durisin, 2007). A balance in influence of power relationships need to be found to take the most out of external knowledge.

4.2.1. Types of information

Knowledge and information are two closely related terms, but are not interchangeable. The relationship between knowledge can be described as: *"Information is a flow of messages, while knowledge is created and organized by the very flow of information, anchored on the commitment and beliefs of its beholders"* (Nonaka, 1994). Thus knowledge is a stack of information held by and individual, based on his previous experiences and/or training (Choudhury and Sampler, 1997). Before and during the development of new P&S, information is used to progress through the process. Scanning for technological developments for instance, has been found to be positively related to innovative performance (Frishammar and Hörte, 2005).

What information is used is depending on the industry or project, but research has identified what information sources are most used and important at various stages of the development process. Frishammar and Ylinenpaä (2007) proposed a model for information use and sources that would benefit innovative performance. In the initial phases of NPD technical, customer needs and

regulatory information would increase performance in this stage. Later, in development and testing stages technical and customer needs would still be essential. Finally in commercialization customer and competitor information would benefit the execution of that stage. In later research, Zahay, Griffin and Fredericks (2011) discovered that the use of customer and technical information in the fuzzy front end are associated with success and that customer, regulatory and market information are such in development and testing. Findings from this research were found in the chemical industry; while high tech, not all findings might apply for SES. It however does confirm that the use of external information does improve innovative performance.

4.2.2. Environmental scanning

Recognizing the knowledge that is interesting for the company starts with an orientation into the external environment and scanning this for developments. Environmental scanning is defined as *"the activity of acquiring information"* (Aguilar, 1967) and involves many techniques. There are formal techniques such as market research and competitor analysis or formalized intelligence-gathering systems, which are planned activities that can be executed and controlled by management and there are informal mechanisms that allow information to flow into the organization continuously and more naturally, such as gatekeepers. We will now explore what activities an organization can undertake to apply environmental scanning.

Gatekeepers

In the vision of Tushman and Katz (1980), information from external sources should flow into an organization via social systems. However, acquiring and using knowledge brings a couple of difficulties. First of all, acquiring and processing external information is time consuming and expensive. Secondly, knowledge can have high specificity, meaning that it can only be acquired and used by those who already contain this or related knowledge (Choudhury and Sampler, 1997). Tushman and Katz introduced the concept of knowledge gatekeepers (not to be confused with project gatekeepers in Stage-Gate). Gatekeepers especially improve the recognition, acquisition and assimilation of knowledge in the absorptive capacity framework (Figure 8) (Jones, 2006).

Gatekeepers are individuals that are both strongly connected internally and with external domains. These gatekeepers play an important role in the acquisition and utilization of information that is available externally. They also have the ability to translate this information and knowledge to make sense of it and make it understandable for the internal colleagues. Gatekeepers keep their knowledge up to date via a variety of sources. Their personal network of researchers, friends, members of communities-of-practice, etc. provide them with a direct inflow of information. Gatekeepers can keep themselves informed by participating in conferences and reading through scientific publications. Furthermore, training and post-doctoral studies can keep a gatekeeper's prior knowledge up to date or even extend it.

Technology intelligence

The goal of technology intelligence (T.I.) is be aware of technological developments; exploit potential opportunities and defend against potential threats. This requires the delivery of up to date information about technological trend in the environment of the company (Lichtenthaler, 2003). In the end, technology intelligence includes the collection, analysis and communication of the information to those who need it in the company. Technology Intelligence can thus be seen as a

social integration mechanism, as it stimulates elements of acquiring, assimilating and by stimulating sharing of knowledge it also increases the possibility of exploiting it (Figure 8).

Technology intelligence has been around since the 1960's and has been under development ever since, distinguishing 3 generations with the earlier ones being less successful. The latest generation can be characterized as in Table 1. The extent of the implementation of these practices is of course depending on the investments in R&D and the company size itself. When investments and R&D departments are small, the corporate T.I. doesn't have a coordinating role, but it is supported by T.I. in business units. Thus more focused on corporate decision making and long term technological planning in business units. Also the level of internationalization in R&D influences the structure. When little internationalism is present and R&D is small, the T.I. unit in the home country coordinates the activities in other units/countries as listening posts. These international T.I. posts provide the information needs in the home country (Lichtenthaler, 2003).

Conclusions that Lichtenthaler took from his empirical research further were that tools such as product technology roadmaps and scenario planning are necessary to get the most out of T.I. Furthermore, decision making moments in planning and resource allocation are a communication platform for information, to assess it and to determine further needs. Informal methods try to stimulate autonomous information gathering by employees/researchers. This can be stimulated by communicating strategies, employees can than filter what information is needed to fulfill the strategic targets.

Characteristic	Third generation T.I.
Focus of Technology Intelligence	• Strategic and operational focus, integrating technology and market aspects • Proactive and reactive to needs in decision making and planning processes
Organization of Technology Intelligence	• Globally present T.I. units at both corporate and business unit level, loosely coupled to decision making at various levels. • Corporate T.I. supports top-management in decision making on a narrow scope. • Uses structural, hybrid and informal methods in parallel, yet structural gathering takes a coordinating role and limits to information not gathered by researchers (Gaps).
Approach to identification of information need	• Participation in decision-making processes and interactions with its 'customers'
Approach to information collection	• Applying structural, hybrid and informal information collection methods • Structural is applied in planning or resource allocation projects
Approach to information evaluation	• Qualitative and quantitative methods. • Intelligence specialists and researchers
Approach to communication	• Mainly via oral presentations • Influencing decision-making through participation

Table 1: Characteristics of Technology Intelligence activities (adapted from Lichtenthaler, 2003)

4.3. Idea generation

Innovation, both radical and incremental, and the exploitation of gathered knowledge starts with an idea (Schilling, 2008). As only a small part of the ideas that are initially introduced into the innovation funnel reach the market and become a success for the company, sufficient ideas need to be introduced into this funnel. On average 1 in 6.6 ideas will become a marketable product (Barczak, Griffin and Kahn, 2009; Griffin, 1997); this includes both radical and incremental innovations. Of those ideas that make it to the launch, only 58% will become a successful product. Some processes describe idea generation as a part of the development process; others see it as a trigger to start the process or part of in initial phase called the "fuzzy front end". Either way, without an idea development will not happen.

Often companies, especially in the service industry, rely on ad hoc idea creation. These companies believe that they can generate new ideas whenever it is needed and there have no formal mechanisms to generate ideas on continual basis (Montoya-Weiss and C'Driscoll, 2000; Kelly and Storey, 2000). In contrast with this measurement in the industry, scientific studies have proven that idea generation and screening are critical activities for a company (Barczak, 1995) and that the best performing firm apply formal, planned activities to generate ideas to fill gaps in the portfolio (Barczak et al., 2009). At SES this idea generation is not delivering sufficient input. In the past brainstorming activities have been utilized for idea generation, but these turned out to be quite ineffective and were experienced negatively by the employees involved. NSI had the role of drop off point or suggestion system and idea management in the past, but popularity became lower as the process matured. What also was discovered, is that SES only applies internal sources (employees) for idea generation, whilst literature argues that there are several sources of innovation and techniques to acquire these ideas (Cooper, 2008).

Ideas can come from many different sources and can spawn in different ways. Probably the most applied approach to actively gather ideas is internal idea generation, meaning that the company applies practises to trigger creative thinking and motivate employees to submit their ideas (Cooper and Edgett, 2008). Examples of these approaches are brainstorming/-writing sessions and internal idea competitions. Another internal input into the NPD process is basic and applied research into new technologies, which then is a platform for a range of products. Research/discovery of a new technology requires a different environment than NPD does and is mostly located in research facilities or departments (Cooper, 2006). Researchers suggest that technological discovery also requires a different process and approach than for NPD, but basic and applied research is minimal at SES thus developing a separate process would not improve the input of technological discovery from internal sources.

While both previously mentioned approaches are internal, external orientation is needed to make the successful. An idea is composed out of two components: functions (or customer needs) and forms (the solution to address a need). The search for ideas can be classified in three ways: (1) *Need Spotting* – identification of a need and de search for a fitting form; (2) *Solution Spotting* – identifying a form and searching for suitable need (or discovering them concurrently) or (3) *Mental Invention* – basing the idea on a cognitive processes and a decision to innovate without market attention, e.g. generalizing a predefined function-form relationship. If an idea can't be classified in any of the three groups, the quality of the idea is reduced drastically (Goldenberg, Lehmann and Mazursky, 2001). Another way to search for ideas is following a market trend or competition, but it results in me-too

products and doesn't generate novelty. Empirical research confirmed that the products that started from a mimicking perspective were more often considered unsuccessful, as was the case for innovators working in isolation from market stimulus. Opposite from this, products based on idea that were triggered by a need and met by a solution or vice versa were often considered a success (Goldenberg et al., 2001).

Having a customer orientation (thus external focused) or technology oriented (internal focused) strategy increases the novelty of the ideas. A competitor orientation, searching for competencies to protect and weaknesses to exploit, neither influences the novelty or volume of idea generation. In general, having a market searching behaviour to spot needs increases both novelty and volume of the ideas (Spanjol, Qualls and Rosa, 2011; Alam, 2002; Von Hippel, 1988). Empirical research has also proven that having a market oriented culture, thus identifying latent customer needs and defining product advantages over existing product early on, leads to bigger product advantages and make product launch activities more proficient (Langerak, Hultink and Robben, 2004; Ernst, 2002).

4.3.1. External oriented idea generation

Ideas can pop up at employees at any given moment when discovering a need or finding a solution to address a need, hence the success of the idea box in the past. However, companies can't rely on ad hoc creation of new ideas, as they need a constant stream of innovations into the market to stay competitive (Barczak, 1995). Companies need to shift from only identifying ideas to an active role in stimulating the generation and explicitly formulating them (Björk, Boccardelli and Magnusson, 2010). Therefore, companies use different techniques to address various sources for ideas. Besides internal approaches for idea generation, Cooper and Edgett (2008) research the use of other sources and approaches categorized as Voice-of-the-Customer (VoC) and Open Innovation methods. Both adopt an external search for ideas, but differ in the way ideas are acquired. The first is often used to discover the (latent) needs of customers and end-users. The latter addresses other sources than customers and tries to acquire readymade ideas from external sources to feed the innovation funnel.

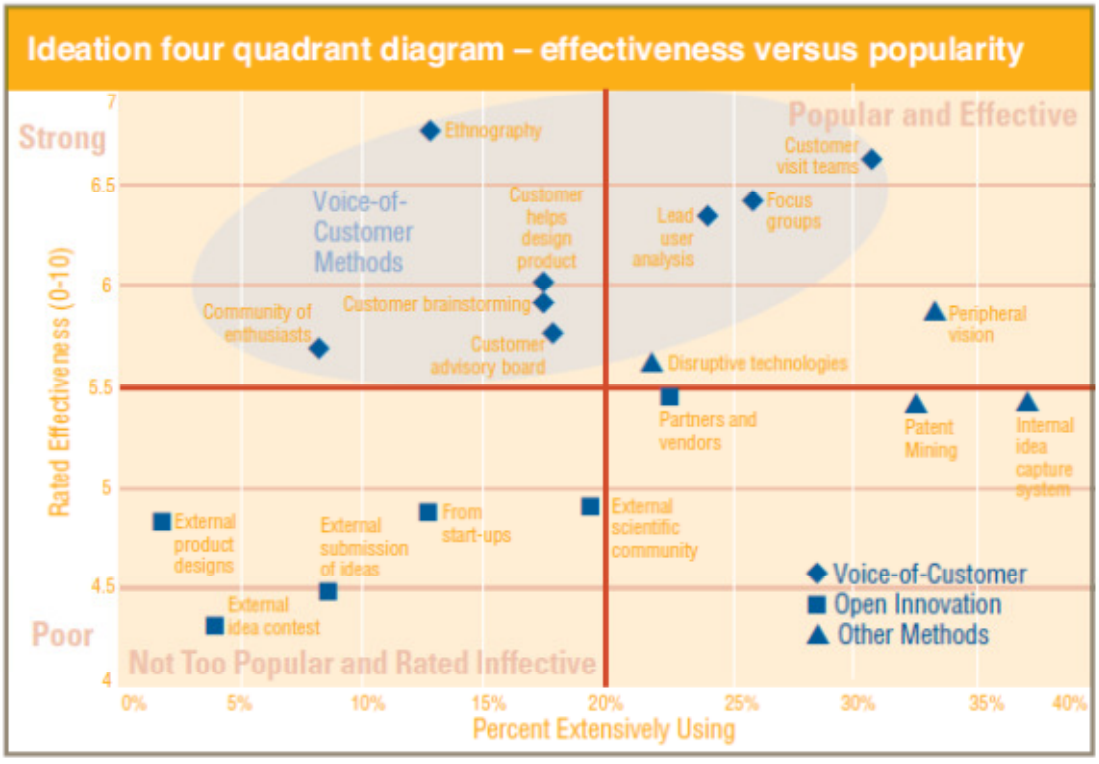

Figure 7: Ideation methods on popularity and effectiveness (Source: Cooper and Dreher, 2010)

Open innovation addresses more than the input of ideas, it proposes that companies should make their funnel for innovation permeable to the external environment at any stage of the development process (Chesbrough, 2003, 2006, 2011). The application of Open Innovation in P&S development will be discussed further in this research. Finally, there are some other approaches that cannot be classified in either category, but that do address an external search. Now we will discuss a number of the approaches that could be applied at SES. An overview of the most prominent ideation methods and the effectiveness are shown in Figure 9.

SES has performed **voice of the customer researches** in the past, but these had other intensions than gathering ideas from customers. The VoC studies that were executed in the past were purposed to discover customer satisfaction, performance measurement and superficial desires. VoC-studies are effective tools for both *need spotting* and *solution spotting*, and there are several methods to discover these opportunities at the customer. The most important ones are discussed by Cooper and Edgett (2008) and Cooper and Dreher (2010) and can be found in Table 2. Appendix 5 briefly explains the attributes of the VoC (and other) methods that were covered in scientific research on VoC techniques.

In their research, Cooper and Edgett (2008) have also described a number of **open innovation methods to search for new ideas**. In practice these approaches are adopted quite rarely and are deemed less effective than VoC approaches. This can be caused by the fact that they are relatively young compared to other approaches. Companies are still implementing them and improving the practices to gather ideas these ways. On the other hand, open innovation practices are more suitable in the design phase, where problems can be defined more easily and more specific technical solutions be sought for (Blackwell and Fazzina, 2008).

There are a number of **other approaches** that do not fit in one of the previously mentioned categories. The best known approaches are internal brainstorming sessions and internal idea capturing, but as these are practiced already and the focus in this thesis is on external orientation, they are kept out of the scope of this research. There are a few other methods which can be practiced by management to gather new product ideas:

VoC studies	Open Innovation	Other
Ethnographic research	Partners and vendors;	Peripheral vision
Customer visit teams	Addressing external communities	Disruptive technology spotting
Customer focus groups	Research centres and universities	Patent mapping
Lead user analysis	Scanning for SMEs and start-ups	
Customer brainstorming	Crowdsourcing	
Customer advisory board		

Table 2: Idea generation approaches

In this section it was discussed how ideas spawn within organizations and of what elements an idea consists. This has led to several approaches that are tried by businesses to increase the number of ideas they capture. These practices have been evaluated by Cooper and Edgett (2008) and were briefly explained in appendix 5. In section 4.6.2 a prioritization for these approaches will be made for SES.

4.4. Open innovation

With the introduction of Open Innovation by Henry Chesbrough (2003), a new paradigm for innovation was born. No longer did companies rely only on internal capabilities to create innovations. Over time firm boundaries have become permeable, as knowledge and skills are flowing in and out of organizations, and thus its innovation funnel, much more easily. Both Stage-Gate and open innovation affect the innovation funnel, so there is much synergy between both. Modern organizations therefore adapt their activities around stage-gating to handle the flow of ideas, IP, technology and totally developed products into the company from external sources. This not only do they let knowledge flow into the funnel, they also let unused projects, IP and product flow outward (Cooper, 2008).

There are a number of arguments why open innovation is becoming more important in the current innovation environment and statements how this should be executed. These have been listed by Chesbrough:

- Building a better business model is more important than being on the market first.
- Research does not have to originate internally in order to be valuable to the company.
- 'Not all smart people work for our company, we should tap into knowledge and expertise outside the organization'.
- External R&D is valuable, but internal R&D is needed to capture a portion of this value.
- The best use of both internal and external ideas will make us win.
- 'We can profit from other's use of our IP and buy other's IP when it increases value in our business model'.

The difference between the traditional closed innovation and open innovation is that in the first inputs come mostly from internal sources and sometimes from observation of external ones (customers). R&D departments then proceed with inventing, improving and perfecting technologies for further development in the products. In the latter companies look outside-in and inside-out during the ideation/discovery, development and commercialization stages to create value (Docherty, 2006). The various stages and the way open innovation is applied can be found in Table 3. At SES open innovation isn't practised as a standard approach, although O3b was an example of open innovation in initial stages of a project. Companies often only apply open innovation in the initial stages of a project, the fuzzy frontend (Lindegaard, 2011). However, open innovation can bring value throughout the entire development process.

4.4.1. Open innovation networks

Although work by Chesbrough has mostly been theoretical and academic, there are several practices that can be applied to start the flow of ideas, technology, knowledge and expertise in and out of the organizations. Very important for open innovation is to build or access a network of innovators. These networks can have various shapes and can consist of different types of nodes. Figure 10 shows the type of nodes, the distance in the network and the kind of relationships in an open innovation network. We will briefly discuss what type of players or networks can be established or accessed (Blackwell and Fazzina, 2008).

Stage(s)	Open innovation	Partners/Approach
Ideation/Discovery	Look beyond own employees creativity and customer unmet needs and problems for new ideas.	• Ideation consultants • Pre-qualified networks • Business partners • Universities • Crowd-sourcing
	Search the inventors, start ups, small businesses, partners and other sources for available technologies; which can be used for internal or joint development	
	Solicit for ideas at external communities	
Development	Search for solutions for technological problems at scientist outside the organization's barriers.	• (Embedded) suppliers • Non-qualified networks • Pre-qualified networks • Business partners • Universities • Crowd-sourcing
	Acquire already productized innovations for own solutions.	
	Let internally developed IP that isn't used in further development flow out of the organization via out-licensing.	
Production	Suppliers can contribute best practices from similar customers.	• (Embedded) Suppliers • Pre-qualified networks • Business partners • Crowd-sourcing
	Support in design phases to prevent production issues in later stages.	
Commercialization and Launch	Finalized products that have more value when exploited elsewhere can bring better value to the company when sold or out-licensed.	• Channel partners • Pre-qualified networks • Business partners • Crowd-sourcing
	Using pre-developed distribution channels can bring extra value or a bigger market.	
	In-licensing or buying complete products might bring immediate sources of growth or might support sales of complementary products.	

Table 3: Open innovation in NPD (Cooper, 2008, Blackwell and Fazzina, 2008)

There are several types of categories of networks or type of players that can be accessed for open innovation activities. Some organizations invest capital and effort to build their own network of innovators, consisting of several types of players to cooperate with. An example of a multinational that built its own network is P&G, with their Connect&Develop program. Their network operates worldwide and includes entrepreneurs, SMEs, individual innovators, research institutes, suppliers, customers and everyone who thinks he/she can contribute with their knowledge or capabilities. Every player is checked before access to the network is given to prevent incorrect behaviour. Connect&Develop provides a platform where P&G can formulate their problems, demands or available technologies, and where all players can communicate and contribute (Huston and Sakkab, 2006).

Some organizations approach the network building differently, by initiating physical colocation (or campuses). Major organizations that are influential in their industry prepare facilities and real-estate where SMEs or start-ups can settle their business. Examples of such campuses are the high-tech campus by Philips or Chemelot by DSM in the Netherlands. By doing this, small businesses get an opportunity to enter existing networks of innovators, get affordable access to technical facilities and

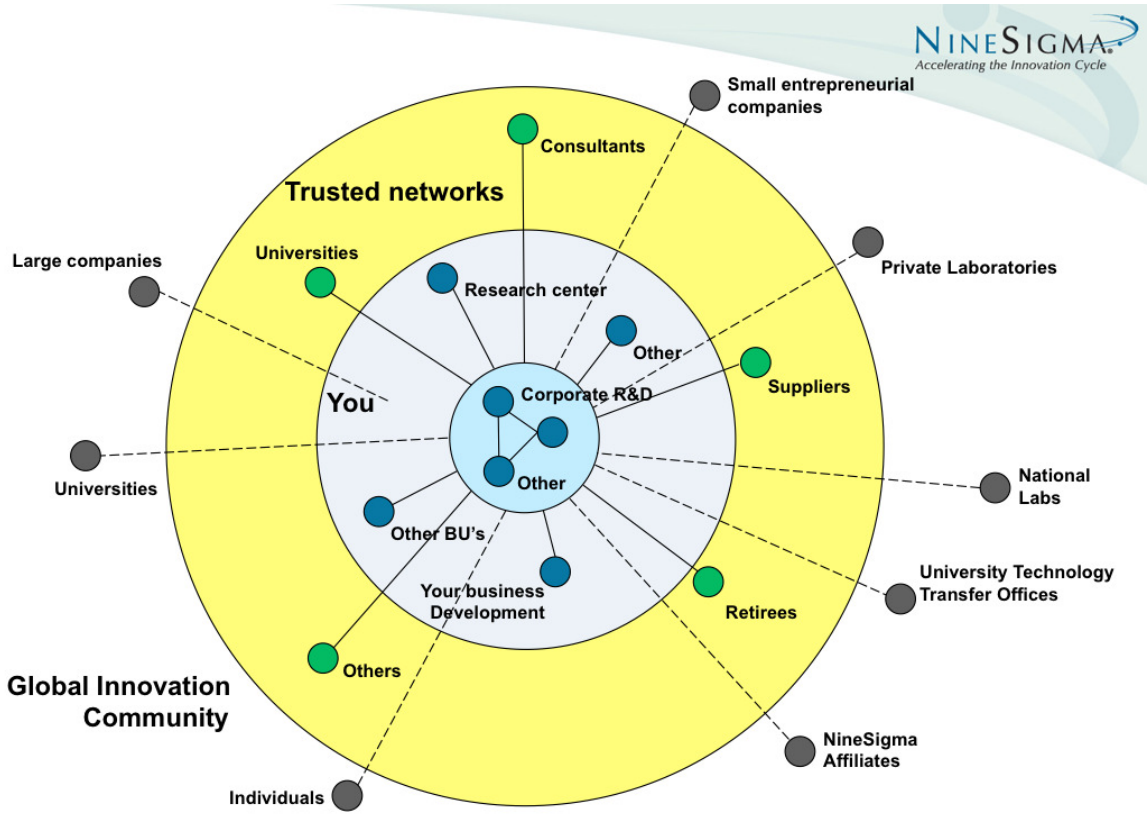

Figure 8: Type of nodes in an open innovation network. (Source: 15inno.com)

have direct contact with a multinational. For the multinational, advantages are that they can apply their IP externally via entrepreneurs or spin-offs; they have easy access to new ideas en promising businesses (venturing or acquisitions); and get more out of existing facilities by renting them out to small businesses. By creating such a campus, the initiator tries to create an ecosystem where ideas and technologies can spread easily, thus increasing innovative performance through cross-fertilization.

Both of the previously mentioned options are mostly exercised by large multinational companies, as they require large capital and human resource investment. These may therefore not be attractive to smaller companies. Yet, these businesses can still benefit from open innovation without investing massively in network or campus building. They can access existing networks or approach other players in their already existing contacts. Examples of these connections are shown in Table 4.

Network/Player	Explanation	Advantages	Disadvantages
Non-qualified networks	Large online communities of innovators that are managed by a third party (e.g. ninesigma.com, innocentive.com)	• Enormous network • Cheap access	• Problems with IP • Not checking players • Specified problems • Too many responses
Pre-qualified networks	Build your own network (e.g. P&G or campus) or access existing networks where qualification is needed before access	• Protect of IP • Large networks • Out-of-the box thinking	• Administrative layer • More costly
Business partners	Build open relationships and trust with business	• Existing relationship • Small partners need	• May steal ideas • May move into your

	partners, both big and small for innovative projects.	your resources • Big partners can think bigger (disruptive)	territory
Suppliers	Similar to business partners, suppliers support in development activities throughout the process	• Knows the business well • Have knowledge of other customers	• May sell to competition too • May perceive open innovation as a threat
Customers	Include the customer in idea generation, co-creation, crowd-sourcing	• Practical knowledge • Customer loyalty • High switching costs for customer	• Can be costly if not managed well
Universities	Several options for open innovation, from IP commercialization to research partnership	• State-of-the-art technology • Eager to collaborate with business	• Not useful for idea generation

Table 4: Type of networks and players (Blackwell and Fazinna, 2008; Perkmann and Walsh, 2007)

4.4.2. Issues with open innovation

There are a few issues with open innovation that make some managers hesitant to implement it. First of all, not all developments are suited for open innovation; some would best be performed via closed innovation. Besides this there are some traps that might hamper the successful implementation of open innovation within a company (Blackwell and Fazzina, 2008):

- The Not-Invented-Here syndrome makes employees reluctant to use technology that comes from external sources.
- Not having a secure approach to handle intellectual property makes employees afraid to share.
- Management's focus and endorsement is often poor. Often only one or a few employees get part-time responsibilities to apply open innovation, while it must be in the mindset of all.
- Only a few companies appoint one or more person(s) to act as a point of contact and have responsibilities for the implementation of open innovation.

Blackwell and Fazzina also discovered structural issues during implementations at various companies. A common problem experienced at companies is that they do not know how to implement open innovation, as it is relatively new and still under development. Often the way to apply open innovation in an organization is developed through trial and error.

Finally there are some arguments against open innovation:

- Finding and educating external sources to work with the company in an open innovation relationship sometimes takes more time than developing it internally.
- Open innovation can only help those problems that are identified and clear, not those that a complex and conceptual.

To address the earlier mentioned issues, a company should actively approach open innovation and change the mindset of employees and managers. Only applying some of the practices that are provided by literature and empirical studies does not mitigate the problems that have been

identified. Targets should be set how much of the innovations should come from external sources and employees should be forced to treat external knowledge as if it was generated internally. Also, people need to be responsible for the integration of external knowledge and searching for possibilities to apply open innovation in the developments. Without this shift and managerial commitment, results will be disappointing and the company will stay with internal R&D and external influence will be limited.

4.5. Product and Service development process

The objective of NPD processes is to guide the development of an idea towards its implementation or commercialization in a structured way. To create a successful product in the end, the process needs to achieve three key goals: maximizing product fit with customer requirements, minimizing the development cycle time and controlling the development costs. Outcomes of NPD should be products that achieve stipulated market share, sales growth customer use and profit objectives. In practice however, only 54,5% has a well-defined developed NPD process (Barczak et al., 2009) and about half (48,6%) of the companies, investigate in an innovation management survey by the F.A.Z. institute, told that they had troubles with NPD due to poorly developed processes (FAZ, 2009).

Between the 1960's and 80's companies started to apply phased development processes (or phased review processes). Here, innovation was broken into functional phases where each phase was another department's responsibility, all in a sequential order. These processes weren't effective as they often doubled the development time (Cooper, 2008). A more effective process for a development process was proposed by Booz, Allen & Hamilton (1982), where a project would go through a number of cross-functional stages before entering the final phase of commercialization. From this early version, a number of variations were developed, also creating several processes for service development (Scheuing and Johnson, 1989; Johnson, Menor, Roth and Chase, 2000; Stevens and Dimitriadis, 2005; Alam, 2006). Though these processes may differ internally, they all include a fuzzy front end, where ideas are captured, and close with the launch or commercialization, sometimes followed by a post-project evaluation.

4.5.1. Stage-Gate Process

The most widely adopted, 60% of the firms in the PDMA best practices study (Griffin, 1997), NPD process is the Stage-Gate model developed by Robert G. Cooper (1994, 2008). A typical Stage-Gate process consists of 5 stages, accompanied by an idea generation stage in front of it and a post-launch review at the end (Appendix 6). This process for innovation, though slightly adapted has also been installed at SES for the development of their services. The process applied by SES for NSI is found in appendix 7. During the stages a team undertakes several activities to drive down risk and develop the project. The team is required to gather vital types of information from several sources to use in the decision making during go/kill moments, otherwise known as gates (Schilling, 2008). This decision is not taken by the team, but by project gatekeepers that look at the project from a different perspective. These project gatekeepers are not to be confused with knowledge gatekeepers in external orientation.

The entire process consists of a series of stages and gates and is having several characteristics (Cooper, 2008). This process as developed in its most basic form and the associated activities are found in appendix 6. The characteristics are stage-gate are: (1) with every stage, the amount of uncertainty and reduced by gathering information. (2) Every consecutive step is more costly than its

predecessor, further increasing the project's costs. (3) Within every stage, activities are executed in parallel and by cross-functional teams. (4) All the stages are cross-functional, thus no stage belongs only to the marketing or R&D department.

Stage-Gate is applied by companies such as IBM, 3M P&G etc., because they believe that the process enables them to estimate the payback of the running projects. The approach to guiding innovative projects to the end allows companies to reduce development time, identify projects that should be killed and eventually increase the ratio of internally developed projects that turn into commercial projects (Schilling and Hill, 1998). In the end, the goal of Stage-Gate is to improve the effectiveness and efficiency (Cooper, 2008).

4.5.2. Recent Developments in Stage-Gate

In more recent literature on the topic of Stage-Gate processes, Cooper researched why the Stage-Gate processes often do not provide the results that are hoped for. Some of the most recognized problems with the implementation of a Stage-Gate process are (Cooper, 2008):

- Gates do not perform the way they are meant. After the initial decision to start a project from an idea, gates become nothing more than a checkpoint for an update. Projects are hardly ever killed in consecutive stages or gates are passed without committing any new resources to the project. These phenomenons are called "Gates without teeth" or "hollow gate" respectively.
- Bureaucracy kills the project's progress. Often it is not clear what deliverables are essential for a gate. To make their project bullet-proof, teams will gather all the information they can find. Much of it might be interesting, but not essential for the decision that has to be made. Sometimes the system itself creates a lot of unnecessary bureaucracy by demanding extensive forms and presentations at every gate.
- Wrong project gatekeepers to make go/kill decisions or bad behaviour by gatekeeper. By rule, a gatekeeper should be a senior person who owns the resources that are required in the next step. Often companies make a mistake by appointing the wrong gatekeepers; too senior managers for low-lever/risk projects or sometimes even the project leaders themselves. Also, wrong behaviour from gatekeepers can decrease process performance. Gatekeepers can show projects special treatment (pet-projects or personal decision criteria), think that one project gatekeepers knows it all, easily cancel or miss gate meeting.

At SES these problem are quite recognizable; as has been identified in chapter 3, gates have changed into check meetings is all steps in that phase have been executed. Hardly ever projects are killed after they have passed the idea screening phase. The second comment on the process that has been applied by NSI is that project managers only saw it as bureaucratic work in exchange for extra funding. For some innovations NSI was completely bypassed, as funding was arranged through personal contact with top management. For those a threat arose that they turn into pet-projects of senior managers and no process like stage-gate was applied to them.

Process Execution - In order to mitigate the problems around the implementation of Stage-Gate Cooper (2008) has argued that rules of engagement are necessary for effective gate meetings and process execution. These rules, when executed well, should prevent companies to fall back into the previously mentioned problems. The rules prescribe what is expected and what project managers, gatekeepers and others need to do. All involved personnel need to agree with these rules, before a

project can be started. Rules of Engagement that have appeared in work of Cooper are shown in Appendix 8. For such rules a company template can be created, which is applied at every innovation project that is initiated.

Setting rules for a gate meeting is the beginning of a structured and fair approach to evaluate ideas projects. However, to select which projects to proceed on and which to freeze or cancel, gate meetings have to be executed in an effective fashion. Over time many organization have applied methods to rate their projects. These methods include scorecards, success criteria, self evaluation via scorecards (on top of the evaluation by gatekeepers), use of in-process metrics and combining the selection with portfolio management. Portfolio management includes a holistic view of all projects, and screens projects against each other, though not as in-depth as individual reviews. Portfolio management can thus be applied on top of gate selection, to keep balance in amongst projects and keep on track with strategic goals.

Although in practice using scorecards isn't the most popular approach, it has been proven quite effective at several organizations (e.g. Johnsen & Johnsen, P&G). Effectively organization gate meetings and applying scoring has been studied by Cooper (2008), and is shortly described in Appendix 8. Users like the scoring method not only for the direct results, but also for the management thought-process that is effectuated by this. A scoring approach also gives gatekeepers the ability to challenge project teams. An addition to the scorecard method that has been proven at P&G is the use of *success criteria*. At every gate, the project team and the gatekeepers agree on gate-specific characteristics and their targets to evaluate the success of a project at each stage. Examples of these criteria are expected sales, launch date, expected profitability. If estimates turn out to fail on the predetermined criteria, killing the project could be an option.

Removing Bureaucracy **-** Bureaucracy led to a lot of employees not participating in the process of NSI or slow progress in projects. This problem has been identified by multiple stage-gate users, thus leading them to develop leaner processes, more flexible to adapt to the project type (Cooper, 2008). Stage-Gate is a method to systematically reduce risk along the projects progress. Gate meetings require the presence of all gatekeepers and preparation from both the team and gatekeepers. However, incremental innovations often do not need such extensive risk reduction, making some of

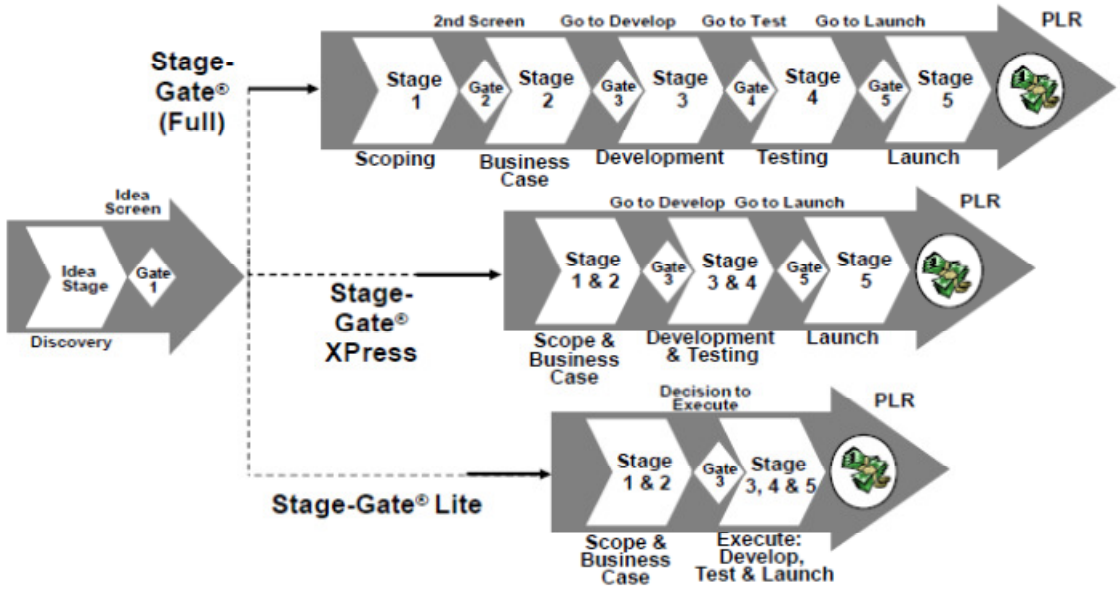

Figure 9: Three versions of Stage-Gate (Cooper, 2008)

the work redundant and some of the gate meetings unnecessary. Examples of such adapted processes have been summarized in Figure 11.

For less risky innovation projects several stages are compressed into one, reducing the total number of gates to 3. For even less risky and smaller projects, such as customer requests, a two staged/gated model is used. After an idea was discovered, managers/gatekeepers can decide what type of project it is and what process should be applied. Having a fitting process makes sure that organization do not waste time and resources on small projects, thus also frustrating the larger projects that are also competing for these resources.

4.6. Conceptual design for Product and Service innovation

In the previous sections both practice and literature was studied how external orientation and subsequent themes can influence the innovative performance within organizations. In the theoretical research, it was addressed how external orientation via gatekeepers and technology intelligence can be performed and how this supports all processes in innovation. As idea generation is the first step in exploitation of gathered and created knowledge, this step can also benefit from external oriented activities. Therefore, several techniques to systematically acquire ideas from the external environment (e.g. customers) were discussed on their applicability at SES. Project execution can benefit from an external and open vision through Open Innovation. While some innovative capabilities are missing within SES, it doesn't mean that they can't make certain innovations happen. Open Innovation helps the organization to access more knowledge and expertise than it could internally or via standard procurement activities. Finally, applying external orientation brings little improvement if an ineffective or no process for innovation is present at all within the organization. Based on experiences in the past with the Stage-Gate process, a modified process and advice for process execution was created. If all theoretical topics are combined, a conceptual framework for the design would look like Figure 12.

Within SES, Product Innovation Meetings have recently been installed to exchange information about new product and service development projects and to share and align practices for innovation over the departments. As all of the VPs who are responsible for innovation are present during these meetings, it is also a fitting place to initiate change in responsibilities and project execution. Currently a period of transition and shaping of activities is happening, thus a good opportunity to discuss

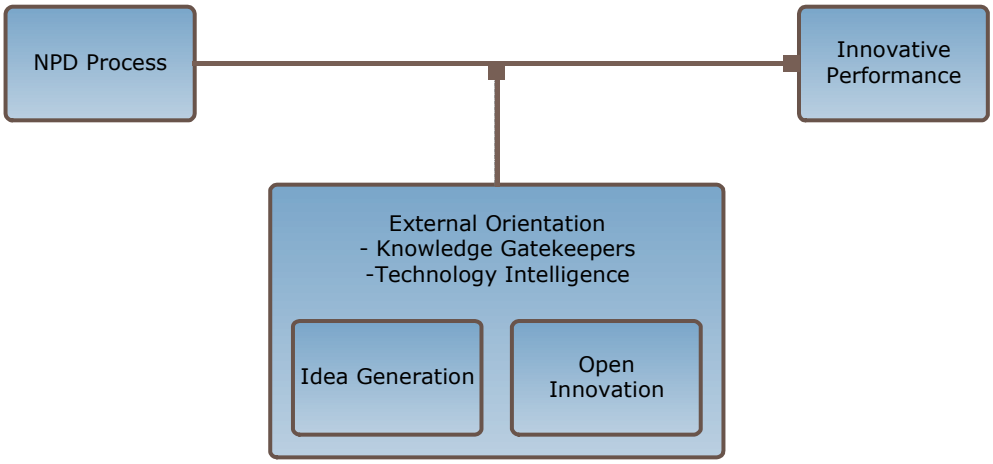

Figure 10: Conceptual framework of the solution design

external orientation for adoption. In the next sections we will discuss how SES/PIM can integrate External Orientation, Idea Generation, Open Innovation and NPD within the innovation activities in Product and Service development.

4.6.1. External orientation

Whilst market intelligence already has dedicated employees to gather information for new products or business case studies, technology or customer needs are studied less or only on an ad hoc basis. There definitely is room for improvement in information gathering and external orientation practices. In the framework of absorptive capacity, power relationships were mentioned as influence on the flow of information from external knowledge sources towards recognition and acquisition internally. Internal powerful actors are all members in PIM, as they have much influence in their own department and decision making on high levels. Therefore, PIM can influence the absorptive capacity internally.

Implement Knowledge Gatekeepers - A first step to extend SES' view into the external environment is to give employees a role as knowledge gatekeeper. Throughout the departments that are represented in the PIMs, there are employees with specific technical backgrounds, who keep themselves informed of the developments in their speciality. Current shortcomings in the organization are that these employees do not have the explicit responsibility to keep track of this knowledge and absorb this into the company's knowledge base. Gathering knowledge is thus done incidentally, for personal motivations and only shared with a limited group. For this reason, knowledge might not reach decision-makers or those who might need it in the project.

To successfully implement knowledge gatekeepers, VPs in PIM should assess who the technological specialists are, as knowledge of a field is necessary to be a gatekeeper. With an overview of the technical backgrounds at SES, managers can also discover where potential gaps in the knowledge base a present, thus which capabilities should be brought in-house. When employees are selected to perform the role of gatekeeper as a part-time function, they should get explicit responsibilities and reward schemes to incentivise them.

Not only do gatekeepers need to gather knowledge, they need to select that which is valuable and interesting for the organization, translate it so that others within the organization can understand it and actively communicate the developments in technology. ICT systems such as intranet or e-mail usually have little effect on the spread of the knowledge. Oral methods are preferred in practice as messages come across much better and information can be transferred much richer. Therefore, a monthly (or weekly if developments are quicker) presentation round of the latest developments should be organized, where managers for the department and other developers attend to inform each other of these technologies.

The PIM platform is an ideal moment to discuss interesting technological developments. As VPs are informed of the developments in technology by their gatekeepers, sharing these findings in PIM facilitates decision-making around existing projects and new ideas. Thus, applying gatekeeping allows SES to build a shared knowledge base about the latest technologies and allows communication of technological developments towards top management.

Implement Technology Intelligence - To structure the search efforts for information about technology, one or more dedicated information specialist(s) should be appointed. Such employee(s)

not necessary execute all the search efforts themselves, but will coordinate information gathering activities from gatekeeper. It is their task to inform top management about the developments in technology, markets and customer needs. These specialists are thus present during decision-making meetings or strategic planning to support management with the right information.

They also have an active task to discover needs for information and gaps in the knowledge base of the organization and in turn coordinate activities to fill these up. By implementing practices as gatekeepers and information specialist, SES can actively scan the environment outside the organization on the latest developments in technology and assimilate this knowledge internally. By sharing the information via internal presentations it will become part of the company's knowledge base, not just of the individuals.

Although creating a function as information specialist isn't within the mandate of PIM, the meeting consist of several VPs throughout the organization. Recommendations from PIM's chairman should thus be taken into account by the EC, thus a push for technology intelligence can be given by PIM. As other forms of information (from the market) are already gathered by team within SES, activities as technology intelligence are an extension, creating an intelligence/information department. Implementing gatekeepers and technological intelligence creates so called antennas in the external environment and stimulates the spread and use of this knowledge internally, thereby increases the absorptive capacity, which in turn positively influence flexibility, innovation and performance (Figure 8).

4.6.2. Idea Generation

Every project starts with the introduction of an idea. At SES ideas were only collected from employees, which were then mostly based on mental invention. In other cases, projects were started to defend the position of satellite TV by developing product and service attributes that are offered by competitive communication technologies. Only a limited amount of ideas spawned from the discovery of a need filled in by a form of technology or vice versa. Yet ideas with such backgrounds are often more powerful and successful than the earlier mentioned. Based on this finding, there is definitely room to improve idea generation by introducing an external focus into the fuzzy front end.

Introducing technology intelligence and gatekeeping to open up the eyes towards technological developments in the external environment allows the company to spot trends and act on those, but it also give SES to possibilities to discover and create forms of technology for solutions. This however is only one side of idea generation for innovation, as discovery of a need is necessary too. In section 4.3 several sources and practices to discover new ideas were discussed. These practices originated from a best-practices study by Cooper and Edgett (2008), which gave insight into their effectiveness and popularity. Idea generation techniques not only aimed at the discovery of needs, but also on readymade ideas from customers or via open innovation techniques. Although Cooper and Edgett made a graphical overview of the practices, not all are very applicable or effective in SES' case. Therefore a prioritization of techniques was made for SES (Table 5).

	Voice of the Customer	Open innovation	Other
Recommended	• Customer Visit Team s • Lead user analysis • Customer Brainstorming (already performed)	• Suppliers and Partners • Addressing External Communities	• Peripheral Vision (already performed)
Neutral	• Customer Focus Groups • Ethnographic Research	• Research centres and universities • Scanning for SMEs and Start-ups	
Not recommended	• Customer Advisory Board	• External Idea and Product Submission	• Patent Mapping • Disruptive Technologies

Table 5: Prioritization of idea generation techniques

Voice of the Customer studies for idea generation **-** VoC studies are very useful to discover needs at current or even potential customers. As shown in Table 5, there are multiple methods to capture problems, needs and wants at customers or even get clear-cut ideas. At SES none of these are methods are practiced. The company does perform a yearly VoC study, but this involves a big sample of the customers answering superficial surveys. Findings from the current VoC study that provide some information about innovative practices are shown in appendix 3, where it can clearly be seen that the study doesn't provide much in-depth information on needs for potential new products or services.

VoC studies are currently the responsibility of the commercial departments and findings are shared very carefully, as they contain sensitive information on the company's performance. The findings from this study are thus not very useful for the departments represented in PIMs. Therefore, PIM should approach the commercial departments to further develop these VoC studies, so that the results are more broadly applicable within the company. To enhance the study, the organizing team should not only try to capture as many respondents as possible, they should also target a smaller group of companies for in-depth studies. These companies should be visited by a team of SES employees with different backgrounds, so that all elements of problems can be discussed and understood. Accompanied by the visit teams, in-depth questionnaired need to be developed in order to capture latent needs, as some customers will have difficulties to make their needs explicit.

As commercial departments are closer to the customer, it will be easier for them to identify lead users in the existing customer groups. However, lead users not only exist within the current customer group, but also in analogue industries. To discovering which companies are at the leading edge (in the same or analogue industries), market and technology intelligence can analyze what trends in the market and technological developments are, and consecutively discover who the leading users are. As not all lead users are willing to share their information to anyone (they might not benefit from it), they should be approached carefully. It will be a task for PIM to approach these lead users and organize workshops to extract their knowledge.

Besides gathering valuable information and ideas for new developments, the VoC approaches have a second advantage. By interviewing customers in-depth, a mutual understanding of problems and each other's situation is created, and customer feel listened too. Not only does it provide advantages for development departments, by improving the relationship commercial departments experience benefit too.

Open innovation for idea generation **-** Although customer needs and wants can spawn great ideas, there are more methods to gather ideas from external sources. In their best practices research, Cooper and Edgett (2008) addressed several open innovation methods to collect readymade ideas. A drawback from the research was that open innovation practices were relatively new to companies, thus popularity and effectiveness were still rated quite low. The external interviews confirmed that open innovation practices are less popular than VoC studies, especially for B2B companies in high tech industries.

As VPs and thus members of PIM are responsible for the amount of innovation they produce, they require sufficient input of ideas. Therefore, PIM can initiate open, where they actively solicit for ideas. Although some open innovation practices might not be as effective in idea generation as they are in later phases of development, there are some that can be initiated by PIM. First of all, not only customers can be addressed for ideas, suppliers and partners are also valuable sources of technology or complete ideas. Even if a need was discovered at customers, they can be addressed for technical solutions. On the other hand, suppliers and partners can deliver ideas for form of their technology at SES. As managers in PIM have extensive business networks, they can actively solicit for ideas or technical solutions, or stimulate suppliers and partners to actively propose ideas.

Not only can suppliers and partners be addressed, but there are more opportunities to gather ideas or technical solutions to form an idea. Large online communities such as ninesigma.com, innocentive.com can be addressed with fairly little effort and investment. Perhaps more valuable and reliable are pre-qualified networks, but these require selecting and accessing first. With these approaches, on top of internal idea gathering, PIM has several methods at its disposal to gather enough ideas. It should therefore be PIM's responsibility that enough ideas are collected on a yearly basis.

4.6.3. Open Innovation

Although open innovation was already addressed for idea generation techniques in the previous section, both the external interviews and the best-practices research on idea generation suggest that open innovation is more valuable in later stages of the development. Implementing open innovation within project execution allows the organization to innovate into products and services, whilst not having the innovative capabilities internally. It thus allows P&S to be developed without big and risky investments to develop all capabilities. Instead it allows SES to specialize in selected capabilities. Further advantages of open innovation for SES are that it can improve time-to-market; it allows SES to reduce risk by delaying financial commitment and allows monetization of unused ideas or technologies.

The advantages make project and process execution more efficient and more effective, as it allow the process to be faster and create more output. Open Innovation is not structurally practiced at SES, but performed on ad hoc basis and often unconsciously. As PIM is a platform where practices can be exchanged and introduced, it is able to initiate open innovation practices at SES. First, target must be set on how much external involvement should be achieved in the projects throughout P&S development. Second, as VPs have extensive business networks, they can provide their project managers with connections that might benefit the execution of projects.

This alone however may not motivate project managers and members to think in an open innovative way. To stimulate open innovation, SES should build a network of innovators, SMEs, entrepreneurs,

researchers, partners, suppliers, universities and customers to cooperate with during development; but this is time and resources consuming process that might be too expensive for SES. Instead, PIM managers should look from which existing external networks projects internally could benefit. After gaining entrance into these networks, employees should be pushed to interact with these networks by posting cases and responding on demands from others. Active collaboration is necessary or other network players might lose interest into collaborating with SES.

Providing external network connection for employees and stimulating them to use these via targets and rewards will introduce an open innovation mindset. Maintaining the networks and finding opportunities for open innovation is a task that might not fit into the responsibilities of VPs within PIM as they have extensive responsibilities already. Therefore, PIM could advise the EC to- or create a function of open innovation specialist itself within the departments. Such a specialist would be responsible for:

- The maintenance of the networks;
- Actively searching for opportunities to use internally created IP or ideas;
- Scanning SMEs and start-ups for new products or services that can be absorbed;
- Helping projects at soliciting for externally created solutions;
- Routes information and requests that come in from external partners.

Such a function does not per se require hiring new employees who are specialized; it can also be a team of current employees who have the part-time responsibility to introduce and facilitate open innovation practices.

To radically implement open innovation, large and resourceful organizations start development of technology parks, or open innovation campuses. Through colocation of start-ups, SMEs and business units, companies want to initiate cross-fertilization of and have access to the latest technological developments in their field. Another benefit of these campuses is that the initiating organization can make their expensive facilities more valuable by renting them out to small businesses. For SES, building its own campus at Betzdorf might not be a realistic option. It requires extensive capital and human resource investments and its remote location might not be interesting for start-ups or other businesses. Instead, the EC could investigate which existing technology parks are interesting for SES and move (part of) the development activities to such a campus. This is a radical step and should therefore be studied carefully, but physical colocation with other businesses will have a big impact on the innovative performance.

4.6.4. Development Processes

As mentioned in the explanation of the framework for the solution design, a well-functioning process is necessary to make changes in external orientation effective. In the old structure of SES, NSI had developed a stage-gate like process to guide projects from an idea towards implementation or launch. This process had a few flaws, as it was conceived bureaucratic showed symptoms of ineffective gate execution. Since NSI doesn't exist anymore, there is an opportunity to revise the process while PIM is being implemented. Eventually a standardized process for development of new products and services is necessary throughout the organization.

The problems that were found at SES with stage-gate were uncovered more often at other organizations. Therefore, Cooper revised the process and researched how successful companies

tackle these problems. From these methods, advices for PIM have been derived. First, to make gate meetings more effective, PIM should set up a *rules of engagement* document, which both the project team and the gate decision-makers should stick to. These rules can thus be derived from the list formulated in appendix 8. Secondly, department leaders should appoint the right gate decision-makers (from now called *project gatekeepers*). For projects with lower risk, decision-making at gate moments can be performed by managers of lower seniority, not by VPs. At NSI project gatekeeping was performed by all VPs while this was not always necessary. This meant that valuable time was taken by less risky projects from those which might need it. In the context of PIM, when projects do not fit into any of the existing departments then PIM is a platform to discuss progress in these projects. However, not all VPs should be involved in project gatekeeping. During the start of a project, decisions who should be project gatekeepers must be made in PIM though.

As projects at SES vary a lot in nature (e.g. product vs services, incremental vs radical), a certain degree of flexibility is necessary. Although every step has its requirements, not every project needs those requirements. Incremental projects require less rigorous pre-development studying and some stages can be executed concurrently, while services require different development work (for instance the creation of service blueprints). To build this flexibility into the process, after deciding that the project receives a GO, teams should set up what deliverables are expected at the end of the new stage. Project gatekeepers should find agreement on these plans with the team and judge on those deliverables. To prevent subjective judgement during gate decisions, SES should employee scorecards. These scorecards need to be developed internally and consist of a number of standard criteria and criteria for success from past projects. VPs in PIM have sufficient experience with projects in the past and are therefore ideal to develop these criteria. It should be prevented to create an abundance of criteria, 6-10 is ideal. With these criteria, project teams know what information they need to present, thus preventing them from creating bureaucracy themselves.

To build even more flexibility into the process, a scalable process was suggested by Cooper (2008). To start discussion how to remodel the process that was applied at NSI, a new model for the process was created. The model shown in appendix 9 is based on both literature and practices in NSI in the past.

4.7. Implementation plan

The focus for the implementation of the recommendations that were made in this thesis is on PIM as this is a platform where information is shared and practices for innovation are discussed. Having such a platform is a necessary first step for implementation on a companywide scale. While every department that has its own explicit responsibilities for innovation, PIM can provide standardization and overview in the practices and projects.

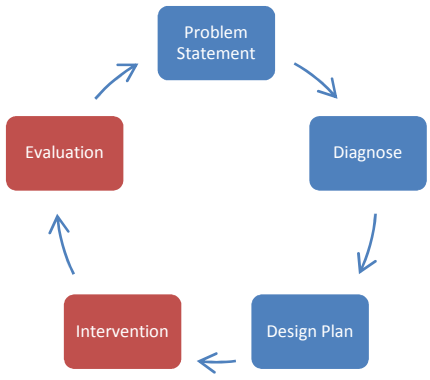

Figure 11: regulative cycle

The next step regulative cycle (Van Aken et al., 2008) consist of the implementation of the designed solution at SES, also known as the intervention (marked red in Figure 13). Although this step is the responsibility of SES, a plan can be made to structure the

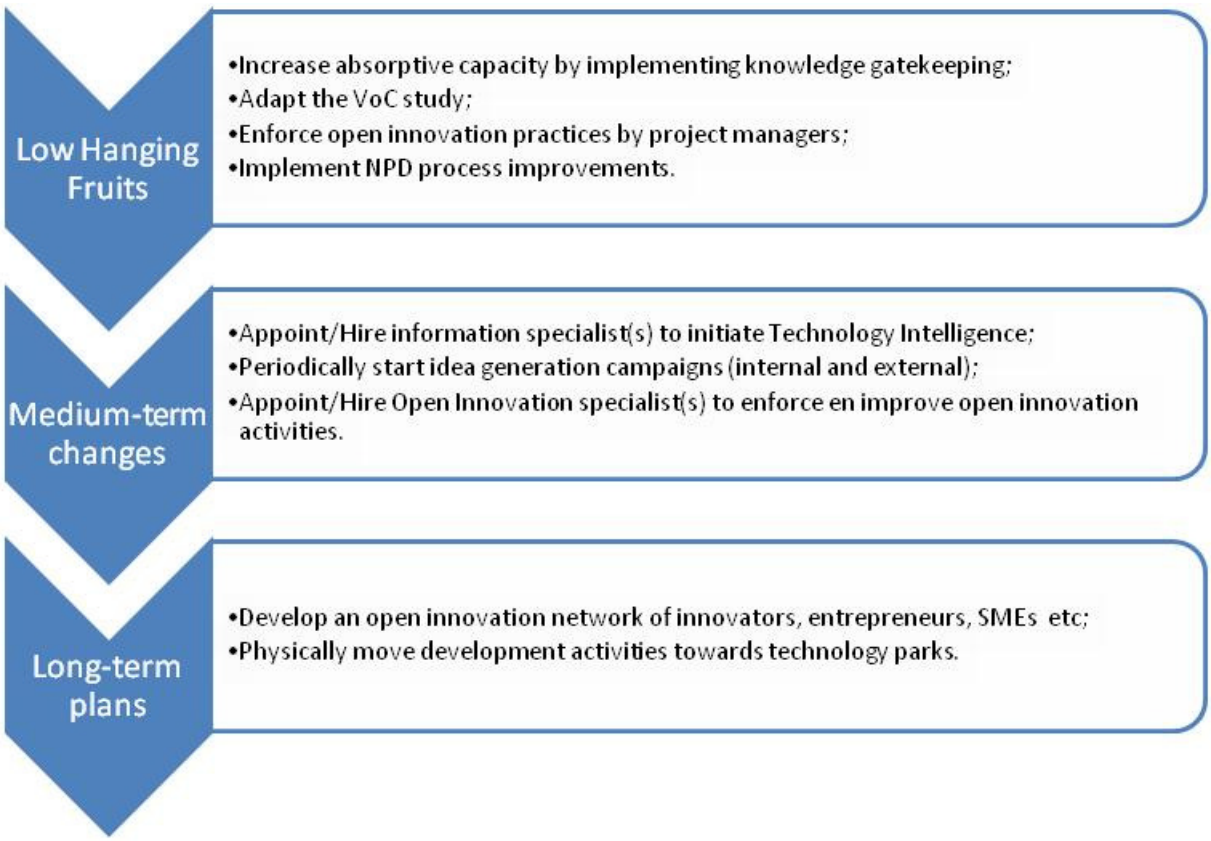

Figure 12: Summarized implementation plan

implementation. In the thesis several recommendation were made which can be implemented in sequence so that the company can experience rewards early on while building towards more rigorous changes. To accomplish this, the company can start by taking on the "low hanging fruits" in the thesis, as these are easy to implement and aren't intense on capital or human resources. The implementation can be structured in the way described in Figure 14.

To implement the **low-hanging fruits**, PIMs top management should (discuss):

- Create roles of knowledge gatekeepers
  - Identify technological areas that are covered internally and those that are interesting for SES.
  - Give explicit responsibilities to current employees to act as knowledge gatekeepers and initiate hiring and/or training for technological fields that aren't covered yet.
  - Discuss changes in reward schemes for gatekeepers to stimulate them to acquire and pro-actively share the knowledge.
- Get together with commercial departments to adapt the VoC-study.
  - Create a cross-functional team that performs customer visits.
  - Initiate development of an in-depth questionnaire.
  - Select companies that should be approached for the in-depth VoC-study.
- Enforce Open Innovation
  - Set targets for the use of external elements in development
  - Evaluate which existing open innovation networks should be accessed and stimulate the use and maintenance of these networks by managers

- Exchange and standardize practices and procedures for innovation (appendix 8 and 9).
    - Initiate the development of scorecards, based on past criteria for success and theoretical criteria.
    - Development of rules and execution structures for project gate meetings.
    - Create a flexible, scalable process as a standardized process throughout SES.

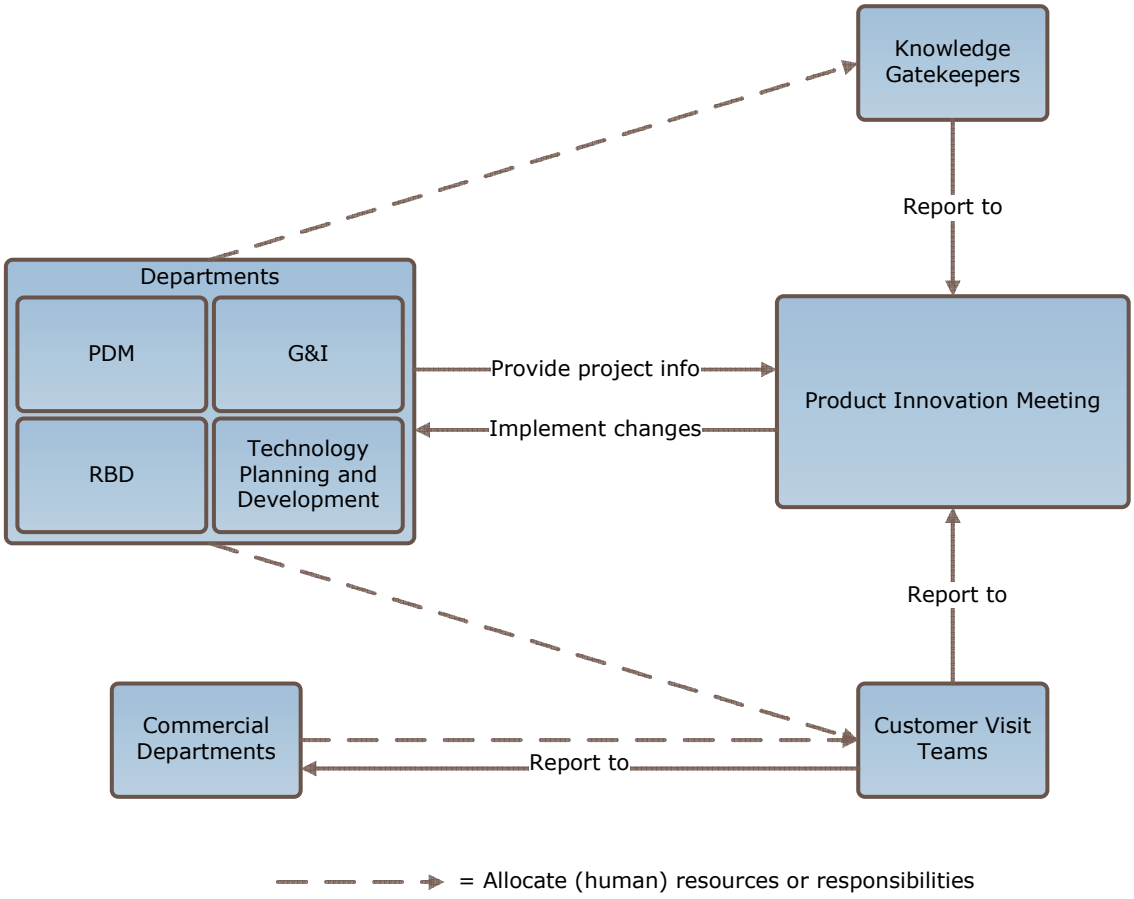

Figure 13: Communication structure after implementation of low hanging fruits

After implementing these low hanging fruits communication and responsibilities are structured as shown in Figure 15. A period of integration and trial is necessary to implement the recommendation so that they work for SES and to give it a chance to pay off. During this period VPs/managers in PIM should:

- Get informed by gatekeepers about technological developments that are interesting for SES.
- Provide budget/freedom for gatekeepers to attend conferences, seminars, courses, etc. on their technological specialty.
- Plan presentations by knowledge gatekeepers to orally spread knowledge throughout the organization.
- Evaluate findings from external VoC-studies and initiate projects based on these findings.
- Stimulate managers to apply open innovation; e.g. partnering in development, search externally for technical solutions
- Provide project managers with external connection from personal business networks and newly accessed open innovation networks.

After this period of implementation and testing the changes, evaluation of these low hanging fruits should be performed as it is a step of the regulative cycle. After this evaluation it can be decided to reinvestigate the external orientation if performance improvement isn't sufficient, or when progress is visible invest in the **mid-term changes**. These changes are thus on top of the changes in low-hanging fruits and are modeled in Figure 16:

- Create specialized functions for Technology Intelligence and Open Innovation.
    - Full-time or multiple people with part-time responsibility to enforce open innovation and search for new opportunities to further implement this.
    - Full-time role to evaluate the knowledge base, discover gaps and initiate filling of these gaps. Communication of the latest external and internal technological developments towards top management to support decision-making.
- Initiate internal and externally oriented idea campaigns besides VoC-studies to increase idea inflow.

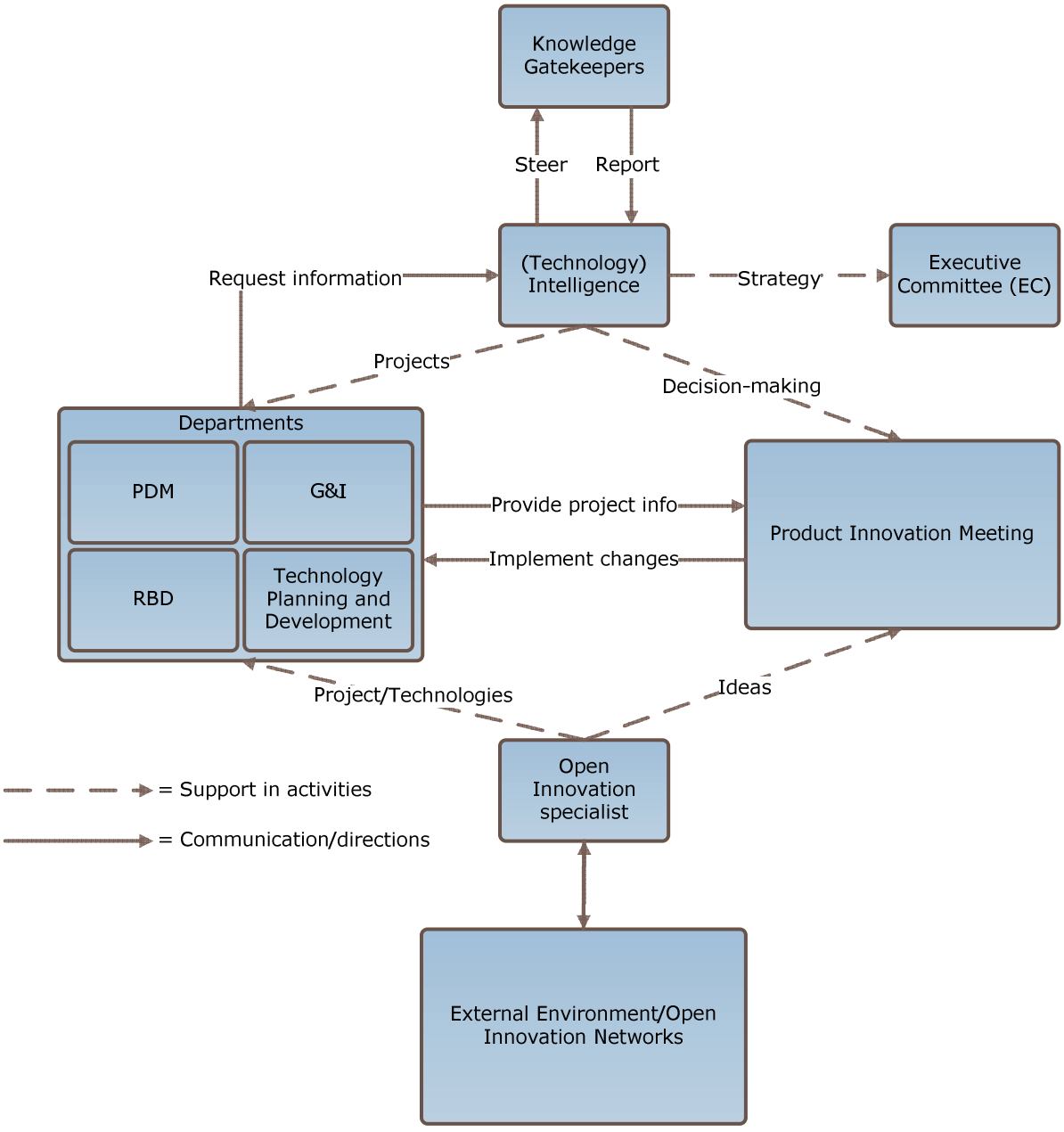

Figure 14: Communication structure after mid-term changes

Again, after a period of implementation and trial and error, evaluation by PIM should be performed to investigate the improvements that were made. This is also a moment to consider investigating more radical and **long-term** changes in organization to improve innovative performance; changes which involve large financial investments, change in organizational structures and time to become effective. The changes are aimed to fully benefit from open innovation, but as the organizational changes are big SES can consider multiple options:

- Development of SES' own open innovation network.
    - Setting up an independent department that actively searches start-ups, innovators, SMEs, existing larger businesses, etc. to form this network
    - Develop a platform where these players can interact, organize events, IT systems to share and request ideas and technology.
    - Develop a policy for IP so that players can interact without fear of stealing technologies.
    - Initiate development of facilities for entrepreneurs, SMEs and spin-offs from SES to colocate businesses, further profit from existing testing and transmission facilities and to create an environment where entrepreneurship can flourish.
- Move internal development activities towards existing technology parks.
    - Set up new business units or move existing development departments to environments where they benefit from cross-fertilization and overflow of knowledge, outside the existing campus in Betzdorf.
    - Restructure the current fragmentation of innovation responsibilities into one (R&)D department, as internal R&D is necessary to benefit from external R&D.

These recommendations are thus potential solutions on the long run and require EC level support to initiate. As these changes are such radical, it will mean that some of the functional requirements in the beginning of chapter 4 can't be left unchanged. These changes will also go beyond the scope of product and service development or PIM.

5. Validation

In order to acquire feedback from the organization to confirm the recommendations within SES, an internal presentation was organized with attendance of vice-presidents and senior managers who are involved with development of new P&S, business models, government contracts, etc. After the presentation there was room for discussion about the findings and feedback on the proposals. It was also discussed how some elements of the solution design can be implemented quickly and how management should steer towards longer term changes. These finding are important to the validation of the recommendations made in this thesis. In the next paragraphs, findings from this session and other arguments for validation are summarized.

- Within the study towards a solution design scientific theory provided a foundation towards practices which managers at SES can apply to improve the innovative performance. Theory already provided several guidelines which could be applied, but this was sometimes too unsubstantiated or abstract to develop practices on. For this purpose external interviews were conducted in parallel; to capture practices at companies that rely on their innovative activities to survive and grow. These interviews not only provided insight into the practices of these companies, it often also confirmed the findings from theory. For instance, how gatekeepers are used to support project development and decision making; how open innovation practices improved the innovative output, or how often customers were used as input for idea generation.

- Scanning the environment for technological developments and other trends that could influence or support development within SES is something that is performed informally and ad hoc. Technological specialists already keep themselves informed of the latest developments in their field by visiting conferences and tradeshows or participating in communities-of-practice. However there are certain shortcomings in the current approach:

    - Not all relevant technological fields are covered; gaps within the knowledge are present.
    - The employees perform this work on their own behalf. Gatekeeping for knowledge isn't a part of their job description or responsibilities, nor are the rewards based on this work. Current responsibilities or schemes rather keep these employees from gatekeeping.
    - There is low internal communication of gathered knowledge. Some codify the knowledge that they acquired at an event and spread this to a small group. Often though, the knowledge doesn't reach decision-makers or those who might need it.

  Several managers agreed in the discussion that a more formal gatekeeper approach to gather and share knowledge should be implemented. They also agree that sharing knowledge via indirect methods (such as e-mail and intranet) does not increase the organizational knowledge, thus oral presentations are needed. The manager at the system engineering team provided an example of a project where several elements of information were missing and that this led wrong decision-making and a market failure when launched.

- Several managers confirmed that customers are not used as a source for ideas and information, the latter in a superficial way. Some also argued that discovering a need is the preferred starting point for new ideas. Commercial departments are close to the customer, but their input is hardly ever collected for innovative purposes. The VoC-study that has been performed in the past has potential to search more in-depth for needs and wants. The conclusion arose that within the VoC-study SES should not only try to capture survey data from as many customers as possible, they should also target a selected amount of current customers and visit these with a group of employees. These employees should have different functional backgrounds, so that they understand different aspects of the customer's problems. Through this process the company can also actively solicit to ideas from their customers and discover latent needs via carefully developed questionnaires.

- Using Customer Focus Groups has been performed in the past, but only a single time and on an ad hoc basis. In this specific case, (home) users of the infrastructure were asked for ideas how the next generation of TV broadcasting via the satellite should look like. This research provided very valuable input and was considered a success. However, the method has not been applied since. Managers attending the presentation agreed that the company can utilise such idea generation tools structurally to collect ideas from customers and users.

- Prioritization of the methods for idea generation for SES was, amongst others, based on a case study of best idea generation practices by Cooper (2008). This research was conducted amongst 170 companies, with annual revenues ranging from 100 million to 10 billion. Experience with several practices within these organizations was the basis for rating their effectiveness and popularity. Validation from practice was further supported by the findings from the external interviews.

- Although Open Innovation is fairly new to the company, some practices from the paradigm were applied on an unconscious and ad hoc basis. First, the company has been creating a platform or networking event where companies in- and related to the industry can present their products, technologies and share thoughts. This multi-day event is organized at the SES headquarters in Betzdorf and was visited by 160+ delegates during the latest edition. Currently, the event is there for discovering the latest (technological) trends in the industry, promoting satellite communication technology and bringing companies together for shared standard development. Yet, there are further possibilities to implement open innovation, e.g. workshops or case studies where organizations can solicit to solutions on their problems or ideas for their next innovation.

- There is another example within the organization where applying openness has resulted into an innovation which otherwise wouldn't have happened. As innovative capabilities for one of the running development projects were not available in-house, the BD manager decided to solicit for solutions externally. A standard procurement approach was not favoured due to the high development and exploitation costs, making that a financial business plan did not close. Therefore, it was decided that the service should be developed in partnership: SES would act as an enabler for defining open standards and provide some necessary items in kind, while the partnering company would develop the service at lower costs for SES, but

being able to demonstrate and validate it with SES. The partner can thus commercialise the service with other customers and refinance its development costs with a mutual benefit to both sides. This example illustrates how applying open innovation enabled SES to offer new services and increase the value of satellite television, while not having the capabilities or strategy to develop this service internally. This particular example was initiated after the researcher brought open innovation to attention at SES. The BD manager commented on this development that "*SES considers open innovation and partnerships with external companies to implement innovative services around satellite TV reception*".

- That the development process within NSI was cumbersome, bureaucratic and thus unpopular amongst idea bringers was confirmed by all participating in the meeting. This has partially caused NSI to be stripped down to a quarterly Product Innovation Meetings (PIMs) where department managers discuss projects, developments and practices, to realign activities within their department. However, the managers still need a process and practices to structurally guide development. They agreed that applying scorecards and setting rules for process execution are interesting for selection of projects and bureaucracy reduction. Further recommendation on the process will be taken into account during the next PIM.

Finally, although the findings were developed in the scope of Product & Service Development, multiple team- and department managers from other departments were attending the presentation or responded to the handouts. As the solution design consist of higher level approaches/strategies for P&S, many of them could also be applied at other departments. Managers from the CTO vertical confirmed that many of the findings were also applicable within their scope and that they will investigate which could be implemented.

6. Conclusions and discussion

In this thesis several recommendation were made for SES to further improve their innovative performance. In previous chapter we first discussed the situation within SES' environment, where the threats come from and why innovation is necessary. Chapter 3 consisted of both the research methodology that was used and the findings of the internal analysis. The internal analysis has shown that in the specific case of SES:

- External orientation by its employees can increase the awareness of technological developments and trends in the same an analogue industries
- External oriented idea generation techniques were not practiced; gathering ideas from customers or other sources allows more and more valuable input of ideas.
- The process that was executed in NSI was cumbersome, bureaucratic and overall unpopular. Revision of the process is needed to make it work again.
- A culture for innovation and risk taking was not present, nor did top management commit much to change this.

From these internal findings, limitation or functional requirements that were found within SES, combined with a discussion with both the university and the supervisor from the company, a number of scientific topics were selected that were the basis for the solution design. In chapter 4 both scientific literature, empirical findings at other organizations and experiences within the organization were used to design a solutions that would fit to the situation at SES. The solution design was structured to fit in the recently introduced Product Innovation Meetings, which is a platform for information and practices exchange of vice presidents and senior managers within the company. The solution design consists of a number of practices that should be introduced via the PIM platform, in order to introduce external orientation and absorptive capacity with SES.

The previous chapter concerned the validation of the recommendations that were made this thesis. Arguments for validation were based on (1) positive outcomes of single projects where recommendations were (partially) implemented, (2) positive responses of management during an internal presentation, (3) confirmation of theoretical findings by external investigation and the use of best-practices studies. Finally, this chapter will consist of conclusions and discussion on the thesis, and recommendations for future research. There will be a discussion on the research and there will be recommendations for future research at SES.

6.1. Discussion

Although the master thesis provided insights on the innovative practices within SES and recommendations based on both theory and empirical evidence, there are influences that might have caused a biased solution design.

As the new structure of SES was developed and implemented recently, changes that could be made to it were close to nothing. This also limits the possible solutions design directions and the effect the current solutions could have. As large structural changes, such as the introduction of R&D, aren't possible, focus was on the current situation and how this could be improved. However, to achieve radical improvement in innovative performance, dedicated R&D will be necessary. Current recommendations are incremental changes that can give the current structure improved performance, however the current structure has a limit to its innovative performance. Allocation of

dedicated research and development within the organization is necessary to become leading on technical innovations.

Not only will R&D itself radically improve innovative performance, the recommendations that are made in this thesis will become more effective with such a restructuring. Scientific research on external orientation mentioned that prior knowledge is necessary to understand the value of new external knowledge. Also, internal R&D is required to capture the most value from external R&D in open innovation. Within the current organization, there are technology specialists who can identify what knowledge is valuable. However, without dedicated R&D the creation of new knowledge internally is limited. To further benefit from the changes that are proposed in this thesis and to build more innovative capacity internally, SES should invest and restructure to initiate internal R&D.

Finally, in this thesis the focus was on opening up to the world for innovation. Several elements to benefit from information, ideas and innovations in the external environment were addressed. These elements have the potential to improve innovative performance of SES, but they do not stand alone. As was mentioned in previous chapters, innovation depends on several antecedents to be successful for the company. A structured, yet flexible process is needed; internal knowledge (sharing) is necessary to understand technologies collectively; a culture and structure for innovation needs to be enforced by top management and structure project and portfolio management is also important. If these elements are not executed or stimulated in a correct way, benefits from external orientation will be limited for innovation.

6.2. Limitations

During the research project at SES, the major reorganization had influenced on the applicability of the thesis finding. When the researcher started its research in February the organization was still divided in two operational companies (SES ASTRA and SES WORLDSKIES), a procurement and operations company (SES ENGINEERING) and a corporate organization (SES GLOBAL). The focus of the thesis was placed on NSI, within SES ASTRA, to discover improvement opportunities. Shortly after the start of the research project SES GLOBAL's CEO announced that there would be a reorganization of SES' companies within 2011, which would streamline activities worldwide and reduce overhead. While the researcher performed the internal analysis, little was known about the structure of the reorganization and how this would influence innovation.

In May 2011 the structure of OneSES was announced internally during an all-staff meeting at the Betzdorf HQ. This initiated a time of transition, where employees were allowed to get used to their new functions and reporting structure. It also led to uncertainty within NSI, where the researcher initially was allocated, as the function and scope of the program was mostly taken over by individual departments. This eventually led to a hold on NSI in July and its replacement by PIMs in September. As parts of the research were performed in a previous organizational context and were aimed at NSI, pieces of the performed work became outdated or didn't have a place within the organization anymore. Internal findings needed to be reassessed and partially designed solutions required changes to fit in the new context. This has led to a more general directions and strategic outcome for innovation, less on specific action and tools and execution plans. This change in focus also has its advantages, as managers within out-of-scope departments see value in propositions that were made within this thesis too.

During the internal analysis phase a diagnosis of the problem was made. This diagnosis was based on internal documents, experience of the researcher by running along with projects and NSI meetings and internal interviews with managers at SES that are involved in innovation projects (thus managers at BD, team and board members of NSI, project managers and technology specialists). These interviews provided insight in problem with innovation at P&S, but although there was overlap on some items, managers' opinions could differ greatly on others. From the findings the researcher selected a number or areas that could be improved. Thus, although the researcher used several sources of information, interpretation of these finding is influence by the researcher and may thus contain subjectivity. Within the organization opinions differ, thus some managers might not agree with these findings. However, in a meeting with both Dr. Keizer and mr. Harles, it was decided to focus the solution design on the introduction of external orientation into the development of products and services. Also, reaction on the presentation that was performed at SES near the end of the research provided valuable input and understanding from those that attended.

As a part of the design phase, external interviews were conducted to find evidence of theoretical recommendations and to discover best practices in External Orientation, Idea Generation, Open Innovation and Innovation Management in general. These interviews were performed in industries different from satellite communication and therefore the question may rise whether these findings would be applicable in the case of SES. A major difference for instance is the lifetime of the main product at SES. Satellites have a lifetime in space of 15 years and a development cycle of 5, thus planning for development should look ahead 20 years when ordering a new satellite. Even if the products at the industries that were interviews would have such lifetimes, there is a possibility to adjust and performance maintenance along the way, which isn't the case for satellites. In this thesis however, innovation in P&S around the satellite reception was addressed, not per se the development of new satellite systems. These P&S have different lifetimes than the satellite itself and therefore closer to the P&S that are developed at the interviewed organizations.

6.3. Scientific Value

This thesis was based on research to solve a single business problem, thus one specific case. The purpose of the thesis was to diagnose the problem and use scientific literature to develop a solution for this case. As the thesis wasn't meant to generate new theory, findings in the solution design are hard to generalize. It does however give us insight how innovation can be organized in infrastructure and service delivery organizations, where R&D intensiveness is low in general. Thus besides providing a fitting solution for SES, the thesis has also resulted in an extensive study of a single case, which may stimulate further research into innovation practices in similar organizations.

In this specific case, no dedicated R&D department was present, nor is it currently an option to install such a departments. Therefore the responsibility for innovation is partial responsibilities of small(er) departments with specific targets or markets (such as G&I, RBD, PDM, and Prod. Div.). In such an organization responsibilities for innovation are spread throughout the organization, not allocated within R&D. This does however bring internal conflict, as employees have priority on operational responsibilities and less on innovative ones. To carefully manage innovative and operational activities, a centralized platform (or board in the past) was installed to communicate information, share practices and advice on decision-making in innovation.

Thus, this thesis provided an extensive case study how a renowned company such as SES organizes innovation in combination with operational activities, and what the problems and difficulties are in such a structure. In existing literature, little attention is paid to organizations that are in similar situations, thus how innovation can be achieved and managed without having dedicated R&D. This study does provide insights into a method to enable innovation without radically changing the structure.

6.4. Recommendation for Future Research

While this thesis addressed elements to improve innovative performance, there are still opportunities to make the activities more efficient and effective for innovation. First, findings from the internal interviews showed that the culture within SES currently didn't promote innovative behaviour by the employees. As this topic was out-of-scope for the master thesis, no solution design was made to improve this element. A culture for innovation however is an important enabler for the development of new products and services. Follow up research could focus on management behaviour and how this can affect the culture within the organization.

In the thesis four major elements were used to design a solution. These elements provide guidelines how SES can plan their efforts to improve innovative performance, yet they can be studies individually and more in-depth to provide further insight how to execute them exactly. Discovering how each element works best for SES is part of the follow up process of the intervention and evaluation, yet they are also topics for in-depth studies in the future.

An element that has been addressed for idea generation and information gathering are VoC-studies. These studies provide valuable insights into needs and ideas at customers, but they aren't executed yet at SES. As commercial departments are closer to the customer than development departments, a leading role on this topic would fit them. It is unclear however how commercial departments and PIM should organize VoC-studies or what questionnaire should be used to gain these insights. Future research could focus on development of in-depth studies at customers and how customers could further support development activities, such as co-creation.

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Appendix 1: Market Analysis North-America [Removed]

Appendix 2: Internal interview results [Removed]

Appendix 3: Voice of the Customer research 2009 [Removed]

Appendix 4: External interview transcripts

1.1. Abstract of the first interview

This interview has been conducted with an expert in project management and open innovation at a large health, nutrition and materials producer.

Innovation management

Research and innovation is one of the foundations of this company as the company had to reinvent itself over time, changing strategy and radically changing products that they developed. Innovations are both incremental and radical, where the first one is mostly the responsibility of the existing business units. The latter one is most often the responsibility of the innovation centre, which has the ultimate goal of creating new business units. The centre has its own resources and budget. Development is organized via a defined stage-gate process, which is applied throughout the organization irrespective of the department where the development occurs.

Sources of knowledge

There are several sources that are accessed for new product ideas and various approaches to acquire it identified. The most important source for the company and within the open innovation campus (company's initiative), are the customers. In case of the campus, suppliers and customers are located relatively closely and relations are intimate. During moments of contact about a product, (frontline) employees can capture signals that spawn new ideas. For the larger company, often big multinationals are their customers. These companies constantly perform market studies and end-user analyses too capture their needs. These findings are also communicated to the suppliers of materials to trigger development into a certain product.

Further approaches besides voice-of-the-customer research are discussion events where representatives of several companies are invited to report on their current problems. Internal and campus-wide idea campaigns or themed events are organised to generate ideas or cross-fertilize for creativity. These two approaches can be seen as idea input methods via open innovation.

Other sources, such as universities, private research institutes and online communities (ninesigma.com) are rarely a source of ideas, but very useful as a source of knowledge to supplement the development process. Open innovation practices such as in-licensing, minority stakes in small high-tech firms, research collaborations and acquisitions are used as input into the innovation funnel at later stages during the NPD process.

Knowledge management

The company tries to get as much out of projects as possible, even if they do not reach the final stage of the NPD process. Via out-licensing of patents or the creation of spin-offs via external entrepreneurs, they try to create a steady stream of royalties. Sometimes entire projects, including the team, are sold to external entities.

Knowledge sharing happens through the demand of knowledge somewhere else. When an employee needs to know something, he/she searches for the knowledge within the company and personal networks. Internal communication is supported by databases, but these prove of little added value.

As with the cross fertilization methods, formal events are organized to share knowledge on certain topics.

Decision making

Extensive studies of the environment, competitors, capabilities and weaknesses, technological development and demand forecasts are made to create long term strategic product plans. These plans look ahead 5 to 10 years and involve the radical innovations and incremental improvements within market units. These plans are extensively challenged, where it is also checked if current and future activities involve enough outside-in thinking. Balance between radical development and exploitation of current knowledge is performed by separating these activities over the innovation centre and the business units. As these departments need to make sure that the company is still competitive in 5-10 years, they are also involved in the strategic plans.

Lessons learned

- Having a separate centre for radical developments with its own budget can make it lose connection with the current business and reality. Ideas from the innovation centre are challenged by business unit managers to prevent this. Top management has the responsibility to align the innovation centre activities with a portfolio of developments.
- Stage-Gate is perceived by project teams as bureaucratic and unnecessary work. To change their attitude, they need to be challenged at each gate to perform towards a gate and present what is needed to a decision maker in an honest way. To do this, gate meetings should only involve that what is necessary and the decision makers should be well informed about the criteria to go/kill to make the challenge.
- With the use of external sources of ideas and knowledge, the NIH-syndrome appears. Even when working internally, people from different department may not be willing to accept advice, solutions or knowledge from other sources and be over critical with it. Appointing independent management should help team members accept external knowledge.

1.2. Abstract of the second interview

This interview was performed with a multi-project manager for communication technologies at a car manufacturer which is world leading in innovation.

Innovation Management

There are several reasons why continuous innovation is so important for this company. First, competition is also putting new products and features on the market, not innovating would mean that the product would be outdated soon. Second, regulation and external forces may result in the switch-off of outdated technologies in the future; they need to be prepared for such occurrences. Finally, the company has adopted an image as innovation leader, which both needs and triggers innovative behaviour. Mismanagement of innovation would cause the company to lose its innovative edge. Low cost strategies at competitors have cost them their brand image and market share.

Innovation is organized within two departments: a research and a development department. Ground-breaking developments start within the research department and move to the development department, together with some of the team members, to complete the development of the product. The research department is an ideal area to spawn new technological and product ideas, as

hierarchy and formality is low. Innovations that are started within the development department are often the incremental improvements of a product. In practice, the incremental innovation will provide the greatest source of revenues. The radical innovations are needed to prevent dead ends for incremental innovations and are what creates publicity on innovation.

Innovation is guided along a stage-gate project, although this has much flexibility in the initial stages at the research department. A decision making board chooses which ideas becomes projects and which projects can progress towards following stages. Project managers can request that board whenever a significant decision has to be taken in development. For these gate meetings a group of board members; that consists of a flexible selection of expert department representatives. All employees are able to apply for a position in the board and are selected by management on basis of the topic.

Knowledge sources

Most ideas in this department come from external companies, such as the communication equipment developers. Close contact with these companies is held, but also conferences and trade shows are a valuable source of knowledge for new product ideas. Internal sources are also quite often bringers of new ideas as employees are encouraged to share them, but most of them are considered incremental improvements. External input is more often a start of radical innovations.

What counts for this particular R&D specialization doesn't count for every other product focus. In the company in general, there is an extensive focus on customer needs, which is dissipated into requirements for every partial product. For some of the departments, customer needs are more important than others. Also, some department rely completely on internal sources as the constantly focus on incremental improvements (e.g. braking systems). What does count for all departments, are the selection criteria for an idea. Most importantly every innovation should benefit the customer, there should also be a financial sense in the development of the product and it should be in line with strategic plans.

Other sources of knowledge are used to support development. Regulatory information is very important as this greatly influences functionalities, shape and performance of the products that every group makes. Therefore there are employees who focus on regulatory issues on a day-to-day basis. Universities and research centres are great sources for solutions and outsourcing of partial development. Sometimes ideas pop up during collaborative projects with these parties.

Knowledge management

Internal experiences are captured via lessons learned reviews at the end of a project, failure or successful. This is documented, but usually knowledge of project execution is shared through start up meetings and the partial reuse of team members for similar project. There is a knowledge sharing culture in the organization, but because a lot of knowledge is specific for one department, sharing it further than that most of the time is redundant. When there is a need for knowledge, formal meetings are organized, often at the start of a project. ICT support for knowledge sharing is limited to storage servers for documents, chat or e-mail, other interactive or database tools aren't used.

Decision making

During development, decision making is performed by the decision making board. At this board, project managers can request a meeting for decision on a project. Top down coordination is also possible, as top management can also approach the board to schedule such meetings for specific projects. The board also has the task to review the portfolio of projects. They have the ability to create a balance between incremental and radical innovation projects. Employees have a primary focus on incremental improvements of the current products. When radical ideas pop up, the decision board has the power to steer that direction.

Lessons Learned

- Rotating members of the board for decision making empowers employees so make decisions on projects. Also, people will not get reluctant towards the board after disappointing decision was taken, as for the next decision different representative can be present.
- The board has flexibility in it to make enforce quick decision making and prevent unrelated people to decide during a gate meeting.
- Fuzzy frontend stages should include a degree of flexibility to give researchers space to explore new ideas. A too rigid process and criteria in initial stages can be a barrier for creativity and kill projects too early in the process. To amount of formality should increase along the process.

1.3. Abstract of the third interview

This interview is conducted with the CTO of a sensory and electronic equipment company that is highly innovative in their products.

Innovation Management

Continuous innovation is necessary, because there are hardly any products that have infinite lifetime anymore, especially in the electronic equipment segment. Our company is pioneering in innovation in sensory technology, but we are also diversifying into products that are only little related to our initial core competences. Cannibalism or product and capabilities is necessary to stay ahead, otherwise the competitor will do it for you. We always have the next product or generation in the pipeline so that it can be released at the correct moment.

Innovation goes through a stage-gate process that has been adapted to the circumstances of the company and industry. In some cases, steps within the process can partially be executed parallel (e.g. development and testing) or extra activities are added to a certain step (i.e. IPR process and production process design). To coordinate this process an innovation steering committee is responsible for idea selection and gate meetings. The focus of this committee is radical innovation that can't be allocated within market units (which in turn are responsible for incremental improvements in their products). The process for radical and incremental innovation is the same in every department or market unit. The steering committee is chaired by the marketing director and further consists of the advanced engineering director and the CTO. Other employees or (external) experts can be called in during gate meetings to support decision making when the committee needs more information. Hereby, the committee is flexible and decision making can be executed quickly without a shortage of knowledge or authority. In the end, the steering committee targets one new/radical product per year, but this requires about 20 times the amount of ideas.

Knowledge sources

Ideas are acquired both internally and externally. Internally we try to access the creativity of the employees by encouraging them to share every idea they have. In practice we see that a few employees provide the largest share of the ideas. We do not have a policy that every employee has a number of hours per week to work on their own idea, but those who have proven more creative are given more room to apply their creativity.

There are a number of external sources that can introduce or trigger ideas. One that is very important for the development of new products is the regulation and law making (e.g. car industry and healthcare). An employee is occupied with gathering information about law development in the US and Europe and in close contact with the steering committee, as laws under development can be product demand in the future. Several employees are also involved with visiting workshops and conferences to gather information on developments in the market and technologies that are available. Finally, the steering committee also invites external consultants and experts share their vision and look beyond the limited vision that the company can have. To gather further insight into opportunities for development, the company buys market studies from segments that have not been considered before to see what their potential in that market could be. Discovery of new market opportunities doesn't happen through a systematic approach; it's an ad hoc occurrence that happens through human creativity and fantasy.

The company is open to customer suggestion for new products; however these ideas are limited to the market units that the company already is present in and will result in incremental improvements rather than radical innovations. There are strong relationships with universities and research centres through personal networks of directors and executives. These connections result in a steady amount of ideas, but these are usually only technical ideas with no product idea or market behind it yet. In practice, this knowledge is more often used during development than as input of ideas. These sources are useful to the company in different ways, as the organization cannot have all the knowledge and engineers working internally. Research institutes are a good partner for outsourcing of development activities.

Knowledge management

Knowledge sharing is well embedded in the organization, but the use of supporting tools is limited. There are documentation and database systems for storage and retrieval of knowledge (for instance lessons learned), but in reality you will still find your needed information faster through social networks within the company. In the past there were issues with employees who considered knowledge a form of power, thus keeping it for themselves. Nowadays those employees and managers have left the company and a change in culture has increased sharing. The steering committee is well informed about the developments within the company and can enforce knowledge sharing when necessary. When the committee considers a development essential for the company, they are able to organize broader communication.

Decision making

Higher level strategic plans involve direction for future product development. To make high management aware of the knowledge and technological development that are present within the

company, meeting at COO lever are organized. During these meeting market units and the advanced engineering department get the opportunity to expose their needs and discuss decision making.

To keep balance between explorative research and exploitative developments, marketing develops a chart that portraits the ideas and projects against technological fit and market potential. Those close to current skills and with high potential will have the biggest chance of being selected/continued, but also alternative and radical developments can be chosen this way.

Lessons learned

- In case of radical projects, about 90-95% of the ideas will not reach it to the market. Aiming at 1 out of 10 ideas would be a good result. Having effective gate meetings enforces a funnel of innovation. For incremental innovations, success rate varies between 50-80% as these are often adaptation to a changing environment.
- Keeping the board as small as possible with the ability to call in experts keeps decision making fast and efficient.
- Focusing on external sources for ideas brings a danger of jumping into developments that in the end will have only a small market size. People with problems tend to exaggerate the relevance of their opportunities. Use basic statistical rules for market research.

1.4. Abstract of the fourth interview

This interview has been conducted at a large printing technology manufacturer and the interview was held with a business development employee at their newly initiated open innovation platform who was a former team leader in services research.

Innovation management

The printing technology business has been changing over the last decades. Some of the elements of printing, especially in the office printers segment, have become commodities as more companies entered this market and competition became fiercer. Nowadays printing isn't the only method to spread and read information/documents comfortably, so new profitable markets had to be discovered. This is why services have become such an important aspect at the company and it is covering a large part of the revenues of the company. Of course some of the printing technologies are still able to get higher margins, such as production facilities, and continuous development in technology and product is essential to the company, but services such as document management are able to gain high margins too. Thus, where the organization used to be a manufacturer of goods, it now delivers product-service-systems which is more service oriented than offering value added services.

Services at the company can be interpreted in two ways: delivery and operational services. The main characteristic that separates the two is when they generate value for the customer. The first only delivers value to the customer at the end of the process or transaction, while the latter generates value for the customer during the process. Examples of the first are consultancy or after-sales, of the latter are document printing and fleet management (which is an ongoing process at the customer). This second form of service is also a source of many new ideas, as close contacts with customers

allows front office employees to discover opportunities for extra services, which can turn into a project to develop services which can be applied at multiple customers.

Innovation in services is managed in two ways. Service opportunities that are discovered at customers are the responsibility of the regional business services office. Although innovations are ad hoc, they are continuous. An important aspect of this approach to service development is that they are very iterative and a standardized process isn't really applicable for such services. A second approach is used for more standardized services, such as software for document management. These projects follow a process that is like the one used for product development. This process consists of 7 milestones, starting with the idea and ending with the launch of a product or service. For service development more flexibility is necessary. Within the organization there are several committees that are leading and making decisions on projects, e.g. product development, service development and portfolio management. As there are many different projects, having the groups is necessary, but it is not clear if this is the most ideal approach.

External view

Customers are a very important source for new product and service ideas. Not only is the intimate and close relationship with them a source for ad hoc innovations, the company also executes extensive surveys and interviews at customers to discover their latent needs. Customers are perhaps even more important during consecutive phases. They are contacted about an innovation as soon as possible to see if ideas could sell in the shape that the company proposes.

The advantage of service or software development over product development is that they can be tested and even sold to customers before they are completely finished, or that readily available solutions can be combined as a cheap approach to test if such a solution would function as expected. This iterative testing with internal or external customers makes it possible to fine-tune a new service or software to fit with the needs of the customer, instead of being a push by the company that might miss those needs.

Open innovation is difficult to apply as there is no approach for IP yet. Open innovation needs a careful approach to IP as companies need to share their technologies to eventually reap the rewards from the innovation network. Another aspect of open innovation is trust, not only are people careful about sharing technology, companies also rely on one another for the development of new technologies and services. The company has only recently started to implement an open view on innovation and still has to learn how to handle IP and trust in the open innovation environment.

Although open innovation is still relatively new for the company, they are one of the founders of a new open innovation platform. On this platform entrepreneurs can start their own company and become part of the open innovation network that is built by it. Also, start ups get support from the founding organizations in setting up there business from idea to their first customers, of course against very competitive prices. The platform doesn't only consist of a network of businesses that are in related industries, there is also a possibility of physical colocation and expensive facilities are available for occasional use. This allows start-ups to actively collaborate and have access to state-of-the-art facilities without much investment. For the founding companies, the open innovation platform gives them an opportunity to easily discover what is happening in the industry and be close to the latest developments in SMEs and start-ups. Also, IP that will not be used by the company can

be spun-out towards entrepreneurs in order to make profit on licensing. Of course they also benefit from office and facility rent, making the investments into testing facilities to pay off quicker.

Lessons learned

- In the printing business, the original business model was losing margin as competition became fiercer and digital alternatives make printing less necessary. New business models were necessary, focussed more on the provision of services.
- The organization is structured to bring the company close to the customer with regional offices and even small organizations that are specifically purposed for big customers (e.g. multinationals).
- Difficulty with this structure is to export service innovations discovered one regional office to another.

Appendix 5: Idea generation techniques

Voice of the Customer studies

Approach	Explanation	Pros and Cons
Ethnographic research	"Camp out" at customers to observe behaviour, discover the use and misuse of products. (Flint, 2002; Cooper and Edgett, 2008)	• Very rich information • Relationship building • Very resource intensive • (un)Willingness of customers/users
Customer visit teams	Visit customers with teams of employees with different background and perform in-depth interviews (Flint, 2002; Cooper and; Thompson, 1997; Reynolds and Gutman, 1988)	• Rich information • Relationship building • Resource intensive • (un)Willingness of customers/users
Customer focus groups	An assembly from customer/users that structurally discuss their problems. Mostly used to test product ideas (Cooper and Edgett, 2008).	• Involvement of customers in idea generation and design • Difficult in B2B situations
Lead user analysis	Identify customers that are ahead of the rest in using your products and identifying their needs and problems, then work with them to create the next innovation (Von Hippel, 1986). Lead users (in analogue industries) can be found by spotting trends and seeing who are leading in innovation, e.g. looking at R&D investments.	• Valuable source for new products • Difficult to discover lead users • (un)Willingness to cooperate • Impractical for short product lifetimes
Customer Brainstorming	Invite customers and users to self-organized business events to discuss developments in their industry and brainstorm about new products and services. (Cooper and Edgett, 2008)	• Introduce external creativity into brainstorming • Collaboration can go beyond idea generation • Mutual benefits • Costly events • Requires long preparation
Customer advisory board/panel	Similar to focus groups or customer brainstorming, with a fixed group of customers or users that brings advice on problems or new product needs (Cooper and Edgett, 2008).	• Maintain good relationships with customers • Useful for product advice, less for ideas

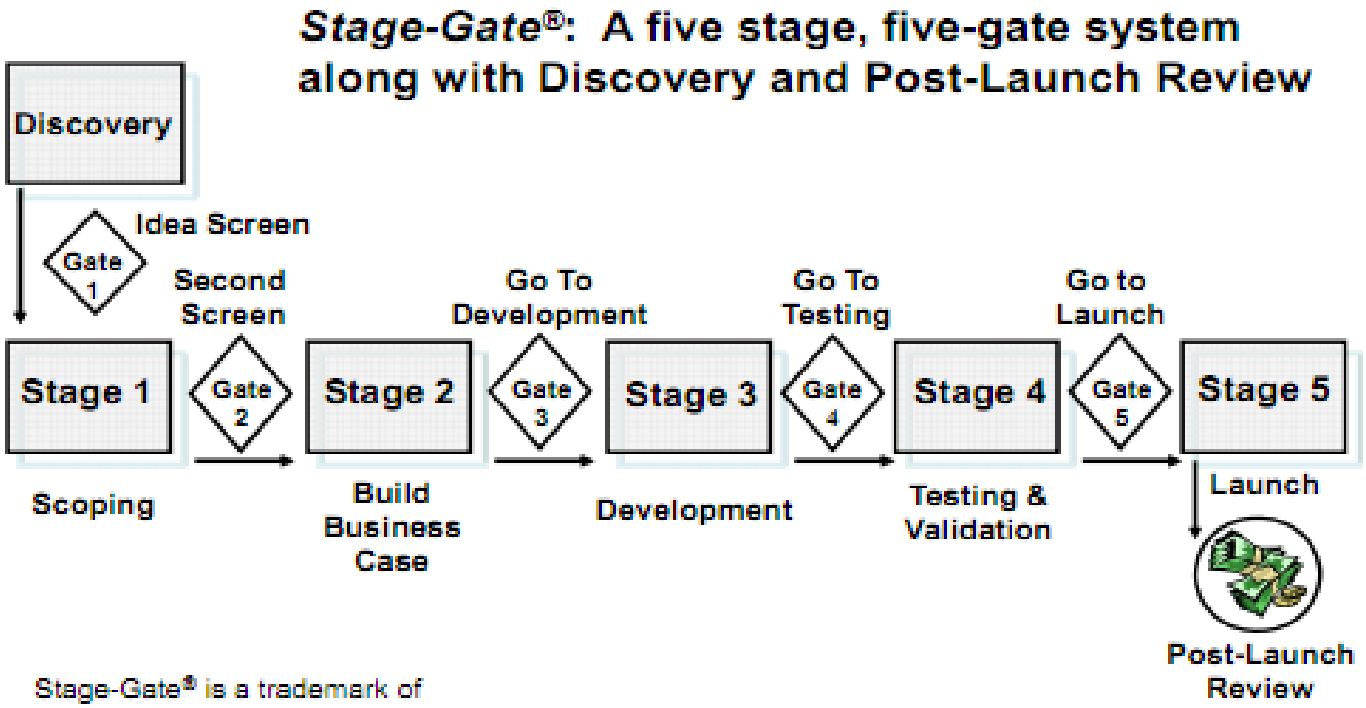
Open innovation for idea generation

Approach	Explanation	Pros and Cons
Partners and Vendors	Partners and vendor can have capabilities and knowledge beyond that of your own organization. Not only can this be used in development of new P&S, it can also spark new ideas.	• Existing relationships • Big partners are able to think bigger • IP protection • Prevent partners to steal ideas
Addressing external communities	These technical communities, also called non-qualified open innovation networks, are accessible for companies to post their problems and solicit for new ideas (e.g. Ninesigma.com, Innocentive.com) (Blackwell and Fazzina, 2008)	• Large number of innovators • IP conflict • Don't over specify demand • More effective for solutions than ideas
Research centres and universities	Collaboration between universities or public research centres and industry can occur in a variety of ways, ranging from high relational involvement (research partnerships) to low involvement (commercialization of IP). Using these sources can thus result in technological forms or solutions. (Schartinger, Rammer, Fischer and Fröhlich, 2002; Perkmann and Walsch, 2007; Cohen, Nelson and Walsch, 2002)	• State of the art technologies • Willingness to commercialize IP • More effective during development stages
Scanning for SMEs and Start-ups	Start-ups and small firms are often a source of innovative products, sometime even capable of beating incumbent firms through disruptive innovation. Build a network of global networks of informants to small businesses for ideas and solutions (Christensen, 1995; Huston and Sakkab, 2006)	• Too many SMEs and start-ups to scan
Crowdsourcing	Can be applied in a variety of ways: external idea submission, external product designs and idea contests. Use social networks, communities of enthusiasts or company websites to post problems and idea demands. (Cooper and Edgett, 2008)	• The world is the source of ideas • Little initial investments • Only useful for low-tech products • Much screening work for a few good ideas

Other external oriented approaches

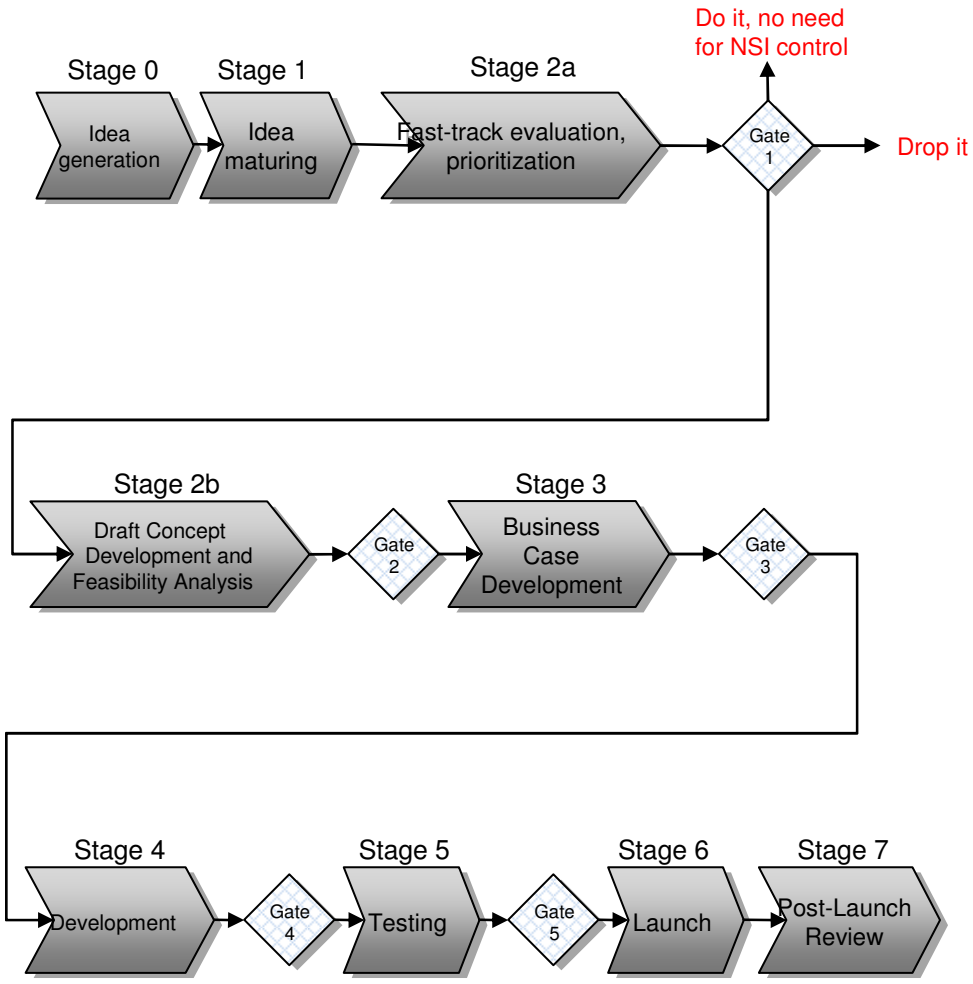
Approach	Explanation	Pros and Cons
Peripheral vision	Assess the external world on trends and threats, to see where innovation should lead to. When making assessments of the trends and threats, the opportunities for new product and services might come to light. (Cooper and Edgett, 2008; Day and Schoemaker, 2005)	• Prevents being surprised by sudden loss of market share • More a strategic exercise than idea generation • Overdoing it causes neurotic behaviour
Disruptive technologies	Disruption in technologies can be a threat to incumbent firms and pose opportunity to those who spot end exploit them. Actively track developments in technology to spot disruptive ones. (Christensen, 1995)	• Disruptive innovations do not have to originate from within • Disruptive innovations are rare occurrences • Can only be determined in hindsight
Patent mapping	Look at patenting activities by competitors or analogue industries to see where innovation is leading too. This can help identifying areas for new products. (Cooper and Edgett, 2008)	• Defensive/reactive approach • Might need to rely on in-licensing from competition to keep up

Appendix 6: Stage-Gate process



Idea discovery	Scoping	Building business case	Development	Testing	Launch
•Describe the idea and its benefits	•Preliminary market assessment •Preliminary technical assesment •Preliminary financial assesment •Actionplan for next stage	•User need and wants study •Competitive analysis •Value proposition defined •Technical feasibility assesment •Operations assessment •Product definition •Financial analysis	•Technical development work •Rapid prototypes •Initial customer feedback •Prototype development •In-house product testing •Operational process development •Full launch and operations plan	•Extended in-house testing •Customer field trials •Acquisition of production equipment •Production trials •Test marketing/trial sales •Finalized launch and operations plan •Post launch and lifecycle plans	•Market launch and roll out •Full production •Begin sales •Result monitoring •Post launch and lifetime plans are executed
Gate 1: Idea screen	Gate 2: Second screen	Gate 3: Decision to develop	Gate 4: Decision to test	Gate 5: Decision to launch	
•Does the idea merit any work	•Does the idea justify extensive investigation	•Is the business case sound?	•Should the project be moved to external testing	•Is the project ready for commercial launch	

Appendix 7: Development process for NSI



Appendix 8: Stage-Gate Process Execution Advices

Rules of engagement in literature

Example for Rules of Engagement (Cooper, 2008):

- All projects must pass through the gates. There is no special treatment or bypassing of gates for pet projects;
- Once a gate meeting date is agreed, gatekeepers must make every effort to be there. If the team cannot provide deliverables in time for the scheduled gate, the gate may be postponed and rescheduled, but timely advance notice must be given;
- If a gatekeeper cannot attend, he/she can send a designate that is empowered to vote and act on behalf of that gatekeeper (including committing resources);
- Pre-gate decision meetings should be avoided by gatekeepers – don‘t prejudge the project;
- Gatekeepers should base their decisions on scoring criteria for that gate, not outside the scope of that stage. Decisions must be based on facts, not emotion and gut feel!
- A decision must be made the day of the gate meeting (Go/Kill/Hold/Recycle). The project team must be informed of the decision, face to face, and reasons why;
- When resource commitments are made by gatekeepers (people, time or money), every effort must be made to ensure that these commitments are kept;
- Gatekeepers must accept and agree to abide by these Rules of Engagement.

Gatekeeper rules for the game (Cooper, 1999):

- Don’t wait to point out key issues until the gate meeting, contact the project team before the meeting to resolve these issues;
- No catching up at gate meetings, no surprise attacks;
- All project must be treated fairly and consistently, no pet-projects for gatekeepers;

Additional rules (Aerts, 2011):

- Gatekeepers must review the presentation files before the meeting;
- No “cross-examination” during team presentations;
- Final vote must be unanimous; gatekeepers must be willing to negotiate with other gatekeepers.

Gate/scoring meetings

- The project team gets the time to present their project at the beginning of the gate meeting;
- After the presentation a vigorous question-and-answer session held;
- Gate keepers fill in their scorecards individually after all questions have questions have been answered;
- All scores are collected and are displayed on a large screen, pointing out areas of disagreement. A discussion on these areas is allowed;
- When agreement is reached a final gate decision is made.

For major projects a scoring session will take about 60-90 minutes, but should not be allowed to take longer. There should be total transparency within gate meetings, which will leave less room for

politics, hidden agendas, etc. Scorecards should exist of 6 to 10 evaluation criteria, which are designed on elements that have proven to be a driver for success. Don't rate projects against each other at this time, but use the score as a support to decide on the project at hand only. Portfolio management should assess the innovation portfolio 2 or 4 times per year, prioritizing projects and balancing out the portfolio (Cooper and Edgett, 2006).

Appendix 9: Scalable innovation process