MASTER THESIS:

FROM BUSINESS TO NEW PRODUCT DEVELOPMENT PLANNING

"Integration of Strategic, Tactical and Operational planning processes"

Ellen Krans

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UNIVERSITY OF TWENTE.

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"Integration of Strategic, Tactical and Operational planning processes"

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Supervisors:

Dr. Matthias de Visser Dr. Michel L. Ehrenhard

Organization:

Sport5 (fictional name) Supervisor: Commercial Manager

Author:

Name: Ellen Krans Student Number: s0067814

MANAGEMENT SUMMARY

The master thesis project has been carried out at Sport5, which is a fictional company name due to confidentiality reasons. Sport5 is an international wholesale company of sport goods and leading in the Benelux. Its brand portfolio is broad and the product issues became more complex over the years. It faced difficulties meeting deadlines considering commercialization and was unable to assure alignment between several departments continuously. Preliminary research and observations gave a better insight of the presumed problems and the main causes. No clear, well founded new product development strategy is available, objectives and positioning per brand are unclear and Sport5 has not enough insight into her new product development procedures and therefore does not know the efficacy and efficiency of its new product development process.

These issues suggested that general structured procedures about new product development planning, from strategic to operational level, were missing. And in addition this company needed more alignment between strategy, portfolio and new product development planning, in order to achieve business objectives. Therefore the research objective became: "To develop an approach, which aligns strategic, tactical and operational new product development processes, in order to support Sport5 to become more long-run orientated and to be able to achieve business objectives."

The issues at Sport5 asked for better alignment between strategic vision, tactical structured brand management and a more efficient and manageable idea-to-launch process at the operation. This means taking into account all three levels of business operations: strategic, tactical and operational. Therefore, the main research question became: "What is an appropriate approach to integrate strategic, tactical and operational business planning processes concerning new product development?".

A structured literature review had been conducted on the four levels of analysis: strategic technology roadmapping (TRM), tactical portfolio management (PM), operational stage gate systems (SGS) and the alignment between these methods.

From the literature review on the separate approaches on the three business levels, we could highlight that strategic alignment for new product development is crucial. Businesses should develop a new product development strategy, driven by the strategic vision of the company. This strategy should guide the strategic business units and the business's product development directions. Next to these directions, this strategy should help in resource allocation and project selection.

It is important to have an established, explicit and formal method for portfolio management in place. Concerning prioritizing issues, strategic methods should play a primary role. In this manner, strategy will split the resources across strategic business units, product types, between short-term and long-term projects, between high-risk and low-risk initiatives and between new products and re-ordering. This should lead to well-founded attack and collection plans.

Next, the review highlighted the importance of having proper integrated new product development processes from idea to commercialization in place. The process should include extended pre-development research and market studies, allowing senior management to make founded decisions considering project prioritizations and selection and as a result, make the front end more effective. When the quality of the early stages is done better, less low impact projects will be executed, prioritization and go/kill decisions can be made on founded data, resources will fit the number of projects better and activities can be more expertly executed. This will result in a more balanced portfolio of projects, which are aligned with strategy, with more efficient cycle times, higher success rates and a positive impact on sales profit at the end.

This extended literature review served as the theoretical basis for the hybrid new product development approach, which aligns, strategic, tactical and operational, respectively TRM, PM and SGS, business planning processes. Best practices were taken into consideration and as a result the developed hybrid STO (Strategic, Tactical, Operational) – NPD approach has a strong theory base. It reveals that new product development planning processes from strategic vision, via portfolio management, towards stage gate systems can be and should be aligned in order to do the right projects and doing the projects right.

The STO – NPD approach is visualised in figure 18, on page 55. This approach integrates technology roadmapping with an established and explicit portfolio management method, which is necessary to forge the link between business strategy and project prioritization and selection. The method should be customized for each particular business that wants to implement the approach. The chosen tools are dependent on the business objectives, but this research highlights that the best performers rely more on strategic methods than on financial methods. The structured and scalable stage gate system integrated in the STO – NPD approach must ensure that projects are well processed and killed when necessary. This should lead to a balanced and valuable project portfolio. Which highlight the importance between portfolio management and stage gate systems. It is almost impossible to use them independently of each other.

Three crucial necessities have been identified for successful STO – NPD deployment: senior management involvement, open communication and a cross-functional team approach. To increase success rates on implementation, change management methods were used to develop an activity guideline for implementation and integration of the STO – NPD at a particular business.

Next, to achieve the objective of this research, the current situation of Sport5 has been analysed on the basis of the knowledge obtained from the literature review. The hybrid STO – NPD approach functioned as a reference. In this manner, we could easily advise Sport5 how to implement and integrate such a hybrid model into its on-going business because of the gaps identified between current state and ideally integrated process.

The main recommendation derived from this research was to implement the STO – NPD approach. But to be able to do so, one concern has been identified which should be resolved before steps towards implementing a hybrid approach can be taken. Successful implementing a STO – NPD approach requires a cross-functional team approach and in the current state, Sport5 does not encourage team settings like these. It is therefore recommended to work towards a team-based structure in which the entire organization is made up of teams.

Major changes for Sport5 implementing the STO – NPD approach are extended market research, business and resource analysis, using explicit portfolio management tools for prioritizing and selecting projects and with less reliance on financial methods in early phases, working with a structured stage gate systems which supports parallel processes, working in cross-functional teams and therefore involvement of various departments in the development of new products.

This report should lay the foundation and create the sense of urgency about changing the new product development processes at Sport5, which is the first step of the hybrid STO – NPD approach implementation plan, table 7 on page 62.

Preface

There it is! After several months (and years...) of work, I present the result of my research, which is the finishing part of my master studies Business Administration at the University of Twente. After successfully completing the Bachelor of Science degree in Industrial Engineering and Management I decided to focus more on Innovation and Entrepreneurship in the Master of Science degree of Business Administration.

The courses went very well, as planned and on schedule, but finishing my Master thesis became an incredibly bumpy road. Due to a re-organization within the company, due to changing priorities, due to some contradictions in a previous assignment and because of some private matters, it became almost impossible for me...

Since 2010 I am working fulltime and the main focus was on work challenges. Until, I decided finishing my Master should become a high priority and I therefore decided to start over. It was Dr. Michel L. Ehrenhard who had confidence in my skills. I discussed the issues with him and he gave me new insights and possible topics. Because of him I was motivated again to complete this most important part of years of study and investments. He also introduced me to my first supervisor Dr. Matthias de Visser. Meetings with him were clear, to the point and focused, exactly what I needed next to a fulltime job. Possible topics were narrowed down. In 2014 the subject of my Master Thesis became: From Business to New Product Development Planning: "Integration of Strategic, Tactical and Operational NPD planning processes".

Therefore, I would like to thank Dr. Matthias de Visser and Dr. Michel L. Ehrenhard for motivating me and giving me the right guidance necessary during my research.

I also would like to thank Dennis, my supervisor at the company. Because of his clarity, transparency, positivity and the inspiring work environment, I could find time and the motivation to finish my thesis.

Last but not least, thanks to my parents, Toos and Theo, for their support and help, particularly in the years of uncertainty. Thanks to my boyfriend, Diederick, for his endless patience and positive perspective on anything. Thanks to my friends, especially Ingri, Linda and Marijke, for always thinking along and listening to me. And thanks to my colleague, Sam, who devoted time and energy to reading through my thesis.

I DID IT! Here it is, enjoy reading this report.

Ellen Krans

August 10, 2015

ABBREVIATIONS

Acronym	Clarification
NPD	New Product Development
M&C	Marketing and Communication
R&D	Research and Development
TRM	Technology Roadmapping
PM	Portfolio Management
SGS	Stage Gate Systems
MT	Management Team
STO	Strategic Tactical Operational

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1 INTRODUCTION

New product developments must be strategically aligned to the business. Freelancing for long periods of time on ideas not well aligned to a business goals and strategy is a recipe for disaster. Successful businesses put a product innovation and technology strategy in place, driven by the strategic vision of the business. This product innovation strategy should guide the business's product development direction and helps to steer resource allocation and project selection (Cooper, 2011).

Strategy should guide the split in resources across product types, between short-term and longterm projects, between high-risk and low-risk initiatives, between new products and platform development versus extensions, updates and fixes. Next to the strategy of product types, it is important to understand the nature of all the business processes in the organization and how these relate to each other in order to gain sustainable impact.

From a business point of view, the front-end of new product development comprises the activities that lead to formal development of new product projects. It is the link between business goals and new product development processes. If a business is ineffective at the front end, there is a high probability of product failure in terms of financial, strategic or commercial expectations. Inefficiencies at this point can lead to cross-functional uncertainties, multiple goals, lack of information and dynamic decisions, also mentioned by Oliveira & Rozenfeld (2010).

In this research, three business levels are separated: strategic, tactical and operational. At strategic level, the vision of the business should be outlined. Where does the organization want to be within the next 5 to 10 years, considering both corporate and business level strategy? At tactical level, action plans for the next couple of years should be developed in order to be able to achieve objectives set for the next 3 to 5 years. And in the end: to be able to achieve the missionized state. Which projects should the business focus on? The products developed now, affect turnover for the next couple of years. The operational level consists of the idea-to-launch processes, which, in most cases, have an extent of time of one year, dependent on newness and risk level for instance.

Nowadays, many businesses are applying technology-roadmapping to visualize strategy and become long term orientated, and it has been widely adopted in different industries and organizations (Phaal, Farrukh, & Probert, 2004). Portfolio management should be the manifestation of the business's strategy. Portfolio management is about making strategic choices, which markets, products and technologies a business will invest in. A various amount of methods exists, used in order to gain high-value projects, aligned with business's strategy, the right balance of projects and the right number of projects. The top performers understate the need for portfolio management and use clear, well-defined portfolio procedures (Cooper, Edgett, & Kleinschmidt, 1999). But portfolio management does not consider project performance itself, while a bit of planning before development of new products starts can make a company act much quicker and more efficient. An operational model for managing the new product development processes and decisions from idea to launch is a Stage-gate System.

There are two ways for businesses to succeed concerning new product development: doing projects right and doing the right projects. Strategic roadmapping and portfolio management focus on the second route, doing the right projects, linking the projects to business strategy. A stage-gate system is a process about doing the projects right, and as an extension to that, ensuring that the product processes result in the business most optimal portfolio.

On-going research reveals, that those businesses that implement a systematic hybrid process for managing their projects clearly outperform the rest (Oliveira & Rozenfeld, 2010; Cooper,

Edgett, & Kleinschmidt, 2001). But how should businesses integrate the planning processes at several business levels in order to become long-term orientated, achieve an optimal portfolio and execute the projects effective and efficient? The challenge many businesses' face is to select the appropriate new projects, stop poor projects, optimize resource allocation, and link new product development with corporate strategy all at once.

1.1 BACKGROUND INFORMATION; COMPANY PROFILE & SITUATION

Due to confidentiality reasons, the name of the researched company will not be mentioned during this research. Although this thesis does not contain competitively sensitive information, the findings are bounded to time, and therefore it is not desirable this report will pop-up in search results years later. The fictional company name is Sport5.

Sport5 is a wholesale company in sports goods. The company is a family business, which was founded in 1985. It designs, develops and distributes several sports brands internationally. The brand portfolio includes five brands, the core business is teamwear for the B2B-market and the main customers are retailers.

Sport5 has become one of the leading sports companies in the Benelux. The key to success lays in the wide and broad collection. It distributes to more than 700 stores in the BeNeLux. Internationally, through her subsidiaries in Germany, Austria, England and Sweden, it provides about 4000 shops. Independent importers are located in the United States, Australia, Japan, France, Switzerland, Finland, Norway and Iceland.

The focus of Sport5 is on team sports such as soccer, hockey, volleyball and handball. But also gear for individual sports like running, cycling and fitness is diversifying the offer.

Mission

Sport5 is a family owned company, which is focussed on sports related products.

"We are passionate about the design, development and marketing of our goods. We base our relationships on trust, honesty and partnerships. Continuity is the foundation for our future."

Vision

"Our vision forms the framework of our roadmap which describes the principles and objectives of the business"

People	To create an environment in which people are inspired to produce excellence.
Portfolio	Product is King.

Partner To be the most preferred and trusted partner.

Profit We aim for profitable growth, continuity and remaining an independent company.

Productivity Manage time, people and goods for the greatest effect.

The sportswear and accessory portfolio persists of several brands. Within these brands several brand segments can be identified, such as teamwear, footwear or individual sports. Figure 1, on the next page, shows the structure of the brand portfolio of Sport5.



Figure 1: Brand Portfolio Sport5

1.1.1 ORGANIZATION STRUCTURE

On page13, figure 2: Organization chart Sport5, displays the functional structure of Sport5. The figure shows that the organization distinguishes four major functional segments in the Netherlands: purchase, commerce, finance and warehouse.

The strengths and weaknesses of a functional structure are well known. A functional structure is most effective when in-depth expertise is critical to meeting organizational goals, when the organization needs to be controlled and coordinated through the vertical hierarchy, and when efficiency is important. Functional structures appear to be successful in large organizations that produce high volumes of products at low costs. It therefore works best for only one product or a small well defined product portfolio. In addition to such advantages, there can be disadvantage from an organizational perspective if the communication between the functional groups is not effective. In this case, the organization may find it difficult to achieve some organizational objectives in the end. Also known is that this structure has a slow response to environmental changes and that in general it results in less innovation (Daft, 2007).

Horizontal linkage mechanisms are often not drawn on the organization chart. They refer to the amount of communication and coordination horizontally across organizational departments. They are designed for learning; reducing control, more coordination and collaboration. When a horizontal structure is dominant, there are: shared tasks and empowerment, relaxed hierarchy with few rules, horizontal (face-to-face) communication, many teams and task forces, decentralized decision making.

Of course the coordinators of the several departments within Sport5 play a crucial role in creating these horizontal linkages, but more of a divisional structure or a team-based approach might be needed to integrate more horizontal linkages in order to manage the broad and complex portfolio processes of Sport5.

With a team-based structure, the organization is able to retain some advantages of a functional structure, such as economies of scale and in depth training, while gaining the benefits of team relationships. It allows the business to more quickly adapt to customers requests and environmental changes. Next, employees are generally more enthusiastic about their involvement in bigger projects rather than narrow departmental tasks. It also enables responsibility and authority to be pushed down the hierarchy, requiring fewer managers for supervision. But also, cross-functional teams may make different demands on employees than do their department managers and members who participate in more than one team must resolve these conflicts. Also a large amount of time must be devoted to meetings, thus increasing coordination time (Daft R. L., 2003).

For medium-sized companies, the choice between functional and divisional structure is difficult because each represents different strengths and weaknesses. Main advantages of a divisional

structure are fast response and flexibility in an unstable environment, raising concern for customers' needs, improved coordination across functional departments of one division, easy pinpointing of responsibility for product problems, emphasis on overall product and division goals and development of general management skills. But businesses should be aware that a divisional structure also means, less top management control, poor coordination across divisions, less technical depth and specialization in divisions and a more complicated process of corporate resource allocation. But the major disadvantage, and the reasons why the transition towards a divisional structure is questionable for many medium sized businesses, is the duplication of resources and the high cost of running separate divisions (Daft R. L., 2003).

The organization should be designed to provide both vertical and horizontal information flows as necessary to accomplish the business's overall objectives. Although the structure of the organization is not the scope of this research, it does have an effect on the processes within the organization. It is therefore wise to ask ourselves the question: is the current organizational structure of Sport5 still suitable for the changes in the market demand? For the broad, complex brand portfolio? Or for the processes Sport5 is trying to implement or integrate in its daily operation?



Figure 2: Organization chart Sport5

1.1.2 ORGANIZATION CULTURE

The corporate culture should reinforce the strategy and structural design that the organization needs to be effective within its environment (Daft R. L., 2003).

The culture of Sport5 can be described as a mission culture. This culture is characterized by emphasis on a clear vision of the organizations purpose and on the achievement of goals, such as sales growth, profitability, or market share, to help achieve the purpose. This culture has always been suitable for Sport5 because it served mainly clubs, and no rapid changes occur.

Because of the roots of the family business, the trading minds of the employees and the functional structure, the culture has also caused disjunctive departments. Departments are habitually thinking about their own interests, instead of those of the whole company. It will be a challenge to break these habits.

Since April 2013, Sport5 has a new CEO. In October 2013 he announced a re-organization. The good thing is that no one lost his/her job, but the organization structure has been changed drastically. New functions were created and responsibilities shifted. A new commercial manager was hired and also the sales function has been updated. Reorganization can, and mostly does, cause uncertainty and anxiety of losing position.

With the conduction of this research we should consider the possible confusion and commotion caused by this reorganization. It is not desirable that any more distress is created. The knowledge of this research may suggest the probability of even more change. It is a confidential research and employees are therefore questioned unaware.

1.2 PRACTICAL ISSUES

Sport5 faces difficulties meeting deadlines at the front end. Year after year the company faces the same troubles.

"We seem to be unable to meet deadlines concerning our new product development processes and unable to assure alignment between the several departments continuously." (Commercial Manager, 2015)

Problems like these can be approached in two ways; either the processes are inefficient and not well aligned or the deadlines are not realistic. Either way, a solution should be found in efficient planning and alignment of processes.

Preliminary research and observations* at several departments gave a better insight of the presumed problem. It was soon found that there are bigger issues, than initially thought. A conceptual point of view, a preliminary cause and effect diagram (figure 3 on the next page), identified the width of this case.

*Because of my function, Marketing and Communication Coordinator, I have worked with every department closely. This made it possible to collect issues and complaints from different colleagues and departments. My function is discussed more in detail later on.

R&D (pink):

- Collection will not be on time (ideally) in the main planning process
- No clear NPD strategy and procedures
- Ad hoc and changing focus per brand
- Goals and positioning unclear
- Dependency of collection meeting

Design (green):

- Samples too late for photography
- Ad hoc information
- Not one overall database where all information is applicable
- Great dependency on information of others

Sales (yellow):

- R&D does not listen to market demand
- Our main sales tool is late year after year
- Feels not heard

M&C (blue):

- Ad hoc communication
- Information too late for planning procedures
- No time for marketing
- Positioning + goals per brand unclear
- Department poorly staffed



Figure 3: Preliminary Cause and Effect Diagram

Despite the market leadership and all the good things that have been achieved in recent years, a lack of sufficient long-term perspective with respect to the products and projects concerns several departments.

The portfolio of Sport5 is broad. From low segment to high segment brands, from soccer to hockey brands, from teamwear to individual sports brands. This makes portfolio management complex. Besides the complexity, there is no comprehensive and clearly communicated brand strategy for the long run. This process is rather ad hoc, which can cause resource allocation problems and inefficient product innovation processes.

Sport5 has not enough insight into its new product development procedures and does not know the efficacy and efficiency of this process. Also the interdependency of departments requires attention. For instance, the marketing and communications department is not integrated into the product development process. Because of this sequential process, time for marketing is missing. This causes various communication and resource issues at the end. The communication overall is rather ad hoc, short-term and overdue product-driven instead of brand-driven.

These issues suggest that general structured procedures about product development planning, from strategic to operational level, are missing. And in addition this company needs more alignment between strategy, portfolio and new product development planning, in order to achieve business objectives and be able to respond to changes in market demand more quickly.

This organization asks for a better alignment between strategic vision, tactical structured brand management and a more efficient and manageable idea-to-launch process in the operation. This means taking into account all levels of business operations: strategic, tactical and operational level.

2 Research Design

2.1 RESEARCH OBJECTIVE

The main objective for Sport5 is to have a functioning, efficient new product development planning approach, from strategic vision to operational outcome.

Since the product planning literature focuses mainly on the separate business levels, a gap exists with respect to the alignment of these levels of planning processes into an integrated approach. The research objective for this thesis becomes:

To develop an approach, which aligns strategic, tactical

and operational business planning processes concerning new product development, in order to support Sport5 to become more long-run orientated and to achieve business objectives.

2.2 RESEARCH QUESTION

In order to meet the requirements of the research objective, the research focuses on the identification and alignment of strategic, tactical and operational new product development planning processes.

The central question is:

"What is an appropriate approach to integrate strategic, tactical and operational business planning processes concerning new product development?"

'Appropriate' relates to the quality of the whole process. This means, that it should consider the requirements from all business levels and that it should produce a reliable and realistic business planning approach that aligns strategic, tactical and operational planning and decision-making processes concerning new product development.

Combining the central question and the research objective, this research consists of two parts, with each forming a separate sub-question:

1. Which methods for business planning processes are well known and widely accepted and how can these processes be aligned into a hybrid approach?

In this research, a hybrid approach is an approach whose elements are being derived from methods from the three different business-planning levels: strategic, tactical and operational level. In addition, it is the real integration of the business planning methods identified by aligning the elements within these methods.

In this first step it is important to find out what an appropriate planning approach constitutes at the separate business levels. Therefore, in a literature review, requirements are to be identified, particularly those coming from the three separate business levels; strategic, tactical and operational. Besides these requirements the challenge lies in the alignment between these business level planning methods in order to be able to develop a hybrid approach.

2. How should a hybrid approach be implemented successfully in an organization?

Once an overall planning approach has been developed, it is essential to embed it into the processes of the particular business. This embedding into unique, and yet, sometimes comparable business processes, is part of the success of the implementation.

2.3 THEORETICAL FRAME

From the research questions, the theoretical frame can be derived. Mainly four fields, the three business levels of planning and the alignment of those, are needed and define the theoretical boundaries. This theoretical frame should consist of the new product development planning process at three levels within the organization; strategic level, tactical level and operational level and the alignment of these processes. In the following, a brief view in each field is presented, which leads to a better contextual understanding.

2.3.1 STRATEGIC LEVEL

Strategic planning usually involves balancing at an external view of the firm (market and business environment) and an internal view (tangible and intangible assets). In order to develop a hybrid model, a flexible approach for supporting strategic planning, which could be used in many areas and situations, was needed. To support this strategic and long-range planning, considering new product developments, technology roadmapping (TRM), which uses simple visual frameworks to support the dialogue and communication necessary to develop and deploy strategy, is a widely used technique. It is applicable to many situations, dependent on purpose and format (Phaal, Farrukh, & Probert, 2004).

Technology roadmaps visualise strategy by combining the disciplines of strategy in layers and sublayers that will form the roadmap. These layers are free to direction, and should match the organizations situation, making the method customizable. Technology roadmapping maps the future and highlights the gaps. The visual representation is easy to understand and can therefore be used as an efficient communication tool.

Technology roadmapping represents a technique for supporting technology management and planning, especially for exploring and communicating the dynamic linkages between (technological) resources, organizational objectives and the changing environment (Phaal, Farrukh, & Probert, 2004), which makes it an appropriate planning tool for this research.

2.3.2 TACTICAL LEVEL

A method with which an organization can operationalize its business strategy is portfolio management (PM). Portfolio management is about making choices in which markets, products and technologies to invest. It's about resource allocation, how to scarce engineering, research and development and marketing resources. It focuses on product and/or project selection (Cooper, Edgett, & Kleinschmidt, 1999).

Project Portfolio management aligns the management of individual projects with the management of business operations (Oliveira & Rozenfeld, 2010). It is an effective communication tool between divisional management and operational management. Portfolio management provides visibility for all projects and their priorities, so that employees understand why the business is working on certain projects (Cooper, Edgett, & Kleinschmidt, 2001).



Portfolio management is the link between business strategy and the business operation.

Figure 4: Positioning Portfolio Management

2.3.3 OPERATIONAL LEVEL

At the operational level, several products should be launched and marketed. A stage-gate system is well know system at this level and is both a conceptual and an operational model for moving new products from idea to launch. Stage-gate systems recognize that product innovation is a process. And like other processes, innovation can be managed. Stage-gate systems simply apply process-management methodologies to the innovation process (Cooper, 1990).

2.3.4 ALIGNMENT BETWEEN THESE BUSINESS LEVELS

The practical issues described in subchapter 1.2: Practical issues, on page 14, highlight the importance of the alignment between business levels. If strategic vision is not proper translated to portfolio requirements, the operation at the end will lose control, with all the issues at the front end and during launch as undesirable consequences. Although literature is scarce considering this alignment, this research attempts to find the alignment opportunities, between strategic and tactical level and between tactical and operational level, in order to develop an overall hybrid approach.

2.4 CONTRIBUTION TO THEORY AND PRACTICE

Having defined what this research is about and having defined the theoretical boundaries, this chapter describes the contribution to theory and practice.

At first, this research aims at improved new product development planning processes from strategic vision to operational projects. Second, this research contributes to theory by linking the existing theories concerning new product development planning processes at different business levels. While a short literature review reveals that a lot has been written about technology roadmapping and long range planning, tactical portfolio management and operational idea-to-launch processes, the stage-gate systems, literature about alignment between these processes is minimal.

Cooper (2011) states that a product innovation and technology strategy (PITS) per product type should be developed in order to let strategy guide the split in resources across product types. He developed a framework to create such a PITS per product type. This framework can be seen as the initial step towards a hybrid method, although the actual idea-to-launch process is missing.

Oliveira & Rozenfeld (2010) imply the integration of technology roadmapping and portfolio management as the opportunity to improve the front end, the link between business objectives and new product development processes. They developed an ITP (Integrated Technology roadmapping Portfolio management) method in which the activities are aligned. But when the actual new product development design phase starts, the model stops. Also in this research, the operation has not been taken into consideration. Although both researchers recognize the link between portfolio management and the idea-to-launch processes should be aligned, the actual links are missing.

And although several authors admit that portfolio management and stage-gate systems should be interlinked (Cooper, Edgett, & Kleinschmidt, 2002; O'Conner, 1994), it was the study of Cooper, Edgett, & Kleinschmidt (2000) that described the alignment in more detail. They mentioned that the first step towards implementing portfolio management successfully is to have a proper new product development process in place, such as a state-gate system. This system should provide the information needed to make substantiated decisions in the portfolio.

Literature linking the three business levels: strategic, tactical and operational new product development processes, is lacking.

Figure 5, on the next page, both illustrates the practical issues of this research and the theoretical gaps because of the minimal studies dealing with the subjects of this research.



Figure 5: Practical Issues and Theoretical Gap

The practical contribution on the left of figure 5 is obvious and based on Sport5. On the right the theoretical gaps between the product planning business levels highlight the scope of this research. Based on the theoretical findings and after the development of a hybrid new product development planning approach, this conceptual model will be used to analyse Sport5. Sport5 will receive recommendations for implementing such a hybrid approach, which should translate strategic vision to a valuable portfolio and result in a more efficient operation in the end.

2.5 RESEARCH STRUCTURE

To gain insights into the different steps to fulfil the research objective, a research structure is displayed below, in figure 6, and is explained afterwards. This model is deducted from the research questions and the theoretical frame given in previous chapter.



Figure 6: Research Structure

By means of a literature study on technology roadmapping, portfolio management and stage-gate systems, overlap and alignment possibilities are discovered (1). Thereafter, a hybrid approach is proposed, specifically for the alignment of technology roadmapping and portfolio management, and portfolio management and state-gate systems. Also the case of Sport5 is examined with reference to this blueprint (2). The theoretical analysis and the practical insights lead to an improvements plan towards this hybrid approach for Sport5 and should lead to recommendations concerning its implementation (3).

2.6 METHODOLOGY OVERVIEW

This research is exploratory. Exploratory research examines a new interest or is executed when the subject of study itself is relatively new. An exploratory research attempts to lay the groundwork that might lead to future studies, or to determine if what is being seen might be explained by a currently existing theory. Most often, exploratory research lays the initial groundwork for future research. Exploratory research is defined as the initial research into a hypothetical or theoretical idea. This is where a researcher has an idea or has observed something and seeks to understand more about it (Babbie, 2010).

2.6.1 LITERATURE REVIEW

In order to gain sufficient knowledge about the three business levels of new product development planning and its alignment, an extended literature research will be executed. The structured approach of Webster & Watson (2002) will be used. This literature review is done in a structured manor in order to

maximize the reliability of this study and to reflect the scope of the literature study. This literature review methodology will be described in detail in the next chapter and the results will be described thoroughly.

2.6.2 QUALITATIVE RESEARCH - CASE SPORT5

The qualitative research of the case can be described as a regulative cycle. This is a common practical research method, first developed by van Strien in 1986, and cited by van Aaken (1994). Van Aaken (1994) mentioned that the task of a professional is always to resolve a unique and specific problem for a client. He describes these problems as value problems, which are problems in real life, to increase the value in reality. This in contrast to knowledge issues, where scientists are more engaged in.

When working on a value problem, van Aaken (1994) states that a professional should generally walk through the regulative cycle, which is visualized in figure 7.



Figure 7: The regulative cycle (van Aaken, 1994 (originally van Strien, 1986))

The main value problem can be identified with a problem mess, also called: cause and effect diagram, which has been made in chapter 1.2: Practical Issues, on page 14. When the main problem has been identified, the diagnosis or analysis begins. A plan for a redesign should be developed next and the actual exploitation, mostly in collaboration with the client, follows. After the exploitation an evaluation should be scheduled. In practice though, these cycle mostly is not executed sequential, but more as an iteration process (van Aaken, 1994).

In the role of marketing and communication coordinator at Sport5 for the past two years, I have worked with every department pretty closely. For instance, I've coordinated the catalogue publication for one year, I've organized international events and I've developed the first overall calendar in collaboration with the several departments; purchase, logistics, design, sales and marketing. This made it possible for me to identify issues at different levels and different departments, but it also gave me insights into the several processes.

Because of my function in the company I will be able to integrate questions concerning new product development processes into daily work meetings without colleagues being aware of the research. In this way I will be able to explore the organization's processes more extensive, without causing any distress. Unconsciously for the interviewee, I will be able to confirm several assumptions about the processes in order to provide Sport5 with a substantiated advice. This research will be described thoroughly in chapter 6: Practical case – Sport5 on page 64, combined with the semi-structured interview with the commercial manager of Sport5.

2.7 STRUCTURE OF THE THESIS

Chapter one gave an introduction to the research and chapter two described the research design. Chapter three is devoted to an extensive review of literature methodology. The findings of the literature review are described in chapter four. Different literature considering technology roadmapping processes, portfolio management tools and stage-gate systems processes are reviewed. This chapter lays down the foundation for a theory-based conceptual hybrid new product development planning approach, which will be developed in chapter 5. The processes are integrated towards a hybrid STO – NPD approach and an implementation schedule for applying such a hybrid process is given.

The extended literate review and best practices serve as the basis on which the current situation of the case, Sport5, is analysed. These results are discussed in chapter 6. This chapter also schemes the implementation of a customized STO – NPD approach at Sport5.

Finally, in chapter 7, conclusions and recommendations for Sport5 with regard to this research are given, limitations of this research are described and opportunities are given for future research.

3 STRUCTURED LITERATURE REVIEW

In this section, a literature review is conducted at three levels, the levels of analysis; strategic planning (technology roadmapping), tactical planning (portfolio management) and operational planning (stage-gate systems). The focus lies on the integration of these business levels concerning new product development.

The structured approach of Webster & Watson (2002) consists of the following steps:

- 1. Remember, the major contributions are likely to be in the leading journals.
- 2. Go backward by reviewing the citations for the articles identified in step 1 to determine prior articles you should consider.
- 3. Go forward by using the Web of Science to identify articles citing the key articles identified in the previous steps. Determine which of these articles should be included in the review.

The outcome of this structured literature review is a description of all relevant aspects of new product development planning at three levels; strategic, tactical and operational.

- 1. Literature Review Strategic level Technology Roadmapping
- 2. Literature Review Tactical level Portfolio Management
- 3. Literature Review Operational level Stage-gate systems

The second outcome, as a result of cross topic analysis of the selected articles, is a description of the overlap in approaches.

4. Analysis 1&2

5. Analysis 2&3

3.1 Keywords and Synonyms

Primary keywords have been identified, including synonyms and related aspects to be used in the review of high quality research and eventually for answering the research question and establishing a theoretical integral planning approach.

A high-quality review is complete and focuses on concepts.

Primary Keywords + synonyms	Related aspects
Technology Roadmapping (TRM)	NPD, planning
Portfolio Management (PM)	NPD, planning
Stage-gate systems (SGS)	NPD, planning

Table 1 Keywords, synonyms and related products

In order to identify potential overlap of theories between the business levels, the following search string combinations will be used. This table indicates all possible combinations:

Search strings		
+ TRM	+ PM	+ SGS
+ TRM + NPD	+ PM + NPD	+ SGS + NPD
+ TRM + planning	+ PM + planning	+ SGS + planning
+ TRM + PM	+ PM + SGS	

Table 2 Search strings used in search indexes

3.2 INDEXES AND SEARCH ENGINGES TO USE

Determining the indexes to use in a research is the starting point of a literature review. A systematic search should ensure the accumulation of a relatively complete census of relevant literature, according to Webster & Watson (2002). A researcher must look not only within the discipline of the search area when reviewing and developing theory, but also outside the field. In this research reviewing literature in related areas like Operations Research and Management Science could also be relevant.

According to the University of Twente relevant databases for research in the field of Business Administrations are:

- Business Source Elite (EBSCO)
- Scopus
- Web of Science

In addition of related areas, the following databases will also be included:

- Emerald
- Science Direct (Elsevier)

Google Scholar is invoked when items were not directly available to view in one of the abovementioned databases.

3.3 INCLUSION AND EXCLUSION CRITERIA

Managing business planning and new product developments are well known research areas that go far back in time. Therefore time is not the first criteria to select on (15 years old). First a selection will be made of articles that have been peer reviewed. This means that the article has been checked by a group of experts in the same field to make sure it meets the necessary standards before it is published or accepted.

Relevant journals can be: research technology management, strategic management journal, journal of engineering and technology management, industrial marketing management, operation management, business economics, operation research management science or journal or product innovation management. Interesting extending research topics can be strategic planning, business planning, new product development, product planning or project planning.

When the search results reveal an immense amount of results, these results will be refined by relevant journals, relevant topics or key words.

When search results still show more than 200 hits, the results will first be sorted out on the number of times a specific article is cited and the number of hits will be reduced by an extra selection in relevant journals or more focused topics.

When search resulted in more than 50 hits, the results will be sorted out on the number of times a specific article is cited.

After that, articles will be selected on basis of the relevance of their title, abstract and keywords.



Figure 8: Workflow of the literature research method

3.4 SELECTED ARTICLES

The final selection of articles is summed up in this subsection. Per research area the total number of citations and the scope of years of publication is given.

3.4.1 TECHNOLOGY ROADMAPPING

Selected articles:

- Technology roadmapping A planning framework for evolution and revolution. (Phaal, Farrukh, & Probert, 2004)
- An architectural framework for roadmapping: Toward visual Strategy (Phaal & Muller, 2009)
- An activity guideline for technology roadmapping implementation (Gerdsri, Assakul, & Vatananan, 2010)
- Technology roadmapping in review: A tool for making sustainable new product development decisions. (Petrick & Echols, 2004)
- Dealing with the dynamics of technology roadmapping implementation: a case study (Gerdsri, Vatananan, & Dansamasatid, 2009)
- An overview of the literature on technology roadmapping (TRM): Contributions and trends (Carvalho, Fleury, & Lopes, 2013)

Total number of citations: 690 times. Scope of publication: 2004-2013

3.4.2 PORTFOLIO MANAGEMENT

Selected articles:

- Integrating technology roadmapping and portfolio management at the front-end of new product development. (Oliveira & Rozenfeld, 2010)
- New Product Portfolio Management: Practices and Performance (Cooper, Edgett, & Kleinschmidt, 1999)
- New Problems, New Solutions: Making Portfolio Management More Effective (Cooper, Edgett, & Kleinschmidt, 2000)
- A Governance Framework for the Idea-to-Launch Process (Baker & Bourne, 2014)
- The influence of business strategy on project portfolio management and its success A conceptual framework (Meskendahl, 2010)

- Portfolio Management for New Product Development: Results of an Industry Practices Study (Cooper, Edgett, & Kleinschmidt, 2006)

Total number of citations: 1160 times. Scope of publication: 1999-2014

3.4.3 STAGE GATE SYSTEMS

Selected articles:

- Stage-Gate Systems: A New Tool for Managing New Products (Cooper, 1990)
- FROM EXPERIENCE: Implementing a Stage-gate Process: A Multi-Company perspective (O'Conner, 1994)
- Perspective: The Stage-Gate Idea-to-Launch Process Update, What's New, and Next Gen Systems (Cooper, Perspective: The Stage-Gate Indea-to-Launch Process - Update, What's New, and NexGen Systems, 2008)
- Best Practices in the Idea-to-Launch Process and Its Governance (Cooper & Edgett, 2012)
- Optimizing the Stage-Gate Process: What Best-Practice companies do I (Cooper, Edgett, & Kleinschmidt, 2002)

Total number of citations: 2174 times. Scope of publication: 1990-2012

3.4.4 BACKWARD/FORWARD RESEARCH

Selected articles:

- Customization of technology roadmaps according to roadmapping purposes: Overall process and detailed modules (Lee & Park, 2005)
- Optimizing the Stage-Gate Process: What Best-Practice companies do II (Cooper, Edgett, & Kleinschmidt, 2002)

Total number of citations: 472 times. Scope of publication: 2002-2005

3.4.5 DURING EXECUTION ADDED LITERATURE

- Perspective: The innovation Dilemma: How to Innovate When the Market Is Mature (Cooper, 2011).

4 ANALYSIS OF THE LITERATURE

The theoretical foundation of this research is built up of four main fields, namely technology roadmapping, portfolio management, stage-gate systems and the alignment between these processes. In the first three sub-chapters, the three approaches per business level planning are presented and reviewed respectively. In the fourth subchapter, the linkages or integration possibilities between the levels of business planning processes are defined. An aspect of this research is to derive a best-practise review in order to be able to develop a hybrid approach and implementation plan in the next chapter.

Most of the studies reviewed in this research applied qualitative research methods, indicating that most of the research is still in exploratory phase.

4.1 TECHNOLOGY ROADMAPPING (TRM)

The term technology roadmap is widely used, but there is no standard meaning or exact definition. Carvalho, Fleury & Lopes (2013) state that the word roadmap represents a summery of science and technology plans in the form of maps, and the roadmapping process is simply the development of this roadmap. Gerdsri, Assakul & Vatananan (2010) describe a technology roadmap as a visual representation of the organization's strategy and the roadmapping process as a strategic planning tool that allows organizations to link their technology strategies with their business strategies.

For the purpose of this research, the definition of Phaal, Farrukh, & Probert (2004) has been adopted:

"Technology roadmapping, the process, is a powerfull technique for supporting (technology) management and planning, especially for exploring and communicating the dynamic linkages between (technological) resources, organizational objectives and the changing environment."

As an addition, 'technology' is often only one aspect of a roadmap and the approach perhaps should be more generally termed, like 'business', 'strategic', or 'innovation' roadmapping (Lee & Park, 2005; Phaal, Farrukh, & Probert, 2004). Although in this research we are searching for this more strategic framework, the term 'technology roadmapping' in literature is the dominant phrase and therefore also used in this research.

Phaal et al. (2004) consider the use of the roadmaps from two main perspectives. The first is a company perspective: roadmaps allow technology developments to be integrated with business planning, and the impact of market developments to be assessed. The second perspective is multi-organizational: roadmaps that seek to capture the environmental landscape, threats and opportunities for a particular group of stakeholders in a technology or application area.

A roadmap can function as the integrating device carrying the business strategy and the planning process forward. It brings together market/commercial and technological knowledge from inside and outside the organization. Multi-organization roadmapping promotes knowledge sharing and facilitates the development of a collective vision that can lead to action and collaboration (Phaal, Farrukh, & Probert, 2004).

Technology Roadmaps can be used in many areas, such as service and product planning, development of product family tree, and program planning. Algright and Kappel (2003) mentioned that technology roadmaps in the corporate setting can be used to define the plan of the evolution of a product, linking business strategy to the evolution of the product features.

A roadmap structure is comprised of two dimensions: timeframes and layers. Phaal & Muller (2009) recommend that five broad time horizons should be included in the roadmaps:

- 1. The past and current situation.
- 2. Short term, one-year horizon. This part should be converted to tangible plans of action.

- 3. Medium term, a three-years timeframe. This part actually links the strategic planning horizon and highlights the broader directions and options that have an influence on the short-term decisions and plans.
- 4. Long-term, a ten-years timeframe. This part should provide a bridge between the medium-term strategy and the vision of the organization. Key scenarios and uncertainties should be expressed and long-term changes in business and market environment should be explored. It should assess long-term issues that probably affect current decisions and plans.
- 5. Vision, the desired future state.

4.1.1 PURPOSE AND FORMAT

In the literature, there are two main groups dealing with the selection of an appropriate technology roadmap, which are Lee & Park (2005) and Phaal, Farrukh, & Probert (2004).

According to Phaal, Farrukh, & Probert (2004), a roadmap is comprised of two distinct layers, (1) an underlying information-based structure dependent of the purpose and (2) the graphical layer, with a format, style and colour chosen to represent the roadmap structure and its content for communication purposes. Dependent of the planning purpose and the format, they identified eight technology roadmap types regarding purpose and eight forms regarding format.

Purposes Product planning Capability planning Strategic planning Long range planning Knowledge asset planning	Generic TRM	Formats Multiple layers Single layer Bars Table Graph
Long range planning Knowledge asset planning Programme planning Process planning Integration planning	Generic TRM	Table Graph Text Pictorial Flow

Table 3: Characterization of roadmaps according to Phaal, Farrukh & Probert (2004): purpose and format

These 16 broad areas of roadmaps types are described in more detail in appendix 9.1: Examples of Technology roadmaps types by Phaal, Farrukh & Probert (2004), page 81.

In relation to the theoretical basis and the objective of this research, product planning, strategic planning and process planning needs to become the focus.

Relating to the insertion of technology into manufactured products, by far the most common type of technology roadmapping is *product planning*. When a more general strategic appraisal at the business level is the aim, in terms of supporting the evaluation of different opportunities and threats, the roadmap for *strategic planning* is more common. This roadmap focuses on the development of a vision of the future business, in terms of markets, business, products, technologies, skills, culture, etc. Gaps can be identified, by comparing the future vision with the current situation, and strategic options explored to bridge the gaps. *Process planning* supports the management of knowledge, focusing on a particular process area (for example, new product development).

Note that roadmaps do not always fit perfectly within the broad areas of roadmaps identified by Phaal et al. (2004). They can contain elements of more than one type, in terms of both purpose and format, resulting in hybrid forms.

Lee and Park (2005) propose three phases to guide organizations through the difficult process of selecting a technology roadmap. They adapt a modularization method for mass customization and suggest a set of different roadmaps for different purposes such as forecasting, planning and administration. These phases were used to narrow down the possibilities of technology roadmaps per business objectives and effectively suit the technology roadmap to the situation of the business.



Figure 9: Overall framework of selecting a TRM (Lee & Park, 2005)

Standardized formats of roadmaps were designed to perform as components and the purpose of roadmapping was used as a basis for customization. Therefore, several standard roadmap formats were defined and some among them were selected to organize a set of formats for a specific roadmapping purpose to realize modularizing customization. For instance, Lee & Park (2005) suggest that all 'product roadmaps' and the 'technology prospect roadmap' will be suitable for the product section and planning module, see table 4.

Application purpose (managerial usage) Roadmaps Types		Forecasting	Planning		Administration
		-	Product	Project	-
Product	Product family map	Х	0	Х	0
	Product planning roadmap	Х	0	0	Х
	Product driver map	Х	0	Х	0
	Product evolution roadmap	Х	0	Х	Х
Technology	Technolgy portfolio map	Х	Х	0	0
	Technology prospect roadmap	0	0	0	Х
	Technology position map	Х	Х	0	0
	Technology trend roadmap	0	Х	0	Х

Case-wise guideline for modularization

Table 4: Case-wise guideline for modularization (Lee & Park, 2005).

The general designs of these roadmaps are presented in appendix 9.2: Examples of Technology types by Lee & Park (2005), at page 85.

The most generic roadmap has a horizontal timeline and three layers: market, product and technology.



Figure 10: Generic Roadmap (Phaal, Farrukh, & Probert, 2004; Oliveira & Rozenfeld, 2010)

This most common format for technology roadmapping is the multiple layers format. In addition, a planning roadmap should be multi-layered, reflecting the integration of technology, product and commercial perspectives in the firm, including internal and external sources and supporting communication across functional boundaries in the organization. The roadmap allows the development

within each layer to be explored, together with the interlayer dependencies, and enables the integration of (technology) resources into products, services and business systems (Phaal, Farrukh, & Probert, 2004).

At the highest level, roadmaps comprise three broad layers (Phaal & Muller, 2009):

- 1. The top layer relates to the trends and drivers that govern the overall goals or purposes associated with the roadmapping activity, including external market and industry trends and internal business drivers, milestones, objectives and constraints.
- 2. The middle layer generally relates to the tangible systems that need to be developed to respond to the trends at top layer. Frequently this relates directly to the development of products or services.
- 3. The bottom layer relates to the resources that need to be marshalled to develop the required products, services and systems, including knowledge-based resources, such as technology, skills and competences or other resources such as finance, partnerships and facilities.

The structure that is adopted for defining the layers and sub-layers of the roadmap is important, and reflects fundamental aspects of the business and issues being considered. Typically these layers relate to key knowledge-based dimensions in the business, such as know-why, know-what, know-how, know-when, know-who, and know-where (Phaal, Farrukh, & Probert, 2004; Phaal & Muller, 2009).

This structure though is flexible and should be directly linked with the technology roadmap objectives in order to achieve the expected result. Therefore the first priority is to understand the strategic context of the business, in terms of focus, scope and aims, together with identifying which perspectives are critical for understanding the systems dynamics, defining goals, exploring strategic options and implementing change. There is agreement in the literature, that it is essential to customize the generic roadmapping approach to the specific needs of the business (Gerdsri, Assakul, & Vatananan, 2010; Phaal & Muller, 2009; Carvalho, Fleury, & Lopes, 2013).

No uniform roadmap exists. The structure of the roadmap must suit the focus, scope and aims of the company, to provide a framework and common language, in order to be able to implement the desired strategy. Which is the main reason why companies struggle with the development of roadmaps and the implementation of roadmapping (Phaal & Muller, 2009). The customization and implementation of a roadmap will be discussed in the following subchapters.

4.1.2 CUSTOMIZATION OF A ROADMAP

As mentioned earlier, there is an agreement among the researchers that it is essential to adapt the generic roadmapping approach to the specific needs of the organization, if the full benefits of roadmapping are to be gained. The approach will need to be customized to suit the particular situation.

Phaal, Farrukh, & Probert (2004) developed the T-Plan fast-start approach for constructing a roadmap. The T-plan process comprises two main parts; the standard approach and the customized approach.

1. Standard approach, for developing the roadmap

The standard T-plan process comprises four facilitated workshops. The first three focus on the three main layers of the roadmap (market, product and technology), with the final workshop bringing the themes together on a time-basis to construct the chart. The process is driven predominantly by market pull, although one of the aims is to generate innovative solutions that may give rise to new product and market opportunities. The parallel management acivities are also important, including planning and facilitation of workshops, process coordination and follow-up actions. Simple linked analysis grids are used to identify and assess the relationships between the various layers and sub-layers in the roadmap (Phaal, Farrukh, & Probert, 2004).



Figure 11: T-plan: standard process steps (Phaal, Farrukh, & Probert, 2004)

2. Customizing of the roadmap

A multilayer roadmap is the most common form and the most flexible in its application. It includes the following dimensions (Phaal, Farrukh, & Probert, 2004):

- Time: This dimension can be adapted to suit the particular situation, in terms of time horizon; scale; intervals. Space on the roadmap can also be allocated for vision and very long-range considerations, together with the current situation and history, with respect to competition or to define the gap between the current situation and the vision.
- Layers: The vertical axes of the roadmap are critical, as these need to be designed to fit the particular business and the problem to be addressed. Often a considerable part of the preliminary roadmapping effort will be directed at defining the layers and sub-layers that will form the roadmap eventually. The different types of layers on roadmaps highlight the flexibility of the approach in terms of providing a framework for supporting strategic planning.
- Annotation: In addition to the information mapped within the layers, on a time-basis, other information can be visualised on the roadmap, including:
 - Linkages between objects in layers and sub-layers
 - Supplementary information, such as a statement of business strategy or market drivers, people involved in developing the roadmap and expectations
 - Other graphic devices, including objects, notes and colour coding, to indicate key decision points, gaps, critical paths, opportunities and threats, including disruptive technologies and markets.
- Process: The steps that will be required to complete the first roadmap, and take the process forward thereafter, will be different for each organization. Which process is most appropriate depends on many factors, including the level of available resources (in people, time and/or budget), nature of the issue being addressed (purpose and scope), available information (market and technology), other processes and management methods that are relevant (strategy, budgeting, new product development, project management and market research). Most customized T-Plan applications have included a combination of market pull and technology push considerations, although generally firms have wished to express the strategic plan in a market-oriented fashion (Phaal, Farrukh, & Probert, 2004).

4.1.3 IMPLEMENTATION OF ROADMAPPING

To successfully develop a map and implement technology roadmapping, Gerdsri, Assakul, & Vatananan (2010) confirm that it is important to establish clear objectives and focus of a roadmap. The TRM and structure need to be customised to synchonise with an organization's objectives and culture. In order to maintain the TRM process after implementation continuously, it is crucial to integrate the process into on-going business planning activities in an organization.

Gerdsri et al. (2009, 2010) define three phases of the implementation process for technology roadmapping.

Phase 1: Initiation

The purpose of this phase is to provide the opportunity for gathering and disseminating necessary information needed in later stages. A team of stakeholders should be formed. A generic TRM concept must be formulated and customized and this TRM process should be aligned with an organization's strategic planning process and working culture in order to be accepted and maintained. The success of this stage's activities can be measured through the acceptance of the TRM concept among key stakeholders.

Phaal, Farrukh & Probert (2004) highlight this initiation preparation phase as the most important consideration to clearly translate the business and process objectives to be able to customize a roadmap and implement the roadmapping process into the business successfully.

Phase 2: Development

The prominence in this phase is to collect and analyse data from internal and external sources. Workshops with stakeholders should be organized to analyse data and present the results in the graphical form of a roadmap, as mentioned in the previous subchapter. Participants from different departments should work together in generating and sharing their knowledge and expertise to develop the general company roadmap. The success of this stage's activities can be measured through the quality of the content presented in the roadmap, as well as the level of knowledge and experience shared among stakeholders and the cross-functional teams of participants.

Stage 3: Integration

The function this latest stage is to integrate the TRM process into on-going business operations, since the TRM initiative should not be considered as a one-off effort. The business should assign ownership of the TRM process to a group of people who are responsible for regularly maintaining and updating the roadmap. The success of this phase's activities can be measured through the quality of the alignment between the technology roadmaps and the corporate strategic plan, as well as the continuation of roadmapping on day-to-day basis.

As these three phases implicate, many of the benefits of roadmapping are derived from the roadmapping process, rather than the roadmap itself. The process brings people from different parts of the business together, providing an opportunity for sharing information and perspectives and providing a medium for consideration of problems, opportunities and new ideas. For instance, the main benefit of the first roadmap that is developed within an organization is likely to be the communication that is associated with the process, and a common framework for thinking about strategic planning in the business (Phaal, Farrukh, & Probert, 2004).

To assure a successful implementation in an organization, acceptance and support from individuals and teams of any initiative are necessary. Gerdsri, Vatananan, & Dansamasatid (2009) describe the most important and influential players; the idea champion, the champion team, the TRM operation team and the support team.

The *idea champion* is the one who provide the energy to move the subject to gain acceptance for the change. His/her role is to guide the individuals of the organization through the implementation process

and narrow down constraints along the way. The team of strategic business unit (SBU) idea champions, *the champion team*, is the driving force of the TRM initiative and is critical to its success. The team is responsible for finding proper ways to integrate the roadmapping process into the on-going business. The *TRM* operation team is a working group assigned and handpicked by the idea champion of each SBU. The members are recruited from major divisions, like strategic planning, marketing, logistics, engineering or product development. The administrative body of the TRM implementation is called the TRM support team, which is initiated by the idea champion. Its main function is to capture, store and distribute information and resources. This team will become the resource centre of the TRM initiative.



The involvement of these key players in each stage is visualised in figure 12.

Figure 12: Dynamics of TRM implementation (Gerdsri, Vatananan, & Dansamasatid, 2009)

4.1.4 BEST PRACTICES

The implementation of technology roadmapping allows the company to focus on its strategic continuity by exploring and communicating the relationships between evolving and developing markets, products and technologies over time. Based on the experiences of the case studies and best practices in the literature (Oliveira & Rozenfeld, 2010; Gerdsri, Assakul, & Vatananan, 2010, Phaal et al, 2004), next key issues can be summed up for successful mapping and implementation:

- Senior management support is important (Phaal, Farrukh, & Probert, 2004).
- Identifying the 'right idea champion' is crucial, because this is the key individual to communicate with top management and rally for buy-in from key stakeholders (Gerdsri, Assakul, & Vatananan, 2010).
- The success of technology roadmapping depends on the support of these influential stakeholders (Oliveira & Rozenfeld, 2010).
- The participation of specialists in the process increases the probability of success (Oliveira & Rozenfeld, 2010).
- Securing management commitment is high priority (Gerdsri, Assakul, & Vatananan, 2010).

- Conducting an initial assessment before planning the TRM implementation for each SBU is necessary (Gerdsri, Assakul, & Vatananan, 2010).
- Roadmapping is a multifunctional process; therefore the involvement of participants form different functional areas is essential (Oliveira & Rozenfeld, 2010).
- Creating an environment supporting open communication is important (Gerdsri, Assakul, & Vatananan, 2010)
- Identifying a proper process owner is also necessary to keep the TRM process alive (Gerdsri, Assakul, & Vatananan, 2010).

4.2 PORTFOLIO MANAGEMENT (PM)

A project portfolio is a set of projects that share and compete for scarce resources and are carried out under the sponsorship and management of a particular organization. Project portfolio management is the periodical process of evaluation and selection of new project proposals and on-going projects under strategic restrictions. Successful project portfolio management needs to contribute to the overall business objectives (Meskendahl, 2010).

Portfolio management and the priorization of new products is vital to succesfull business for many reasons. First, portfolio management is one method by which senior management can operationalize their business strategy. It is about making strategic choices. Second, these new product and technology choices that the management makes today, determines what the business will look like 5 years from now. Portfolio management is also about resource allocation, the allocation of scarce resources at R&D, engineering, marketing, and within the operation. Finally, portfolio management deals with the balancing the number of projects in execution (Cooper, Edgett, & Kleinschmidt, 1999).

For the purpose of this research, the definition of Oliveira & Rozenfeld (2010) has been adopted:

"Portfolio Management is dynamic process in which the portfolio of active projects is reviewed and updated periodically. During the process, current projects are reviewed and cancelled and new projects are assessed, selected and prioritized."

Portfolio management is important for a number of reasons (Cooper, Edgett, & Kleinschmidt, 2000):

- Financial: to maximize return on R&D and technology spending
- To maintain the business's competitive position
- To properly allocate scarce resources
- To forge the link between project selection and business strategy
- To achieve a stronger focus
- To yield the right balance of projects and investments
- To communicate project priorities both vertically and horizontally within the organization
- To provide greater objectivity in project selection

4.2.1 METHODS USED

In literature, several portfolio management methods have been identified. Cooper, Edgett, & Kleinschmidt (2001) researched the popularity of portfolio methods and what distinguishes the best. They found that just because a method is popular, that doesn't assume that it gives the best results. In fact, a confrontational finding was that the most popular portfolio method overall produced the poorest results.

Summed up by popularity, Cooper, Edgett & Kleinschmidt (2001) identified the portfolio methods: financial methods, strategic approaches, bubble diagrams, scoring models, check lists and some other less popular methods. These methods are described in more detail in the next subsections.

4.2.1.1 Financial Methods

Financial methods dominate portfolio management and project selection approaches. These methods include various profit abilities and return metrics, such as Net Present Value (NPV), Return on Investment (ROI) or payback period. In the analysis of Cooper, Edgett, & Kleinschmidt (2001), a total of 77.3 per cent of businesses use a financial approach and 40.4 per cent of these businesses rely on financial approaches.

Most often, the financial method is used to rank projects against each other. The project's expected financial results or economic value is determined, and then used to rank order projects against each other in order to compose the portfolio of projects. A slightly less popular method is the use of a financial measure compared against an acceptable level in order to make Go/Kill decisions on individual projects. Some businesses do both; the project's financial value is used to rank projects against each
other, and also compared to an acceptable level to make Go/Kill decisions (Cooper, Edgett, & Kleinschmidt, 2001).

4.2.1.2 Strategic approaches

The second popular approach is where the business's strategy is the basis for allocation of money across different types of projects. First, money is allocated across different types of projects and into different envelopes or buckets. Projects are then ranked or rated within buckets. A total of 64.8 per cent of businesses use a strategic approach to select their portfolio of projects; for 26.6 per cent of businesses, this is the dominant method (Cooper, Edgett, & Kleinschmidt, 2001).

The dimensions of buckets can vary greatly among businesses, but the most popular splits, dimensions or buckets are: type of market, type of development, product line, project magnitude, technology area, platform types, strategic trust and competitive needs.

Once the different buckets are defined, each with its allocated resources, the question rises: how are projects prioritized within a bucket? Out of research from Cooper et al. (2001) there was found that in most cases no formal method is used. Only strategic issues drive the portfolio selection. In cases were formal methods are used, the most frequently ranking techniques used are 'financial methods' and 'scoring models'.

4.2.1.3 Bubble diagrams

In bubble diagrams (or portfolio maps) projects are plotted on an X-Y plot or map. Projects are categorized according to the zone or quadrant they are in. Popular axes used according to Cooper, Edgett & Kleinschmidt (2001) are summed up in table 5, ranked according to popularity, with the most popular type at the top.

A total of 40.6 per cent of businesses use bubble diagrams; only 5.3 per cent uses this as their dominant methods (Cooper, Edgett, & Kleinschmidt, 2001). Bubble diagrams appear to be more of a supporting decision-making tool.

Type of Chart	Axis 1	Axis 2
Risk vs. Reward	Reward: NPV, IRR, benefits after years of launch, market value	Probability of success (technical, commercial)
Newness	Technical newness	Market newness
Ease vs. Attractiveness	Technical feasibility	Market attractiveness (growth potential, consumer appeal, overall attractiveness, live cycle potential)
Our Strengths vs. Project attractiveness	Competitive position (our relative strengths)	Project attractiveness (market growth, technical maturity, years to implement)
Cost vs. Timing	Cost to implement	Time to impact
Strategic vs. Benefit	Strategic focus or fit	Business intent, NPV, financial fit, attractiveness
Cost vs. Benefit	Cumulative Reward	Cumulative development costs

Table 5: Axes used in popular bubble diagram plots (Cooper, Edgett, & Kleinschmidt, 2001)

4.2.1.4 Scoring models

In scoring models, projects are scored on a number of questions or criteria. The ratings on each scale are added to a total project score. This total score becomes the criterion used to make project selection and/or ranking decisions. This addition is done in a simple or a weighted matter. A weighted matter should be applied when certain questions have greater importance, and therefore, should weight more heavily. A total of 37.9 per cent of businesses use scoring models; in 13.3 per cent this is the dominant decision method (Cooper, Edgett, & Kleinschmidt, 2001).

Scoring models tend to be employed as a prioritization tool. The project score is used to prioritize order projects against each other. Relatively few businesses use scoring models to make Go/Kill decisions.

4.2.1.5 Checklists

Projects are evaluated on a checklist with a set of Yes/No questions. Each project must achieve either all Yes answers, or a certain number of Yes answers to proceed. The number of Yes's in 'Must meet' and 'Should meet' questions is used to make Go/Kill and/or ranking decisions. Only 20.9 per cent of businesses uses check lists; and in only 2.7 per cent is this method a dominant one (Cooper, Edgett, & Kleinschmidt, 2001).

Like bubble diagrams, checklists tend to be viewed more as a supporting tool, with some other method dominating. A checklist is often used as a Go/Kill decision tool, for making Go/Kill decisions on individual projects, and barely for prioritizing of projects. Checklists focuses on individual projects, whereas scoring models are most popular as a prioritizing tool.

4.2.1.6 Others

Twenty-four per cent of businesses indicate that they use some other method. But deeper examination by Cooper, Edgett, & Kleinschmidt (2001) revealed that these 'other' methods are variants or hybrids of the above models and methods.

In summery, the methods suitable for prioritizing or decision making purposes are shown in table 6.

	Prioritizing	Decision
		making
Financial methods	Х	Х
Strategic approaches	Х	Х
Bubble diagrams		Х
Scoring models	Х	
Checklists		Х
Others	Х	Х

Table 6: Suitability of portfolio methods

4.2.2 CUSTOMIZATION

Dependent of the purpose of portfolio management, value maximization, more balance or strategic direction, different tools appear to be suitable (Cooper, Edgett, & Kleinschmidt, 2000).

Goal 1. Value Maximization - To allocate resources in order to maximize the value of the portfolio in terms of business objectives.

Tools used to assess project value include:

- Financial models
- Checklists
- Scoring models

Goal 2. More Balance - To achieve a desired balance of projects in terms of a number of parameters: long-term versus short-term; high-risk versus sure bets; and across various markets, technologies and project types.

Visual charts display balance in new-product project portfolios, such as:

- Portfolio maps
- Bubble diagrams

Goal 3. Strategic Direction - To ensure that the final portfolio of projects reflects the business's strategy, the breakdown of spending across projects, areas, markets, etc., mirrors the business's strategy and that all projects are 'on strategy'.

The Strategic Buckets approach is used by leading firms to ensure that portfolio spending's mirrors their strategic priorities.

4.2.3 IMPLEMENTATION

The portfolio decision process overlaps a number of decision-making processes within the business. Think of periodic reviews of the total portfolio, making go/kill decisions on individual projects continuously and developing new product strategies for the business, with strategic resource allocation decisions included (Cooper, Edgett, & Kleinschmidt, 2001). This highlights the cohesion of portfolio management with other business processes. In order to apply portfolio management successfully, a business needs to be aware of this dependency and align these processes seamlessly.

Some management actions mentioned by Cooper, Edgett, & Kleinschmidt (1999):

- 1. Recognize that portfolio management is vital to new product success. Portfolio management is critical because...
 - portfolio management and picking the right new product projects is fundamental to maintaining your business's competitive position,
 - efficient resource allocation is essential,
 - project selection is closely linked to your business's strategy, and
 - your business must be focused.
- 2. Move toward a recognized, communicated, open, and consistently applied portfolio management approach in your business.
- 3. Next, as you design your portfolio management process, strive for a portfolio management method that is a high-quality, capable method and, at the same time, fits management style of your business. The method should be: realistic, effective, efficient, user friendly, truly used to make go/kill decisions on projects and easily understood by management.
- 4. Fits management's decision-making style. Consider a multiple portfolio methods approach. Best practices firms employed two or three methods per business.

But the first thing to do, before implementing portfolio management tools, is fixing the quality of information when the quality at this moment is questionable or unknown. The fact is, no matter how sophisticated the portfolio selection and decision tools are, if the input is poor, so will the decision-making be (Cooper, Edgett, & Kleinschmidt, 2000).

In previous research, experiences dictate that it is very difficult to implement portfolio management without an effective product process, such as a Stage-gate, in place be (Cooper, Edgett, & Kleinschmidt, 2000; Baker & Bourne, 2014; Cooper, Edgett, & Kleinschmidt, 2006; Cooper, Edgett, & Kleinschmidt, 2002). A Stage-gate system is an effective tool for improving the quality of information generated in projects. First, the system defines the tasks, activities within each stage, the gates define deliverables required, and the method specifies the criteria against which each project is evaluated.

4.2.4 CHALLENGES OR PROBLEM AREAS

Cooper et al. (2000) identified four main challenges or problem areas in businesses performing portfolio management:

- 1. Too many minor projects in the portfolio
- 2. Prioritizing projects against one another
- 3. Making go/kill decisions in the absence of solid information
- 4. Resource balancing

A universal complaint within product development groups: there are too many projects for the available resources. The results of too many projects in the pipeline can be serious. Time to market might start to suffer, people might get thinly spread across projects and start to cut corners and execute in haste and therefore quality of execution starts to suffer. Also the quality of information on projects might get poor, while there is no time for decent market research. Consequently, projects are approved which should be killed. Finally, with people so thinly across projects and trying to cope with their 'real jobs', stress levels go up and morale suffers.

Another challenge is to use the right tools for portfolio management. For instance, the financial method Net Present Value (NPV) was designed for one-of decisions, for example to buy a new piece of equipment. But NPV was never meant for portfolio decisions, where multiple projects compete for the same resources. The method ignores resource constraints. Scoring models are valuable decision tools for evaluating projects. But they too tend to rate projects against absolute criteria, rather than against one another. Bubble Diagrams have the advantage of looking at all projects together, finding more balance within the portfolio. The trouble is that bubble diagrams tend to be information displays only, a discussion tool, and do not produce a list of prioritized projects (Cooper, Edgett, & Kleinschmidt, 2000). This challenge highlights the importance of the use of several portfolio management tools for different purposes. Where one tool falls short, another tool fills in.

For each project, a team is required to submit a business case, which includes information about market size, expected revenue and profits. These data will be key input to prioritization decisions. When this front-end of projects are weak, for instance; dismal market studies, no marketing inputs, barely adequate technical assessment, so will the prioritization of projects and eventually the portfolio be. With low impact projects, poor cycle times and high failure rates as results.

When the quality of the early stage is done better, activities are more expertly executed, better product design, better testing, better launch and a better production start-up. Also the management has the information they needed to make more informed decisions, selecting the winning projects and remove 'the dogs'. The result is a much better portfolio of projects and higher success rates. This highlights the importance for a business to have a well structured and defined product planning process, such as a stage-gate system, implemented and aligned with portfolio management.

Short-term projects are clearly important projects to remain competitive and keep the product line up to date. But if these projects consume all of the available resources, the issue becomes on balance. A certain proportion of the resources must be committed to projects that promise breakthroughs or to changing the basis of the competition; platform developments, innovative products or even technology developments.

The four problem areas described are clearly interlinked, see figure 13 (Cooper, Edgett, & Kleinschmidt, 2000).



Figure 13: Poor portfolio management and no new product processes – cause and effect diagram (Cooper, Edgett, & Kleinschmidt, 2000)

These lack of resources, no portfolio management and no new product process are the causes of all these other problems, which feed on one another, resulting in a downward spiral of negative effects and results, as you can see in figure 13.

Although most businesses in previous studies recognized the need for and importance of portfolio management, there are still issues that need to be addressed. For instance a challenge identified by Cooper, Edgett & Kleinschmidt (2001) is the need to create a positive climate, culture and buy-in for the portfolio method. A key issue in any implementation of a new process is the need to obtain organizational acceptance for the change. Without total management support, the portfolio management process might become a difficult sell.

4.2.5 BEST PRACTICES

As might be expected, the top performers achieve better portfolio performance results across all six performance metrics defined by Cooper, Edgett and Kleinschmidt (2001) projects are better aligned, portfolio contains high value projects, spending reflects the business strategy, projects are done on time, portfolio has a good balance of projects and portfolio has the right number of projects.

What distinguished the best?

- The best performer's' senior management view portfolio management as very important (Cooper, Edgett, & Kleinschmidt, 2006)
- The best performers have an established, explicit and formal method for portfolio management. The method they use features very clear and well-defined rules and procedures for portfolio management; these businesses consistently apply their portfolio methods to all appropriate projects, they treat all projects together as a portfolio. In contrast, lower performing businesses tended to lack an explicit, formal, well-defined, consistently applied portfolio (Cooper, Edgett, & Kleinschmidt, 1999; Cooper, Edgett, & Kleinschmidt, 2006)
- The best performers use an average of 2.4 portfolio management tools each (Cooper, Edgett, & Kleinschmidt, 2000).
- The best tend to rely much less on financial models and methods as the dominant portfolio tool than does the average business (Cooper, Edgett, & Kleinschmidt, 2006).
- The best let the business strategy allocate resources and decide the portfolio much more then do the worst (Cooper, Edgett, & Kleinschmidt, 2006). Business strategy methods are the number one method for the Best, used even more so than the popular financial approaches as the dominant decision tool.

4.3 STAGE GATE SYSTEMS (SGS)

New products can help a company much more quickly and efficiently with a bit of planning before developments start. The basic benefits of the stage-gate process are evident. The model puts discipline into the new product development process and provides the quality focus that is often missing in firms' new product programs (Cooper, 1990).

Stage gate systems has become a popular method for driving new products to market, and the benefits of using such a clear idea-to-launch system has been well documented. Indeed, many well-managed companies, such as Procter & Gamble (P&G) have prospered and profited from using Stage-Gate systems (Cooper, 2008).

For the purpose of this research, the definition of Cooper (2008) has been adopted:

"A stage-gate process is a conceptual and operational map for moving new product projects from idea-to-launch and beyond, a blue-print for managing the new product development process to improve effectiveness and efficiency."

Although conceptually quite simple, as we shall see later, the design, customization and implementation of stage-gate approaches are considerably more complex, due to the dynamics of time, changing organizational structures and the transition of key personal (O'Conner, 1994).

4.3.1 DESIGN & DEVELOPMENT

Twenty-five years ago, Cooper (1990) already recognized that Stage-gate systems are helpful in providing an overview of the entire new product process for senior managers. Giving them structure and a vocabulary for better management and control. During the last years several authors have updated the process, by introducing innovations to the process based on internal and external developments, in order to improve the system.

Besides all the developments, there is still an agreement in literature about the basic design of a stage gate system (O'Conner, 1994; Cooper, 2008; Cooper, 1990; Cooper, Edgett, & Kleinschmidt, 2002). This subchapter describes this basic design and the developments of recent years.

4.3.1.1 Basic Design

Stage-gate in its simplest format, consists of a series of stages, where the project team performs the work, obtains the needed information and organizes the subsequent data integration and analysis, followed by gates, where go/kill decisions are made to continue to invest in the project (Cooper, 2008).



Figure 14: A Stage-Gate system component (Cooper, 2008)

Characteristics of a stage

Each stage is composed of a set of required or recommended best-practice activities needed to progress the project to the next gate or decision point. The characteristics of a stage (Cooper, 2008):

- Each stage should be developed to gather information to reduce key project uncertainties and risks
- The activities inside stages should be undertaken in parallel
- The team members of each stage should be cross-functional
- Each stage costs more than the previous one

Characteristics of a gate

A gate serves as quality control checkpoint, a go/kill and prioritization decision point, and a point where the path forward for the next stage of the project is agreed to.

The structure of each gate is similar and consists of the following (Cooper, 2008):

- Each gate is characterized by a set of deliverables or inputs. The inputs are the deliverables from the previous stage that the project leader must bring to the gate.
- Each gate has a set of exit criteria. The criteria are the items upon which the project will be judged, the assessment that the project must pass at that gate to have the gate opened to the next stage.
- And each gate has got outputs. The outputs are the decisions at the gate, typically a Go/ Kill/Hold/Recycle decision, and the approval of an action plan for the next stage.

The stage-gate system

Usually stage-gate systems involve from four to seven stages and gates, depending on the business and/or the product. A basic stage-gate system is shown in figure 15, with 5 gates and 5 stages (Cooper,



1990).

Figure 15: An overview of the basics of a Stage-Gate system (Cooper, 1990)

The content of the various gates and stages are described in more detail in blocks; block 1: research, block 2: development, block 3: commercialization, in appendix 9.3; Content of a Stage-Gate system, on page 86.

No two processes are identical; each business should create its own customized version by emphasizing different elements and activities. Each business stage-gate system is unique and even each product group stage-gate system might differ. This will be outlined in more detail in chapter 4.3.2. Implementation, on the next page.

Management of the system

Gates should be managed by senior managers who act as "gatekeepers." The role of these gatekeepers includes:

- Review of the quality of the inputs or deliverables
- Assessment of the quality of the project from an economic and business point of view, resulting in a Go/Kill/Hold/Recycle decision
- Approval of the action plan for the next stage (in the event of a Go decision) and allocation of the necessary resources

A gatekeeping group should be multidisciplinary and multifunctional, and its members are senior enough to have the authority to approve the resources needed by the project.

Next to the gatekeepers, per project, a business should allocate a project leader. This project leader drives the project from stage to stage, gate to gate. He or she is well aware of what inputs are required to pass on to the next gate and organizes the team to meet the input requirements of the upcoming gate.

4.3.1.2 Development throughout the years

The most revolutionary development over the past few years is that it has become a scalable process. It evolved to a process that is suitable for very different types and risk levels of projects. From very risky and complex platform developments through to lower-risk extensions and modifications or even to rather simple sales force requests (Cooper, 2008).

Cooper (2008) noted that each type of projects has risk, consumes resources, and thus must be managed. But not all need to go though the full five-stage process as shown in figure 15 on the previous page. The process has thus transformed into multiple versions to fit business needs and to accelerate projects.

Such a scalable process works as follows: all projects should enter Gate 1 for initial screening. The idea screening decision is made here, as is the routing decision. But next, only major new products go through the full five-stage process. Moderate risk projects, including extensions, modifications and improvements, use the three-stage process. And sales-force, marketing or very minor changes in products use the minimal of two-stage route.

Next to the scaling development, leading companies are creating more rigorous Go/Kill decision points and are implementing more effective portfolio management. They recognize that portfolio management must be integrated into the gating process in order to yield the right mix, balance and number of projects, and to deal with the challenge of maximizing the value of the portfolio and ensuring that it reflects their business's product innovation strategy (Cooper, Edgett, & Kleinschmidt, 2002).

4.3.2 IMPLEMENTATION

The benefits of developing new products through a Stage-gate system are well known. Yet implementing such a process can be a challenge. It might get pretty complex due to dynamics of time, changing organizational structures, and the movement of key personal (O'Conner, 1994). This subchapter start with the phases of implementation that can be identified in any change process. It outlines the importance of the uniqueness of a stage-gate system en summed up a few common errors during implementation phases.

4.3.2.1 Phases of Implementation

O'Conner (1994) suggests that the task of implementing a stage-gate process could itself benefit from a process. He highlighted that organizational change experts admit that all successful change initiatives proceed through a logical sequence of phases. He suggests a model of progression with five phases of implementation. Each phase requires inputs and feedback that are top-down, bottom-up and horizontal throughout the organization.

- Phase 1. Laying the foundation (time required, two to four months). Gathering information. Establishing the need for a state-gate process. Analysing the current practices and comparing them to best practices observed outside the organization. Identifying and understanding the hurdles to implementation.
- Phase 2. Gaining Initial commitment (Time required, two to four months). Selling the need for a stage-gate process to all top managers. Outline a process that uses a stage-gate system and takes into account the possible concerns of management. Describing the activities of stages and the criteria of gates. Creating an implementation plan. Gaining the required budget to implement.
- Phase 3. Effective change (Time required, six to twelve months). Training individual stakeholders and management in the process. Motivating active participation in the process. Develop and launch tools to support the process. Initiating new projects into the process. Comparing the collective effort of implementation to those of other organizations.
- Phase 4. Working the transition (Time required, eighteen to thirty months). Seeking continual feedback on the process, analysing the feedback and taking appropriate actions when necessary. Conducting "just-in-time" training. Improving the tools of the process.
- Phase 5. Monitoring and improving (On-going). Rigorous benchmarking and analysing alternative best practices. Seeking for alternative practices and tools to improve the process.

4.3.2.2 Uniqueness of a Stage-gate system

As mentioned in subchapter 4.3.1 Design and Development, on page 42, no two processes are identical. Each stage-gate system must be customized, which makes the implementation even more complex. Each business should emphasize different elements and activities. O'Conner (1994) identified a few key uniqueness's:

Stages and Gates; customization of stages and gates is essential to achieve effectiveness of the process. Gate activities differed somewhat for each of the processes. Activities within stages are different as well.

Process Documentation and Literature; perhaps the most notable differences in implementation are the variety of tools and variations on methods used. For example, support documentation and internal promotional literature for each of the processes varies widely, from extensive manuals, to internal/external brochures, to pocket guides for all gatekeepers.

Other uniqueness's found were the way the organization documents experiences throughout the process, the way the businesses handled the cross-functional teams and the rewarding methods they used were very different handled (O'Conner, 1994).

4.3.2.3 Common errors

Implementing a stage-gate system is not simple, nor quick. Challenges and problems might occur during the process. The main challenge is that implementation is a dynamic and on-going task.

Cooper (2008) identified a few common errors:

Problems with the Stage-gate governance

A common complaint is that gates do not have teeth. The result is that projects are rarely killed. Another complaint at gates is that resources are not committed. Instead, projects are approved, but resources are not, also known as a 'hollow go' decisions. The project leader and team should leave the gate meeting with the resources they need to progress their project.

Many businesses also face troubles defining who the gatekeepers are. For major new product projects, the gatekeepers should be a cross functional senior group, the head of marketing, sales, purchase, operations, and finance. And the gatekeeper groups must involve executives from resource-providing areas so that alignment is achieved and the necessary resources are in place.

Some companies are facing troubles distinguishing gatekeepers and project leaders. The gatekeepers mentor, oversee, and finance the project, much like the owners, managers and coaches of a football team; by contrast, the project leader leads the project and team stage by stage down the field to the goal line, much like the captain of that football team.

Another complaint at the gates concerns the behaviour of senior management when in the role of a gatekeeper. Cooper (2008) attended many senior gate meetings and he identified some bad behaviour:

- Executive 'pet projects' receiving special treatments (note that these projects have the highest failure rates)
- Gate meetings cancelled at the last minute because the gatekeepers are unavailable
- Gate meetings held, but decisions not made and resources not committed
- Single persons gate meetings or decisions by executive edict, the assumption that one person knows all
- Go/kill decisions based on opinion and speculation rather than on facts
- Using personal and hidden go/kill and prioritization criteria. Although this behaviour may be tolerated when senior management are in their own departments, when in the role of a gatekeeper, the rules change. As a gatekeeper, that senior person is no longer a functional boss, but rather a member of a decision-making team, which highlights that the greatest change in behaviour might take place at the top.

Trying to do Portfolio Management without a Stage-gate system

An effective Stage-gate system is essential to complete portfolio management. The gates eliminate the poor projects early in the process and the overall result is a better portfolio. And even more important, a solid stage-gate process leads to reliable information (Cooper, Edgett, & Kleinschmidt, 2002).

O'Conner (1994) on the other hand, state that the most significant factor affecting one project is that there are too many other projects underway or that the business unit does not have the appropriate or necessary resources. It therefore highlights that a poor portfolio of projects can be a serious obstacle to setting up a stage-gate process.

Too much bureaucracy in the idea-to-launch process

A common fault is that companies designed a cumbersome, bureaucratic process with a lot of makework and non-value-added activities. Some results of a to authoritarian process are deliverables overkill with too much paperwork or to much useless activities in the gates with long lists of tasks.

4.3.3 BEST PRACTICES

Within the literature (O'Conner, 1994, Cooper, 1990) key success factors to implementation were identified. Some organizational changes within the business might be needed to implement stage-gate systems successfully.

Manage the expectations

It is relatively easy to communicate to the organization that a Stage-Gate process would yield substantial benefits, but much more difficult is to say when. Making sure that everyone - whether senior managers or individual contributors, understands what the process is, how and why it works, and what should be expected of it and when. Management of the expectations is a crucial factor of implementation.

A project team approach is needed

A project team approach is fundamental in order to organize new product projects through stage-gate approaches. No longer can projects be handed from department to department within a firm; a cross-functional team and leader must carry the project through all stages.

Gates should provide top management involvement

Involvement of senior management as gatekeepers is crucial. Successful new product developments require significant resources and demand the commitment of top management. But also, senior management should be the driving force during the implementation. If senior management is involved at all gate reviews, lower management participation in the process will tend to follow.

Focus on market orientation

Stage-gate systems provide the quality focus that is often missing in firms' new product development processes and they provide a much stronger market orientation in the new product process. The stages of the process typically include a number of market-related activities, such as: user needs and wants research, concept trials, competitive analysis, development of a detailed marketing plan, product tests with customers, trail sell, and formal launch.

The project leader must ensure that these critical steps are executed, unless they are, the project does not pass on to the next gate.

Stage-gating systems provide a focus on homework

The seeds of success or failure are located in the first few steps of the process: the predevelopment or homework stages. The predevelopment activities are important because they qualify and define the project. When projects are poorly defined in the development phase: the target user is not well understood, user needs and wants are vaguely defined, and required product features and attributes are fuzzy. With a poorly defined project, R&D might waste considerable time seeking definition, often recycling back several times to 'get the product right'.

More homework up front encourages changes to occur earlier in the process rather than at the end, when they are more costly. The result is a considerable savings in time and money at the back end of the project and a more efficient new product process.

Parallel processing is an important feature of stage-gate systems

Product managers are often caught between conflicting demands of time efficiency and project effectiveness. Parallel processing compresses the development cycle without losing quality.

Parallel processing, an essential component of stage-gate systems, means that more activities occur in the same period of time, which results in time compression. The process is obviously more complex than the series approach, and therefore requires more skills from the team and requires more cautious management. A parallel process needs to be launched with a well thought out process plan.

Effective project evaluation is critical to successful new product programs

Stage-gate systems are filled with evaluation and bailout points. A project cannot proceed to the next stage until the evaluation is done and necessary criteria have been met. In the early gates, these criteria tend to be largely qualitative and deal with "must meet" and "should meet" questions. At later gates, a stronger financial method is introduced, where expected financial return becomes the focus.

While many factors drive a business's new product development performance, having an effective Stage-Gate systems supported by effective management is an important best practice in new product development itself.

4.4 TOWARDS A HYBRID MODEL

From the literature review on the separate approaches on the three business levels, we can highlight that strategic alignment for new product development is crucial (Cooper, Edgett, & Kleinschmidt, 2006). When the projects are not well aligned, achieving business objectives is unmanageable and may even be impossible. Businesses should develop a new product development strategy, driven by the strategic vision of the company. This strategy should guide the strategic business units and the business's product development directions. Next to these directions, this strategy should help in resource allocation and project selection. In this way, strategy will split the resources across strategic business units, product types, between short-term and long-term projects, between high-risk and low-risk initiatives, between new products and re-ordering, and between platform developments versus updating.

Next, at the front-end of new product development, which is the link between the business objectives and new product development processes, the activities that lead to the actual development of new projects are started. If a business is ineffective at this point, there is a high probability of product failure in terms of financial, strategic or commercial expectations (Oliveira & Rozenfeld, 2010). Inefficiencies at this point can lead to cross-functional lack of clarity, unclear goals, lack of information and ad-hoc decisions.

This highlights the importance of having proper new product development processes in place. These processes should include extended pre-development research and market studies, allowing senior management to make founded decisions considering project prioritizations and selection. When the quality of the early stages is done better, less low impact projects will be executed, prioritization and go/kill decisions can be made on founded data, resources will fit the number of projects better, activities can be more expertly executed, which will result in a better portfolio of projects aligned with strategy, efficient cycle times, higher success rates and a positive impact on sales profit at the end.

In order to gain sustainable impact, it is therefore important to understand the nature of the three business level processes of new product development in the organization, from strategy to the operations, and to know how these processes should relate to each other. Such a hybrid method for new product development from strategy to the actual operation does not yet exist in detail in literature.

A roadmapping approach is considered flexible and capable of integrating the use of other tools to implement and improve its advantages, to eliminate knowledge gaps and improve the results and the quality of decisions made by managers of organizations in following processes. However, Carvalho, Fleury and Lopes (2013) found in their extended literature review that only ten organizations, out of seventy-eight, have effectively used hybrid procedures that combined TRM with other management techniques, like strategy analysis or portfolio management. This confirms the expectation that the process is capable of integrating other processes, but how to integrate other processes, methods or frameworks is not well understood.

Two authors have made the first steps towards an integrated approach: Oliveira & Rozenfeld (2010) and Cooper (2011). Those models focus on the integration of strategic and tactical level, respectively roadmapping and portfolio management. These frameworks are described and discussed in more detail in the next subchapter; technology roadmapping & portfolio management.

As a follow up, the alignment between portfolio management & state gate systems will be discussed. Cooper, Edgett, & Kleinschmidt (2000) propose two approaches how these two processes can be aligned.

The literature review and the results of this alignment analysis will form the input towards a hybrid approach from strategic, tactical to operational processes in chapter 5; A hybrid NPD approach, on page 53.

4.4.1 TECHNOLOGY ROADMAPPING & PORTFOLIO MANAGEMENT

The standalone application of technology roadmapping does not result in a portfolio of products and portfolio management needs a list of projects as input, which should be future-oriented and aligned

with the companies' strategy. If portfolio management is applied without this orientation, it may have a limited list concerning future orientation. The other way around, by implementing a standalone technology roadmap process, several gaps might occur between the projects within the operation and the strategic alignment of all the projects as a whole. Nevertheless, there is little evidence of their specific integration.

Strategy guides the split in resources across product types, between short-term and long-term projects, between high-risk and low-risk initiatives, between new products and platform development versus extensions, up-dates and fixes. It is therefore interesting to implement a Product Innovation and Technology Strategy (PITS) per product type. A PITS should define the goals for this new product type, it should define the arenas for focus (the key markets, technologies and product types that your development effort will focus on), define allocation of resources (across project types, across markets, and across product types), define the attack plan for development in a given arena (being the innovator or the fast follower, or focusing on superior product performance versus best costs) (Cooper, Edgett, & Kleinschmidt, 2000).

In 2011, Cooper visualised the development of such an innovation strategy into an integrated model. He introduced a framework, which maps the process from defining strategy and goals to project selection, prioritization and resource allocation. Although his research was also more focused on being innovative, the model is a valuable input for the purposes of this thesis. The emphasis is different, but the steps form a suitable approach to this issue. Figure 16 maps this framework. The dotted areas have been added for this research in order to highlight the three business levels.



Figure 16: Framework to develop a business' PITS (Cooper, 2011)

As one can see, the framework is more of a follow-up model, than an integrated process. Cooper (2011) treats the strategic level and the tactical level, but an integration of the operation is lacking. He appoints the importance of having an idea-to-launch process, but the link between operational processes is not emphasized.

In addition, this model is mainly top down. When a project is selected, there is no way out. This can cause too many projects for the limited resources available, which can cause poor jobs done on projects with poor cycle times and high failure rates as a result (Cooper, Edgett, & Kleinschmidt, 2000). A top down and bottom up model integrating a state-gate system should prevent these kinds of problems.

The benchmarking studies of the research of Cooper (2011) reveal that five vectors must be in place to undertake innovation and develop successful new products. He states that a business should develop

an innovation strategy that focuses on the right strategic arenas that promise to be engines of real growth first. Second, foster a climate and culture that promotes innovation. In this second step, senior management plays a vital role here in promoting a proper climate in the business. Next, create ideas for integrated product-service solutions. Followed by driving these concepts to market quickly via a systematic and disciplined idea-to-launch system designed for innovation initiatives. And finally, build a solid business case and focus on winners. Also Cooper (2011) highlights that it's essential to do the front-end homework well, building a compelling business case in order to be able to make the right investment decisions.

Since technology roadmapping and portfolio management have complementary features, Oliveira & Rozenfeld (2010) imply the integration as an opportunity to improve the front end, the link between business goals and new product development processes. Their research explored the complementary features of technology roadmapping and portfolio management at the front-end of new product development. Since technology roadmapping and portfolio management are flexible approaches, it is possible to integrate them in different configurations, but Oliveira & Rozenfeld (2010) have made the initial steps of integration, which is of interest for this thesis. They developed a conceptual model, the ITP method, which stands for (I) Integrated, (T) Technology Roadmapping and (P) Portfolio Management.

The ITP-model is visualised in figure 17. In this figure, the dotted areas have been added for this research in order to highlight the three business levels.



Figure 17: ITP method overview (Oliveira & Rozenfeld, 2010)

This integration contributes to align new product development teams with front-end goals. It enables a holistic understanding of the activities; tools and information from the beginning to the end of the frontend. This facilitates the execution of activities and improves quality since it reduces misunderstandings. The process becomes also more efficient in terms of information exchange and communication (Oliveira & Rozenfeld, 2010).

Although this model has a project interrelationships analysis implemented and a path towards new product development design phase, it is unclear how this method relates to the actual new product development operation. The proposed project prioritization models are mainly financial, while the selection is dependent of bucket analysis and critical resource analysis. This can eliminate innovative products in an early stage. Less financial methods and more reliance on strategic approaches can increase the probability of success, mentioned in the best practises in chapter 4.2.5 on page 41.

Next to the strategy of product types, it is important to understand the nature of all the business processes in the organization and how these relate to each other in order to gain sustainable impact.

Layers and sub-layers from the roadmap should, if possible, be compatible with organizational structures and 'language', such as market segments, product architecture and research groups (Phaal & Muller, 2009).

4.4.2 PORTFOLIO MANAGEMENT AND STAGE-GATE SYSTEMS

In businesses with large product portfolios, managing product portfolio performance, using stage-gate system as a new product development process is a crucial part of key value-creating activity (Baker & Bourne, 2014).

Portfolio management and stage-gate systems also have additional features. As mentioned in subchapter 4.3.2.3: Common errors, trying to do portfolio management without a stage-gate systems, considering a bottom up approach, an effective stage-gate system is essential to complete portfolio management. From top down, if too many projects are selected out of strategy, without enough resources, caused by poor portfolio management, setting up a proper stage-gate process is nearly impossible. This underlines the importance of integration of these processes.

Where stage-gate processes fall short in project prioritization and resource balancing, that's where the portfolio methods should integrate.

Cooper, Edgett, & Kleinschmidt (2000) state that the first step towards implementing portfolio management should be having a proper new product development process, such as a stage-gate system. They developed two fundamentally different approaches of how portfolio management tools can be used in conjunction with stage gate systems.

Approach 1: the gates dominates

The idea of this approach is that if your gating or stage-gate system is working well, the portfolio takes care of itself. Therefore, it is crucial to make good decision at the gates. The importance of this approach is on improving gate decision-making on individual projects. The portfolio review serves mainly as a check if the gates are working well. Senior management should meet perhaps once or twice a year to review the portfolio of all projects.

Businesses, which already have a stage-gate process in place, and one that is working well, are using this approach frequently. They add portfolio management to their stage-gate system, almost as a complementary decision procedure.

In this approach, the gates become a two-part decisions phase. The first half is a pass-versus-kill decision. The second half of the meeting involves prioritization of the project under discussion versus the other projects, with use of a portfolio method. In practice this means making a go/hold/kill decisions, and if a project is a go, allocating resources to this project. This approach is therefore especially appropriate when portfolio reviewers and the senior gatekeepers are the same people within the business.

Note that the gates dominate the decision process in this approach: go/hold/kill, prioritization decisions and resource allocation decisions are made in real time, right at the gate meeting. But other projects are not discussed and reprioritized at the gate; only the project in question is given a relative priority level versus the rest.

Approach 2: portfolio review dominates

The viewpoint of the second approach is that every project must compete against the others. A single decision of all projects, with the use of a portfolio method, replaces one of the gates in the gating process.

The Portfolio/Gate 2 decision meeting is where the key decisions are made in this approach. The portfolio review is really a Gate 2 and Portfolio management tool all in one, and held 2-4 times a

year. It is here that the key Go/Kill decisions are made, and, consequently, is a senior management meeting. With all projects at or beyond Gate 2 on the table, the meeting:

- Spots must do and won't do projects
- Scores (forced ranking) the ones in the middle.
- Checks for balance and strategic alignment (using various portfolio charts and bubble diagrams).
- Decided the portfolio: which projects, what priorities, and how many resources.

Both approaches have some advantages and disadvantages. From the examination of Cooper, Edgett, & Kleinschmidt (2000) managers indicated that it is easier to prioritize projects when looking at all projects on the table regularly, as in approach 2. As a follow up, some people have difficulties with the two-part gate approach (approach 1), how does one find resources for a good project when that is the only project being considered?

On the other hand, some managers believe that if projects are to be killed, the project team should be there to defend the project, which is an advantage of approach 1. The gate reviews in approach 1 also provide a much more in-depth assessment than is ever possible when all the projects are considered at a single meeting. But a disadvantage might be that the gate review meetings require a major time commitment from senior management.

The challenge in both approaches is still to select the appropriate new projects, stop poor projects, optimize resource allocation, and link new product development with corporate strategy all at once.

5 A HYBRID NPD APPROACH (A CONCEPTUAL MODEL)

Underpinned by the results of the literature review, a hybrid approach is developed in this chapter. The literature review serves as the theoretical basis for this integrated NPD approach that should align business, tactical and operational, respectively TRM, PM and SGS, business planning processes. Therefore, in this chapter an answer to the research question is given.

The development of the approach will be described in the first subchapter, followed by the visualisation and implementation schedule given in the second subchapter. Which answers the two sub question of the research question.

5.1 THE STO – NPD APPROACH DEVELOPMENT

In this subchapter, the conceptual model STO – a hybrid NPD approach will be discussed. STO stands for (S) strategic, (T) tactical and (O) operational.

In figure 18, on page 55, the STO – NPD approach is visualised. The light grey lines indicate the levels of the business in which this model operates. The aim was to preserve the advantages and integrate the best practices properties from the three different levels of business new product development planning processes into a hybrid approach. A derivative of the initial steps towards a hybrid model of Oliveira & Rozenfeld (2010) and Cooper (2011) has been made concerning the integration of technology roadmapping and portfolio management with two main additions.

The first addition is the dotted loop between the strategic and tactical methods. This line has been added in order to implement a method for technology roadmapping at various levels within a business. Oliveira & Rozenfeld (2010) added this activity to establish the boundaries of the method's application in terms of business unit, market segment and product line. The unit of analysis should reflect the scope the company wishes to consider in the front-end of NPD. But it might occur that a business needs to consider more than one unit: next to a total business overview, also the separate business units to be able to analyse the use of technologies or resources in more depth (Gerdsri, Assakul, & Vatananan, 2010). From a brand perspective, you might need to dig deeper into the products or product lines, market segments and/or technology in the business unit of that brand.

For instance, think of a business with a large portfolio of brands: first unit of analysis might be the company as a whole and considering brand portfolio management. But the next step should be the separate brands. In which the business needs to go through the same process of technology roadmapping, followed by project portfolio management methods. This dotted line represents the possibility to implement and make use of the several methods at different unit of analysis, for instance at corporate level, for the separate strategic business units or per brand.

Second, the reliance on a more strategic approach at the beginning of the new product development process, next to financial methods, is made to increase the probability of success of this approach. In figure 18, on page 55, visualised by an increased presence in the sets of portfolio management tools, both prioritizing and decision making tools. As mentioned in subchapter 4.2.5, best practices of portfolio management tools and tend to rely much less on financial methods as the dominant portfolio tool than does the average businesses. The best let the business strategy allocate resources and decide the portfolio; business strategy methods are the number one method for the best performers (Cooper, Edgett, & Kleinschmidt, 2006).

Another best practice is having an established, explicit and formal method for portfolio management. The method should have clear and well-defined rules and procedures in order to apply the portfolio methods to all appropriate projects and treat all projects together as a portfolio (Cooper, Edgett, & Kleinschmidt, 1999; Cooper, Edgett, & Kleinschmidt, 2006). This leads to the next level of integration; tactical versus operational alignment. To treat all projects as a portfolio, approach 2, where a portfolio review dominates, described in subchapter 4.4.2 Portfolio management and state-gate systems, seems to be most suitable. This is also the most appropriate alignment when not yet a proper idea-to-launch system is available, which makes this model better generalizable in the end.

In this approach, a single decision of all projects, with the use of a portfolio method, replaces one of the gates in the gating process, visualised figure 18 on the next, by a loop in gate 2. The viewpoint of the second approach is that all the projects selected from gate 1 must compete against all projects already in execution.

Note that this alignment is only necessary for all new ideas and should be held 2-4 times a year. It is here were the Go/Kill decisions about new projects, but also about current projects in execution, are made and is a senior management meeting. This enables the business to look very closely to the use and deployment of their total package of resources, without requiring a major time commitment from senior management, who already run quickly out of time. One disadvantage is that the project team is not available to defend a project at this decision gate. We therefor suggest that in gate 2, the teams for major new ideas, can present their idea within 15 min, before the traditional gate 2 goes into operation. If there are still questions after the gate 2 meeting, one or two team members can be called in for more information and details. This has been visualised in figure 18 by a pre- gate two hour, a presentation hour.

Gate 1, is a moderate screen, and amounts to exposing the prioritized projects to a handful of key 'must meet' and 'should meet' criteria using portfolio management tools, like checklists. These criteria should deal with strategic alignment, project feasibility, differential advantage, synergy with the business core business and resources and market attractiveness for instance. This has also been visualised by a loop in figure 18 on the next page.

In lateral gates, in gate 3 in this generic STO – NPD approach, a stronger financial method can be used when expected financial returns becomes the focus, visualised also by a loop in figure 18, on the next page.

In the STO – NPD approach the scaling development of a stage-gate system is implemented. Dependent on the risk level of the project, it should go through a full five-stage process, a medium risk three-stage process or a low risk two-stage process. High risk projects are new products or product lines in the business, medium risk projects can be extensions, modifications or improvements to current products and low risk projects might be sales-force or marketing request or even minor changes in products.



Figure 18: STO - a Hybrid NPD approach

5.2 FROM ABSTRACT APPROACH TO USAGE

The approach developed in the previous subchapter is still pretty abstract. In order to make this hybrid approach more comprehensible, this chapter runs through the main blocks of the approach.

The unit of analysis of the STO – NPD approach should reflect the scope the company wishes to consider. This activity establishes the boundaries of this approach in terms of corporation, business units, market segment and product lines.

Next, the business drivers that establish the direction and targets in the new product development process should be analysed (*business strategy analysis*). The performance dimensions of the product line, which represents quantitative and qualitative product aspects, should be examined (Oliveira & Rozenfeld, 2010).

If the unit of analysis considers more then one business unit, the priorities may be different due to the possible existence of independent strategies in each business unit. We therefor suggest that the separate business units should be examined independently and perhaps even by different teams.



In order to define the strategic focus of a business, the TRM T-plan workshops (Phaal, Farrukh, & Probert, 2004) can be executed.

The workshops consist of the following content and should be executed cross-functional (Oliveira & Rozenfeld, 2010):

Figure 19: TRM T-plan workshops

The main aim of the first workshop is to execute a *market analysis (external)* for the unit of analysis examined. Here the business should identify and prioritize market and business drivers that represent market needs and trends. Some examples of market drivers are: customized products, cheaper products, smaller sizes, etc.

The second workshop is the *product analysis*. Appropriate product feature concepts are to be identified that could satisfy the business and market drivers. Some examples of product features are type of material, modular framework, size specifications, etc. In order to determine the most important features the impacts between the drivers and the product features is evaluated using easy grids.

The technology / resources analysis (internal) involves identifying the technologies and resources and evaluating their ability to deliver the product features. Based on this information, the company can ascertain whether or not the required technologies or resources are available, for instance enough production capacity, accurate purchase partners, design specialism, the right number of skill and expertise among employees, etc.

The result of the three workshops is three business areas connected to each other by relevant grids. In the fourth workshop the information in the preceding activities are analysed to formulate product strategies. In this activity the actual generic roadmap is developed, integrating business, market, product and technology information. The relationships indicated in the roadmap define the strategic focus for new product development. In addition, the roadmap clarifies product opportunities.

Out of this strategic focus, several attack plans should be developed. This activity involves the definition of product concepts and projects that meet the product strategies. A template describing the minimum information required proposing new product development projects should be used. For instance, such a template might include: project type, market segment, estimated price, potential revenue, primary market requirements, product vision, main product materials and components, critical competencies, estimated resources and product life cycle planning (Oliveira & Rozenfeld, 2010).



Figure 20: PM customization

Next the proposed new product projects should be ranked relative to each other.

The STO – NPD approach shows three methods for prioritizing projects; business strategy methods, financial methods and scoring model.

Dependent on the business objectives, each company should make their own selection in order to prioritize the projects against each other (PM customization). The portfolio management methods the business choses to use in this phase should feature very clear and well-defined rules and procedures. Remember from best practices, in this initial phase of new product development, companies should mainly rely on business strategy methods and much less on the popular financial methods. The management team should fulfil this phase and brand / product managers should play a major role in the delivery of the necessary information.



Figure 21: SGS implementation

output this As an of management team meeting, a project plan or a collection plan should be developed. Within this collection plan, products or projects should be categorized by newness and / or risk level. This categorization is necessary in order to select a properscaled stage gate system for the project.

The basics of this stage gate system are derivatives of the system of Cooper (1990) and Oliveira & Rozenfeld (2010). All projects go through the initial moderate screen, Gate 1. In gate 1, the prioritized projects are exposed to a checklist of 'must meet' and 'should meet' criteria. This is where the first go/hold/kill decisions are made.

Stage 1 is the preliminary assessment. This inexpensive stage has the objective to determine the project's technical and marketplace, like size, potential and likely acceptance. Activities might be: a library search, contact with key users or focus groups, sales force feedback, or perhaps a concept test with a handful of potential users. Stage 1 should gather information at low costs and in a short time, so the project can be re-evaluated more thoroughly at Gate 2.

For new products, gate 2 is the point where all the projects selected from gate 1 must compete against all projects already in execution, with the help of the new information obtained in stage 1. In a pregate2 meeting, project teams may present their ideas towards the management team when necessary. For example, if a projects risk level is high that additional explanation and interactive discussion is needed. This is the point where more reliability on financial methods is wise, but in order to oversee the whole projects span, bubble diagrams can be of great help. Also business strategy methods are still applicable here.

Stage 2 is the final stage prior to product development. The project must be clearly defined. Market research to identify customer's needs, wants and preferences should be executed. Competitive analysis is also part of this stage. An operational appraisal can also be part of stage 2, where issues of manufacturers cost to manufacture and essential investments are examined. If appropriate, detailed legal/patent/copyright work is undertaken too. And finally, a financial analysis should be conducted as an input to the next gate. For instance, a discounted cash flow approach, complete with sensitivity analysis.

Gate 3 is the last point at which the project can be killed before entering substantial spending. It is the final stage prior to development. The project is subjected to the set of 'must meet' and 'should meet' criteria again and because of heavy spending commitment as the result of a Go decision at this gate, the results of the financial analysis are an important part of this screen.

A second part of this gate concerns the definition of the project. The project must be well defined, including target market definition, definition of the product concept, specification of a product positioning strategy, and delineation of the product benefits to be delivered. Also there must be agreement on essential and desired product features, attributes and specifications. The development plan and the preliminary operations and marketing plans should be reviewed and approved at this gate.

Stage 3 is the development of the product and a detailed marketing and operation plan should be executed here. An updated financial analysis is prepared and the legal/patent/copyright issues are resolved in this stage.

Gate 4 is the post-development review. Which is a check on the progress and the continued attractiveness of the product and project. The development progress is reviewed. This gate should ensure that the work has been completed in a quality that is desirable. The developed plans should also be reviewed for probable future execution.

Stage 4 is the validation stage. This is where the viability of the entire project should be tested. Activities can be: in-house product tests, user or fields trials, pilot production, pre-test market and/or trial sell. Also a revised financial analysis should be done in order to check on the continued viability of the project based on new and more accurate revenue and costs data.

Gate 5 is the pre-commercialization decision. It is the final point at which the project can still be killed. Financial projections play a key role in the decision to move ahead. Finally, the operation and marketing plans should be approved for implementation in the next stage. Stage 5 is the final stage and involves implementation of both the marketing launch plan and the operations plan.

This entire process and its three key parts are visualised in figure 22.



Figure 22: STO – NPO approach implementation areas

This research reveals that new product development planning processes from strategic vision, via portfolio management, towards stage gate systems can be and should be aligned in order to do the right projects and doing the projects right. Two methods, technology roadmapping and stage gate systems need to be integrated in the business according to the STO – NPD approach. Portfolio management should be customized for the business, but the several portfolio methods are mainly linked to either technology roadmapping processes or the stage gate systems.

Fundamental elements before implementing a STO – NPD approach are the existence of crossfunctional teams and an open and transparent culture. A project team approach is needed for this approach and top management involvement is crucial during the whole process, from implementation to continuation.

5.3 A STO – NPD APPROACH IMPLEMENTATION

A business is a web of interconnections and therefore, a change in one area might have an impact on others. Change management approaches help business's to manage and guide their people through changes, like a new STO – NPD approach.

A STO – NPD approach implementation probably means some changes within the business, in the way people work and in the way people think. In general, people do not like change. Resistance to change commonly comes from employees who have negative attitudes or counter-productive behaviours. The responses of individuals toward changes originate from a variation of their status quo; lack of trust and understanding, fear of the unknown and uncertain future, different perception on the benefits gained from a change, as well as reservation of organizational culture valuing tradition and usual ways. In uncertain times, for instance during a re-organization, resistance can become a daily matter. It is therefore even more important to guide individuals through a process of change (Gerdsri, Assakul, & Vatananan, 2010).

First a method for preparation and a method for management of change will be outlined. Next, the application of these methods during the implementation of a STO – NPD approach will be described.

5.3.1 ADOPTION OF A NEW APPROACH

To effectively manage change, key players need to understand the elements of change and a stepby-step process leading the change. Gerdsri, Assakul, & Vatananan (2010) suggest the Prosci's ADKAR model to prepare individuals for the change and the eight steps of change from Kotter's to manage the change.

The ADKAR model focuses its attention on five elements to prepare individuals for a change (Gerdsri, Assakul, & Vatananan, 2010):



Figure 23: Prosci's ADKAR model¹

- (A) Awareness \rightarrow to be able to change, the business and its members need to be aware of the need for change.
- (D) Desire → represents the willingness to support and engage in a change. To motivate people to change, the organization needs to create positive or negative consequences influencing individual's desire for engaging in a change.
- (K) Knowledge \rightarrow individuals need to know what proper behaviour towards the change looks like.
- (A) Action \rightarrow basic practices need to be provided to attain the abilities and skill necessary for engaging in a change.
- (R) Reinforcement \rightarrow individuals need some reinforcement to keep the good behaviour going. Reinforcement consists of both internal and external factors.

¹ https://frontlinemanagementexperts.wordpress.com/2015/04/17/using-a-change-model-like-adkar/

Kotter's eight steps of change introduce the eight-step process to manage change, which relates directly to the eight most common errors management make when confronted with change (Gerdsri, Assakul, & Vatananan, 2010):



Figure 24: Kotter's eight steps of change model²

Step 1 – Create a sense of urgency – with the prime objective to raise awareness of the need and importance for making changes. It will generate interest and motivate individuals to take action.

Step 2 – Create a guiding coalition – which helps to facilitate the decision-making process. Enhance a synergistic effect among individuals by providing some assistance to a team in areas like communication and knowledge sharing.

Step 3 – Develop a clear, shared vision – a motivating picture of the future. A vision helps to coordinate actions and to identify behaviours that should be stimulated or eliminated.

Step 4 – Communicate the vision – which is essential to develop understanding for the importance of the change and to convince individuals to buy-in. It helps to gain access to alternatives and captures the commitment of the team members. By sharing the desired future, it creates motivation and provides support to coordinate all stakeholders through the transformation.

Step 5 – Empower people to act on the vision – obstacles must be removed. Each individual must be enabled to take broad-based actions leading through or needed for the change.

Step 6 – Create short-term wins – to build the credibility needed to sustain the change effort over time. These timely, visible and meaningful achievements provide a visible proof to stakeholders that the work is paying off and thus helps to maintain motivation, moral and commitment of key players.

Step 7 – Consolidate and build on the gains – it is crucial for change leaders to continue assigning their commitment to the team and management as well as to maintain the urgency and not to announce victory to soon. The short-term wins can be used to move the change effort forward and enable key players to take on greater changes.

Step 8 – Institutionalize the change – in this final step, new behaviours are woven into the organizational culture. To achieve a sustainable integration of the change, change leaders need to adopt the new approaches themselves as well as recognize and optionally reward the stakeholders for adopting them.

² http://fromstartuptogrowup.com/the-8-steps-of-successful-change-management/

5.3.2 AN ACTIVITY GUIDELINE FOR A STO - NPD APPROACH IMPLEMENTATION

In this subchapter an activity guideline will be sketched with the use of the change methods elaborated in the previous subchapter. Remember that the STO – NPD approach elements need to be customised for each business to fit with its organizational situation. The implementation plan given below is general and can be applied to most situations. The timetable is indicative only and may vary per business. Within this schedule a reference is made to figure 22 on page 59, which visualizes the three levels of business NPD planning processes integrated in the hybrid model.

Change management concepts		ment concepts		
			Action plan to support the STO-NPD	
ADKAR	Eight ste	eps of change	Implementation process	
Awareness	зтер і	of urgency	 Understand the value of applying STO – NPD in the organization. Analyse the current practices of NPD processes at the three business levels Build awareness of why STO - NPD implementation is 	2 – 4 montris
			needed.	
Dosiro	Stop 2	Form a quiding	 ✓ Gain acceptance and support from top-management. ✓ Discuss the details of STONPD concept 	2.4 months
Desile	316p 2	coalition	 A Raise urgency of why STO – NPD implementation is necessary to all stakeholders. 	2-4 monins
Knowledge	Step 3	Develop vision and strategy	 Develop a vision, objective, and scope of STO – NPD implementation for the business. 	6-12 months
		-	 Set the plan to rollout STO – NPD implementation. 	
	Step 4	Communicate vision	 Communicate the vision for the buy-in and support from stakeholders. 	
			 Form a team responsible for activities related to STO - NPD implementation. 	
			 Provide the fundamental elements of STO - NPD to all stakeholders. 	
			 Prepare all stakeholders to be ready to implement the STO – NPD process. Training sessions must be provided 	
			 Considering IRM / SGS. Customise the STO – NPD process to fit with the 	
			organizational setting. o Select proper TRM	
			 Customize and design PM process (PM customization, see figure 22) 	
	Stop E	Empowerpeeple	• Define the SGS	19.20 months
ADIIITY	sieb s	Empower people	 Plan and organize a series of workshop sessions to develop the roadmap within STO - NPD (TRM T-plan workshops, see figure 22) 	10-30 11011115
			 Plan and organize a series of workshop sessions with key players to develop the state-gate system within STO 	
			(SGS implementation, see figure 22)	
			 Allocate responsibilities to individuals in the composite team as well as set up ground rules for the team 	
			participation ✓ Allocate project leaders and acteleapers	
	Step 6	Create short-	 Milecule project reducts and gatekeepers Maintain the momentum and energy from all 	
		term wins	stakeholders throughout the STO - NPD development	
			 Remove barriers blocking stakeholders from carrying out their STO - NPD activities 	
			 Conduct review sessions and conduct 'just-in-time' training 	
Reinforcem	Step 7	Consolidate	✓ Establish the procedures to review and improve the	On-going
ent	Stor 0	gains	process or tools when necessary	
	этер я	the change	 integrate ional side approach (link the methods) into organization's existing processes 	
			✓ Transfer ownership of the process to the proper people	
			or teams.	

Table 7: A STO-NPD implementation plan

6 PRACTICAL CASE – SPORT5

To achieve the objective of this thesis:

Develop an approach, which aligns strategic, tactical and operational business planning processes concerning new product development, in order to support Sport5 to become more long-run oriented and to achieve business objectives.

Sport5 should be equipped with a hybrid NPD planning approach. This chapter analyses the current situation of Sport5 per business level on the basis of the knowledge obtained from the literature review. The STO – NPD approach developed in chapter 5 is used to advice Sport5 in an effective and efficient way, to show how the organization can improve its processes. This chapter also advises Sport5 on how to implement and integrate such a hybrid model.

In order to analyse and describe the current situation at Sport5 at the three NPD planning levels, qualitative research is conducted. As mentioned before it was undesirable to question employees knowingly about the subject of this research, because it could cause more distress. Because of the ongoing reorganization and new business models announced, possible new working processes could be the reason for employees to build resistance to current changing processes, which is definitely undesirable. This research therefore requires extra caution.

In a qualitative field research, the researcher will be confronted with decisions about the roll the researcher plays as an observer and his relations with the people he's observing (Babbie, 2010). Observers can play several roles, including participating in what they want to observe. Babbie (2010) highlights that in any event, whenever the researcher acts as the complete participant, he must let people see him only as a participant, not as a researcher. This confirms the importance of the caution of this research exportation and the silence of its existence.

In this case it was easy to become a complete participant of the process, because I was working as the marketing & communication coordinator at Sport5 at the moment of research. I was confronted with the idea-to-launch processes because of my function and with issues at the front end, because this was my working area on a daily basis.

6.1 METHODOLOGY

Qualitative research is typically used when research is conducted in the field. It is generally carried out to study social sciences and developing a thoughtful understanding of these disciplines (Babbie, 2010).

Concerning the regulative cycle, see figure 25 on the next page, this chapter is the initial step towards possible exploitation of the new STO – NPD approach, a re-design for new product development processes from strategy to operation, at Sport5.



Figure 25: The regulative cycle (van Aaken, 1994 (originally van Strien, 1986))

This research of the current situation can be divided into two parts. The first part is the analysis of the processes by participation in these processes and the non-structured interviews about the process during daily work meetings. The second part is a semi-structured interview with the commercial manager of Sport5, who is aware of this research.

Considering the analysis of the process by participation, you should think of questions implemented in conversations during brand development meetings and marketing meetings, but also during canteen visits, travel time, etc. In this way I was able to talk to brand managers, product designers of the several brands, graphic designers, quality employees and product purchasers about current new product development processes and the alignment with business strategies, other processes and projects.

The second part was a semi-structured interview with the commercial manager. Contrasting with survey interviewing, the qualitative interview is based on a set of topics to be discussed in depth rather than based on the use of standardized question (Babbie, 2010). Semi-structured means the interview is based on a list of predetermined subjects that are transformed to a list of open questions, which are to be covered during the interview. The advantage is that the interview becomes flexible; the order of the questions may vary and additional questions may be added. This suits the nature of an exploratory research. The subjects in this case were; strategic vision, portfolio management and new product development processes at Sport5. The semi-structured interview is shown in appendix 9.4; Semi-structured Interview, at page 89.

6.3 CURRENT SITUATION SPORT5

The current situation of Sport5 is difficult to describe, because the process is not fixed. For each project and even per product designer, the process can vary. Although the initial steps towards a more systematic idea-to-launch process have been taken, the current situation is still unclear. Therefore the current NPD process of Sport 5 will be discussed with the aid of the new STO – NPD approach. For convenience, the three levels of the company are discussed separately, which is visualised by the three block in the background of figure 26.



Figure 26: Current NPD process Sport5

6.3.2 CURRENT NPD PROCESS AT SPORT5 - STRATEGIC



corporate level, At the mission and vision of Sport5 have been formulated last year. In previous years these strategic issues were stored only in the heads of the board members and the strategic goals were not always clear to everyone. Without proper communicated objectives and a clear vision, the management of the operation becomes complicated.

Figure 27: Current strategic NPD process at Sport5

As a consequence, there used to be a lack of focus and strategic direction throughout the business. Although within the last two years, due to a re-organization, a new external chief executive officer and a new commercial manager, the focus and the long-run orientation have been approved, still business plans, brand plans, sales- and marketing plans, documentation and reference books are lacking. Without these documentations, it is difficult to communicate strategy and the business objectives to lower levels within the organization.

On a strategic level, the financial targets are set for the next five years, but the shifts in the market and the future (external and internal factors) are not taken into consideration in a structured manner. At brand level Sport5 mainly works with key performance indicators (KPI's). Financial targets are set for all brands, largely based on the sales of the previous years.

These financial objectives should give some guidance considering the focus of Sport5 for 2015. Logically, most resources and financial investments will be allocated to these brands, but in practice this is not always for the best. As mentioned by Cooper, Edgett & Kleinschmidt (2006), the best let the business strategy allocate resources and decide the portfolio much more then the worst performers do.

There is a need for a (visual) representation of the future at corporate level and per brand. What comes to path and which models and resources do we need to prepare ourselves for developments in the market to gain competitive advantages now and in the future? This vision must be clearly communicated in the organization and everyone must stand behind it, understand the consequences and move away from personal gain.

The STO – NPD approach helps develop and visualise the future. It contains a simple visual framework to support the dialogue and communication necessary to develop and deploy corporate strategy. The roadmap developed in the STO – NPD approach seeks to capture the environmental landscape, threats and opportunities. It adds extensive market research and investigates whether the proper techniques and adequate resources are provided in the organization. The roadmapping promotes knowledge sharing and facilitates the development of a collective vision that can lead to action and collaboration.

This corporate level roadmap should function as the visualisation of the corporate and brand focus for the next years. This business strategy analysis should be an input to the separate brand strategies and vice-versa.

6.3.4 CURRENT NPD PROCESS AT SPORT 5 - TACTICAL LEVEL



Figure 28: Current tactical NPD process at Sport5

The last year, Sport5 attempted to work with well-structured year plans, considering three presentations of collections: the AW textile collection, the AW accessories collection and the SS textile collection per brand. It has been agreed that a collection plan per brand should be developed in advance. This collection plan should contain components such as product lines, new products, scheduling, colours, fabrics, technical developchecklist ments and а considering these specifics (commercial manager, 2015).

In a management team meeting, composed of CEO, commercial manager, product manager and financial controller, the collections are discussed and updates and new ideas are formulated. With this guidance, the product manager instructs the team of purchase and product design.

Also seen in the functional structure of Sport 5, the 'product managers' main task is purchase. All textiles, of all brands, are the responsibility of one purchaser. The same counts for the hard goods, all brands under one roof. In the past, the brands had some sort of similar strategy, similar price / quality ratio. However, in recent years, several brand segments has been added with other strategies, different positioning, different pricing and more fashionable items that for example require higher qualities. In the current situation, the strategic reference, to which the projects should be verified, is unclear, undefined and it too much relies on financial perspectives.

In an organization with an extensive brand portfolio like Sport5, the process of new product development from strategy till operation will stay unclear and unmanageable without proper brand/product management. Brand strategies must be defined in order to align and verify products and projects, in every department involved.

At Sport5, new ideas for products and collections are the result of four factors (commercial manager, 2015):

1. Sales figures

Based on sales numbers one will decide whether a collection is purchased or if there's a need for creating a new collection. However, this is not a structured process. It's mainly based on the successes of the past and on the point of view: "this is how we've done it for years", which is not desirable (commercial manager, 2015). Successes of the past are no guarantee for the future.

2. Product management supplier's developments

At the product level, the suppliers are also inspiring the product managers. They develop new techniques and are acting at the forefront of new product development. In terms of NPD, you could say Sport5 is leaning a lot on suppliers and takes a close look at what the main brand are developing. Therefore, Sport5 mainly can be labelled as a trend follower instead of a trendsetter, which is a strategic choice. But that's not for every brand suitable. This highlights the importance of having separate brand strategies and new product development processes.

3. The sales representatives

The representatives have a say on the collections. However, the input they give is questionable and unstructured. Their feedback is most of the times not quantitative and therefore not significant. The market needs are mainly based on a gut feeling. Which of course does not mean is always wrong; the best ideas came from gut feelings, but in an organization like Sport5, such information is no longer applicable or accepted. It should be founded in some kind of way, with good arguments or quantitative data.

Last year, Click View was introduced. Click View is a tool that analyses sales. It seeks to provide the ability to support the needs for significant quantitative data. However, the use by representatives is still minimal (commercial manager, 2015).

4. Financial KPI (key performance indicator).

The organization searches for key performance indicators to fit the operational objectives. These KPI's can assess performances, and, if necessary, can make sure disappointing performances are timely adjusted or adapted. KPI's are formed on a strategic level and should give guidance to the organization. However, the translation of financial KPI's on a strategic level to objectives and product plans in the operation level proves to be difficult.

Within the current situation of Sport5, only short-term product developments will be conducted. Long term projects and gaps in the market cannot be identified during this process. A comprehensive market analysis per brand and even per brand segment is missing. What are competitors doing? How is the market demand shifting? What are the future needs of your target groups? Who are the users of the products?

Another concern is the basis on which such a collection plan has been established. Too much reliance on a gut feeling and the past, with poor market research, no competitive analysis and no proper portfolio management tools to allocate resources can cause tremendous issues. For instance: poor project prioritization, failure to kill projects, too many projects for the limited resources available and poor launch, with low impact on sales profit, poor cycle times and high failure rates as a result (Cooper, Edgett, & Kleinschmidt, 2000). Of which a few are indeed detected in a cause and effect diagram of Sport 5 at page 15.

Therefor portfolio management tools should play a role at tactical level. This means in management meetings and in collection meetings.

The checklist mentioned on the previous page in the first paragraph, does suggest that in addition to financial considerations, other tools are used. However, by asking to see a collection plan or such a checklist, an astonished reaction followed (CEO, 2015; product designers, 2015).

The big question is whether such a collection scheme, attempted to start using from August 2014, is actually implemented. The product managers are responsible in this process, but do they really see the need and the benefits of changing towards a, in the current situation initial, structured process? Or is their focus solely on purchase?

The cause and effect diagram sketched by Cooper, Edgett & Kleinschmidt (2000), figure 13, on page 40, is applicable to the current situation of Sport5. Inefficiencies and not sufficient research at this level, is one of the main causes of all the issues sketched in the cause and effect diagram of Sport5, figure 3 at page 15. The best performers have an established, explicit and formal method for portfolio management. The methods they use features very clear and well-defined rules and procedures, they consistently apply their portfolio methods to all appropriate projects and treat all projects together as a portfolio (Cooper, Edgett, & Kleinschmidt, 2006). The STO-NPD approach helps develop and implement such a well-defined, formal portfolio management approach.

6.3.5 CURRENT NPD PROCESS AT SPORT5 - OPERATIONAL LEVEL



At operational level, Sport5 is lacking considering structured and well-defined portfolio management during the idea-to-launch process. Extensive market research and competitive analysis are missing other and departments are not or hardly involved in these processes.

Figure 29: Current Strategic NPD process at Sport 5

Processes are executed in series, therefore there is no time for marketing in the end. Other departments, such as sales and marketing should play a greater role in the new product development process. Marketing can provide the CEO and its management team with the information they need to make founded decisions. Sales should translate the needs and necessities of the users, of course well founded, no gut feelings allowed.

The first collection meeting can be seen as the research and pre-development phase of the 'new ideas' at Sport5. This is where the first Go/Kill decisions are made. But in the current situation some crucial interrelationships between the brands and projects are missing. How do you allocate resources if you do not look at the portfolio as a whole?

In addition, the total process of idea-to-launch is not sufficiently clear. Because of the complex structure of all brands and segments, the design and purchase departments lose the overview quite fast. There are plans for collections and there are schedules with optimum timeframes, however when the overall process is not transparent, following up these schedules is almost impossible. There is no structured process for new product development processes from idea-to-launch per product type.

Additional colours are applied and incorporated into the collection, without getting the various departments involved. Risky, innovative products are being sampled, even though no comprehensive market research for this product has taken place. Sport5 tends to take a jump in the market and make every effort for such products, without realizing what the effects on other processes are and without involving the other departments, like marketing, in an early stage. The marketing department might find out about new products only when they are nearly or already on stock (marketing & communication coordinator, 2015).

Minimal changes or updates on products are often deficient communicated, both horizontally and vertically. However, the modern consumer cares whether pants contain zippers or not, and whether the colour is black or anthracite.

And because brand strategy is lacking and unclear, the project cannot be aligned. As an example, in the past it was not inconceivable that a new product was designed for a new market, was discussed in collection meetings and sampled, whereupon a marketing plan was composed and in the final stage the plug was pulled out, because on second thought that 'the target group was too small' for the product. Despite of the fact the launch plan was practically complete and all the stages of sampling and testing had been completed. This was obviously an inefficient and expensive process. This should be avoided in the future at all times (marketing & communications coordinator, 2015).

The planning and introduction of collection plans form the initial steps towards a more streamlined process, but the procedure is still far from clear or accepted. Let alone that the implementation of the process is being managed and supported in a proper way. As long as the product managers in the current situation have recognized no 'necessity', and there is no one responsible for the brand development short-term, medium-term and long-term, implementing a new process tends to be anything but effective.

In conclusion, the current NPD process is not cross-functional, nor parallel executed. The biggest challenges for Sport5 lie in renewal and customization of their idea-to-launch process according to the STO – NPD approach. A change in culture and a cross-functional team approach are necessary. But the positive thing is that the initial steps have been taken, stakeholders have been informed about the necessity for more structured processes. This might be of some advantage introducing a STO – NPD approach at Sport5.

6.4 IMPLEMENTATION OF THE STO-NPD APPROACH AT SPORT5

To successfully develop and implement a STO-NPD approach, like the individual methods, it is important to establish clear objectives for the process. The process needs to be customised and synchronised with an organization's structure and objectives. In order to maintain the STO - NPD process after implementation continuously, it is crucial to integrate the process into on-going business and planning activities in an organization.

This subchapter develops the initial steps for an implementation of the STO-NPD approach at Sport5.

6.4.1 INITIAL CUSTOMIZATION OF STO - NPD IN CURRENT STRUCTURE OF SPORT5

In which way the separate business level planning processes included in STO – NPD relate to the complex portfolio of Sport5 is visualized in figure 30. We can divide the several levels in five parts; [TRM1] vision of Sport5, [TRM2] vision per brand, [PM1] portfolio management of Sport5, [PM2] portfolio management per brand, [SGS] Stage-gate systems per project or product.



Figure 30: Visual representation integration TRM, PM and SGS processes at Sport5

Two levels of integration of a STO-NPD approach should be distinguished, dependent of the unit of analysis; level 1 strategic business opportunities (TRM1+PM1) and level 2 strategic brand management (TRM2 + PM2 + SGS), which are clearly interlinked.

Level 1: Strategic business opportunities

1. Vision of Sport5 – TRM1

Objective: overall development and communication of strategic focus, which indicates that the 'strategic planning' map (appendix 9,1, figure 32.c) is most appropriate. This type is suitable for

general strategic appraisal. It highlights the opportunities and threats at a business level. This roadmap focuses on the development of a vision of the future business, in terms of markets, business, products, skills, culture, etc. Therefore, TRM2's should function as an input to the development of TRM1. Comparing the current position, with the future vision, identifies gaps. Strategic options are explored to bridge the gaps.

Time: scope of 5/10 years

Layers: Because Sport5's product portfolio is not focused on high-technology, this TRM is more set up based on market-, brand portfolio- and resource analysis. International markets should be considered.

The output should be a TRM for Sport5, from where attack plans, considering new business models or brand/product opportunities, can be derived.

Project leader: CEO

Team members: management team (MT).

2. Portfolio Management of Sport5 – PM1

Portfolio management tools should be customized to the objectives of the development of the STO – NPD approach at this level. Mainly strategic decisions should be made considering the strategic options, therefore strategic buckets and the use of bubble diagrams (for instance risk vs. reward) are appropriate.

The development and adjustment to this STO – NPD approach should be done on an annual basis. In addition to monthly management team meetings for the daily business and the several collection meetings, an annual strategic STO – NPD process meeting to adjust the TRM1 should be put in motion.

Level 2: Strategic brand management

1. Vision per Brand – TRM2

Per brand a customized strategic roadmap should be developed.

Objective: generic strategic assessment per brand, which indicates that the 'strategic planning' map (appendix 9.1, figure 32.c) is also most appropriate here. If the objective is more concerning product planning, for instance when the unit of analysis is a product line, than the most common type of technology roadmaps is more appropriate: the 'product planning' map (appendix 9.1, figure 32.a)

Time: scope of 5 years

Layers: Because the brand portfolio is not focused on high-technology products, this TRM is also set up based on market segments-, brand- and resource analysis. Because of the same construction as a TRM1, these strategic brand roadmaps are easy to integrate into the overall strategic map.

The output should be a TRM per brand, from where attack plans, considering new market segments and product opportunities, can be derived. A vision for the next five years should be outlined in the TRM and a brand strategy should be formulated in the Marketing and Sales plan for the next year. The roadmaps per brand should also serve as inputs for the total Sport5 TRM1.

Project leaders: Brand / Product managers

Team members: R&D managers, brand designers, marketing and sales managers / coordinators.

2. Portfolio Management per Brand – PM2

The concrete initiatives, the output of the TRM2, should be exposed to a set of portfolio management tools. Main objective is to prioritize the projects in order to forge the link between project selection and business strategy, to properly allocate scarce resources, to provide greater objectivity in project selection and to achieve a stronger focus. Strategic buckets, financial methods or scoring models can be used to prioritize the projects.

This prioritization is a management team decision at Sport5. All brands and projects must be viewed next to each other in order to make sustainable decisions, with a balanced portfolio and high valuable projects with the right amount of resources as a result.

The output is a prioritized set of initiatives for this brand, which can easily be vertically and horizontally communicated within the organization, by means of a collection plan and marketing perspectives. These initiatives should go through a well-defined idea-to-launch system developed together with the company.

3. Stage-gate systems per project or product – SGS

Due to the dynamics of time, changing organizational structures and the transition of key personal, the implementation of a state-gate system itself is complex.

Where in PM1 the brands and in PM2 all the new initiatives per brand are force ranked against each other, during the stage-gate process, portfolio management tools are being used several times for different purposes:

At gate 1: the initial screen \rightarrow the moderate screen, this is where the projects are exposed to a handful of key 'must meet' and 'should meet' criteria, with care defined by the business. Financial criteria should not be part of this first screen.

At gate 2: the second screen \rightarrow here is where the projects should be re-evaluated against all projects in execution.

At gate 3: decision on business case \rightarrow this is where the projects are exposed to more financial methods. The following stages contain major investments. It is the last gate where projects can be killed at relatively low costs.

Each stage should be cross-functional, which is new to Sport5. Sport5 should implement a team approach for their new product development processes. Which means composing team members for new initiatives from departments like; Purchase, R&D, Product Design, Graphic Design, Marketing and Sales in an early phase.

Because the various specialisms are involved in an early stage, processes can be executed in parallel instead of sequential, for instance the definite product design and the accompanying marketing plan, which is much more efficient than current processes.

The map developed at level 1 and the prioritized attack plans provide the framework in which the separate brand plans should be developed. The other way around, maps developed at level 2 are relevant information to and should be integrated in the overall business strategy map of level 1. This makes the two processes inseparably, shown in figure 31: Interrelationship between STO – NPD approaches at Sport5, on the next page.


Figure 31: Interrelationship between STO-NPD approaches at Sport5

6.4.2 IMPLEMENTATION OF STO-NPD APPROACH AT SPORT5

In order to implement the STO-NPD approach at Sport5, the business can follow table 7 on page 62: A STO – NPD implementation plan.

In general terms, this table considers three phases: introduction, development and integration, which will be described broadly below.



Table 8: Phases of implementation of a STO - NPD approach

1. Introduction

The goal of this phase is to introduce the STO - NPD approach to the business.

This research is the initial step in creating a sense of urgency. It highlights the issues at the company and it proposes a hybrid best practices approach, in order to redesign the processes and improve the effectiveness and efficiency of new product development processes at Sport5.

The details and urgency should be discussed with management team members. Therefore an internal presentation during a management team meeting should be held, presenting the results of this research. It is important for key players as well as for the team to prepare themselves by learning and understanding the STO – NPD approach. Therefore two presentations should be held, the first to introduce the concept and the second to explain how the STO-NPD approach actually works.

For the vision, objective and scope of the STO - NPD approach within Sport5, acceptance and sponsorship from top management is crucial. The success of this approach depends on the support of these influential stakeholders, therefore, securing management commitment should be of high priority.

A cross-functional project team approach should be introduced concerning the several brand product development processes, which is one fundamental element of STO - NPD.

The success of this phase can be measured through the acceptance of the concept among key stakeholders and the development a customized STO – NPD method.

2. Development

The objective of this phase is to develop and customize the elements of the STO – NPD approach. As a result, the complete hybrid approach should be launched and implemented. In collaboration with the stakeholder the processes of TRM and SGS should be developed:

- Workshop sessions with the management team should be held to develop the technology roadmaps
- Workshop sessions with management team and product managers concerning the several portfolio management tools should be held in order to develop a customized portfolio management method
- Workshop sessions with product managers and cross-functional project team members should be held to develop and integrate the idea-to-launch process into daily work processes
- Project leaders and gatekeepers should be selected
- Cross-functional project teams should be selected

The most important thing in this phase is to collect and analyse data from internal an external sources. During the workshop sessions, colleagues from different departments should work together in generating and sharing knowledge and expertise to develop the two processes included in the STO – NPD approach: TRM and SGS.

The success of this phase can be measured through the quality of the content presented in the TRM1 and TRM2's, as well as the acceptance and the usage of the SGS by the project team members.

3. Integration

The function of this phase is to integrate the STO – NPD approach into the continuing business operation. Ownership is important; it is therefore necessary to assign a group of people who are responsible for regularly maintaining and updating the process. But not only for the process as a whole, also for the separate elements; for instance, the CEO or the Commercial manager could be responsible for the TRM1, the brand / product managers for the TRM2's. In direct collaboration with the stakeholders these project leaders should be assigned in an early phase.

The success of this phase can be measured through the quality of the total alignment within the STO – NPD approach, but also with the alignment with other business processes, as well as the continuation of the processes on a day-to-day basis.

7 CONCLUSION AND DISCUSSION

All activities in the master thesis were intended to answer the research questions and to achieve the research objective. The main objective had been to develop an appropriate hybrid new product development approach in order to support Sport5 to become more long run oriented and to achieve business objectives. This chapter concludes with the main findings contained during the development of the hybrid STO – NPD approach process and necessities for the approach to be applicable. Next recommendations are given to Sport5 considering implementation and deployment. This report finishes with the limitations of this thesis and future research opportunities.

7.1 CONCLUSION

In order to answer the research question, "What is an appropriate approach to integrate strategic, tactical and operational new product development planning processes", an extended literature review is carried out on the three business levels. Out of the theories and best practices of technology roadmapping, portfolio management and stage gate systems, a conceptual hybrid approach has been developed, the so-called STO – NPD approach. In which STO stands for strategic (S), tactical (T) and operational (O).

This STO – NPD approach, which is visualised in figure 18 on page 55, assists in developing a new product development strategy, driven by the strategic vision, and guides the process from idea-to-launch. Within this approach the resources will be split across the unit of analysis, for instance strategic business units, brands or product types. It seeks to the optimal balance between short-term and long-term projects, between high-risk and low-risk initiatives and between new products and updates.

Because of the integration of the three business levels, the STO – NPD approach makes the front-end of new product development more effective. Proper market research will be executed, market and business drivers will be analysed, and product feature concepts will be developed on the basis of information that has been gathered. In this manner, the product concepts will fit strategy and are well founded. Based on this substantiated information, presented in a technology roadmap and well defined in new product development strategies, senior management is able to make better decisions considering portfolio issues and project prioritization and selection. Which will result in clear attack plans and proper collection plans at the front end.

The STO – NPD approach highlights that an established, explicit and formal method for portfolio management is important. Dependent on the business objectives, each business should design its own portfolio management method in which projects can be prioritized against one another. The STO – NPD approach recommends that the first prioritization phase, considering the new initiatives, should rely less on financial methods and more on business strategy methods. In this manner, the business strategy allocates resources and fills the portfolio, which is a characteristic of the best performers (Cooper, Edgett, & Kleinschmidt, 2006).

Next within the STO – NPD approach, the selected projects go through a well-defined and scalable idea-to-launch system. Dependent of the risk level of the project and its newness, the project goes through a 5, 3 or 2 stage gate system. If the complete process needs to be fulfilled, gate 2 functions as a project battle gate. In this gate projects should compete against one another to assure resources are allocated to the 'winners' and to assure that the portfolio is still strategically aligned.

Three crucial necessities have been identified for successful STO – NPD deployment: senior management involvement, open communication and a cross-functional team approach.

Senior management support and involvement

During the introduction, development and integration phases of implementation, senior management commitment and involvement is important. Without management support, implementing a new structured process is going to be difficult. If senior managers encourage the use of new product development processes and are standing behind the actions to be followed, subordinates will follow. But supporting the method is not enough, senior management should also play a key role in development of the STO – NPD approach. In collaboration with senior management the approach must be customized. The customized process should aim for specific business objectives and it should fit into current business processes.

Open communication and transparent culture

Without open communication and a transparent culture, implementing new processes is difficult. At the three business levels, strategic, tactical and operational, people should know why certain change must be implemented and what kind of benefits it entails for them.

A cross-functional team approach

Next to the cross-functional senior management team, who should customize the STO – NPD approach, at operational level cross-functional teams are also needed. Cross-functional senior management teams should execute the gate meetings. In this manner, the business will be able to perform tasks, resulting from the gates, in parallel instead of in series, which is a timesaving feature of the system.

A plan should be developed how to implement this hybrid approach into a particular business. Change management models can help the approach to be adapted. The activity guideline for a STO – NPD approach, visualised in table 7 at page 62, can support the implementation. In order to fill knowledge gaps in the business, customization phases and model usage workshops are taken into account. This contributes to the success of integration and implementation at any particular business.

As the activity guideline implicates, many of the benefits of a STO – NPD approach are derived from the initial steps. These steps bring together people from different departments, providing the opportunity to share information and perspectives. The STO – NPD approach provides meetings for consideration of issues, opportunities and new ideas. The communication associated with the development of the customized approach is a beneficial side effect.

7.2 **Recommendations**

In order to achieve the objective of this research, "To develop an approach, which aligns strategic, tactical and operational new product development processes, in order to support Sport5 to become more long-run oriented and to achieve business objectives", chapter 6 analysed the current situation of Sport5, after the hybrid STO – NPD approach had been developed in chapter 5.

It is clear that the STO – NPD approach can help Sport5 solve the issues identified in the cause and effect diagram on page 15. Main causes identified were: no clear new product development strategy and no fixed procedures available, goals and positioning per brand not fixed nor communicated throughout the organization and no proper market research. These causes had some adverse effects: sales force felt not heard, there was no time for marketing and achieving deadlines concerning different products and projects was very difficult.

These issues suggest that general structured procedures about product development planning, from strategic to operational level, were missing. And in addition Sport5 needs more alignment between strategy, portfolio and new product development planning, in order to achieve business objectives and be able to respond to changes in market demand more quickly. It is therefor recommended to implement the STO – NPD approach at sport5. But in order to be able to do so, Sport5 must be aware of some necessary changes for successful implementation and integration of a STO – NPD approach within its organization.

A main concern at Sport5 is the organizations structure. It is recommended to transit towards a teamapproach before implementing the STO – NPD approach. Next it is recommended to work towards proper brand management, while this is currently lacking.

From functional structure towards a team-based structure

The current structure of Sport5 is functional, with a disadvantage that the communication between the functional groups might not be effective. Successful implementing a STO – NPD approach requires a cross-functional team approach and in the current state, Sport5 does not encourage team settings like these. It is therefore recommended to work towards a team-based structure in which the entire organization is made up of teams. Each team bring together employees from different functional areas, which are focused on specific tasks or projects. It highlights horizontal communication and information sharing, because representatives from all departments are coordinating their work and skills to complete specific collective projects.

In the future, a divisional structure might be needed. In contrast to the functional approach, in which common skills and resources group employees, a divisional structure occurs when departments are fully grouped together based on organizational outputs. At Sport5 each division can represent a brand. The major disadvantage, and the reasons why the transition towards a divisional structure is questionable for Sport5 at this moment, is the duplication of resources and the high cost of running separate divisions.

Implementing the STO – NPD approach

By implementing the STO – NPD approach, Sport5 will be forced to execute proper market-, product-, research. This will lead to a well-defined strategic focus at corporate and brand level. This research will highlight the gaps in the market and will lead to clear attack and collection plans. The visual representation of strategy, an output of the STO – NPD approach, helps in understanding and communicating the business objectives throughout the organization.

Next the analysis of resources is a valuable addition to the organization. Through this analysis, the capacity of the business and departments is reviewed and when resources are lacking, the capacity or portfolio can be adjusted early in the process. Next, projects can be prioritized on the basis of this analysis, and put on hold when resources are finished.

The STO – NPD approach will also assist in developing and implementing a well defined, formal portfolio management method. The selected tools should support the go/hold/kill decisions and should lead to the appropriate number of valuable projects carried out, with a more balanced and valuable project portfolio as a result.

Implementing the STO – NPD approach does also mean redesigning the whole idea-to-launch process in collaboration with senior management and members of the process. The STO – NPD approach stimulates parallel processes, which will save time in the end. Next it executes projects cross-functionally, and therefore several departments are integrated in an early phase of new product development, in which time for marketing and sales plans is created.

Proper brand management

The next recommendation considers brand management. In the current situation, this responsibility falls in between: between the product managers and the product designers. And the marketing department is not yet integrated into the new product development process. The focus of the product managers at Sport5 is on purchase and the focus of the product designers on short- / medium-term collections. This highlights the gap of proper brand management. The process of new product development from strategy till commercialization is not managed. On short notice, the STO – NPD approach can function as the brand management device, while cross-functional teams must be set and are held responsible for the management of the process. In the long run though, it is recommended to consider brand managers per brand.

7.3 LIMITATIONS

The aforementioned key findings should be put in perspective. The design process and the conducted research are not free of limitations. There are several conditions that limit the possibilities of this research and its conclusions.

The first limitation is the explorative nature of this research. Exploratory research assists to identify the best research design, but it cannot be claimed that it is. Next, findings determined by qualitative research could be disposed to significant interpreter bias. I was working for three years at Sport5 at the moment of research and although I tried to look at the current situation of Sport5 objectively and without bias, it cannot be said with certainty it did.

Next during the development of the hybrid approach, some choices are made based on the characteristics of Sport5. Although these choices were also made in order to design a most generalizable approach, it does not mean the choice would be for the best in every situation. For instance, if a business already has a proper idea-to-launch process running, an optimal hybrid approach could be differently equipped.

Also a limitation is the 'unaware' involvement of interviewees in the analysis of the current situation. Even though this was pretty easy to solve, because of my job at Sport5 at the time of research, in depth conversations and discussions on relevant topics was not possible. Aware involvement may have resulted in more diverse and more robust input.

The fourth limitation to this research is the broad scope of research, from strategic to operational level. Because of this broad scope, in depth research on each level was difficult due to time issues. In an early phase I therefore choose to focus on well-known methods for new product development planning on each level: technology roadmapping, portfolio management and stage gate systems. It therefore cannot be claimed that the developed hybrid approach is the best or only approach to answer the research question.

The last limitation is time. Besides the fact that this research had to be executed next to a full time job, also a limited time is set for a Master thesis execution.

Despite these limitations, the STO – NPD approach can be valuable for Sport5 and other companies. It is theoretically founded, and the elements of the approach have already shown practical applicability in literature. Therefore, further research may build on the findings of this thesis.

7.4 FUTURE RESEARCH

This research highlights the importance of the integration of strategic, tactical and operational business processes. The focus of this research is on new product development. This research can provoke other researchers to further customize the current STO – NPD approach, but I can imagine it's also an interesting topic for other focus areas, less related to new product development. For instance for service companies or maybe even at health centres, where appearance and exportation of services are directly linked.

Another direction is to build on to this thesis and broaden the scope of the research area. This research can be broadened on strategic level, in which more literature is reviewed and various methods will be investigated dependent on the characteristics of more than one organization.

Another extension, quantitative research related to the use of this hybrid approach would be valuable. To conclude, this thesis serves as a solid basis on which further research can be built, it might provoke researchers to go into more detail or challenge the results by taking a broader theoretical basis.

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9 APPENDICES

9.1 EXAMPLES OF TECHNOLOGY ROADMAP TYPES BY PHAAL, FARRUKH, & PROBERT (2004, PP. 11-15)

Phaal, Farrukh, & Probert (2004) examined a set of approximately 40 roadmaps, which has revealed a rang of different types, clustered into 16 broad areas.

The following eight types of roadmap have been identified by Phaal, Farrukh, & Probert (2004, pp. 11-15), in terms of intended purpose:

- (a). Product planning: This is by far the most common type of technology roadmap, relating to the insertion of technology into manufactured products, often including more than one generation of product. Fig. 32a shows a Philips roadmap, where the approach has been widely adopted. The example shows how roadmaps are used to link planned technology and product developments.
- (b). Service/capability planning: This type is more suited to service-based enterprises, focusing on how technology supports organizational capabilities. Fig. 32b shows a Royal Mail roadmap, based on an initial T-Plan application, used to investigate the impact of technology developments on the business. This roadmap focuses on organizational capabilities as the bridge between technology and the business, rather than products.
- (c). Strategic planning: This type is suitable for general strategic appraisal, in terms of supporting the evaluation of different opportunities or threats, typically at the business level. Fig. 32c shows a roadmap format developed using T-Plan to support strategic business planning. The roadmap focuses on the development of a vision of the future business, in terms of markets, business, products, technologies, skills, culture, etc. Gaps are identified, by comparing the future vision with the current position, and strategic options explored to bridge the gaps.
- (d). Long-range planning: This type is used to support long-range planning, extending the planning horizon. Roadmaps of this type are often performed at the sector or national level (foresight), and can act as radar for the organization to identify potentially disruptive technologies and markets. Fig. 32d shows one of a series of roadmaps developed within the U.S. Integrated Manufacturing Technology Roadmapping Initiative. This example focuses on information systems, showing how technology developments are likely to converge towards the 'information-driven seamless enterprise'—a 'nugget'.
- (e). Knowledge asset planning: This type aligns knowledge assets and knowledge management initiatives with business objectives. Fig. 32e shows an example developed by the Artificial Intelligence Applications Unit at the University of Edinburgh, enabling organizations to visualize their critical knowledge assets, and the linkages to the skills, technologies and competencies required to meet future market demands.
- (f). Program planning: This type focuses on implementation of strategy, and more directly relates to project planning (for example, R&D programs). Fig. 32f shows a NASA roadmap (one of many) for the Origins program, used to explore how the universe and life within it has developed. This particular roadmap focuses on the management of the development program for the Next Generation Space Telescope (NGST), showing the relationships between technology development and program phases and milestones.
- (g). Process planning: This type supports the management of knowledge, focusing on a particular process area (for example, new product development). Fig. 32g shows a roadmap developed using T-Plan to support product planning, focusing on the knowledge flows that are needed to facilitate effective new product development and introduction, incorporating both technical and commercial perspectives.
- (h). Integration planning: This type focuses on integration and/or evolution of technology, in terms of how different technologies combine within products and systems, or to form new technologies (often without showing the time dimension explicitly). Fig. 32h shows a NASA roadmap, relating to the management of the development program for the NGST, focusing on technology flow, showing how technology feeds into test and demonstration systems, to support scientific missions.



Figure 32: Examples of technology roadmap types (purpose): (a) product planning; (b)service/capability planning; (c) strategic planning; (d) long-rang planning; (e) knowledge asset planning; (f) program planning; (g) process planning; (h) integration planning.

The following eight types of roadmap have been identified by Phaal, Farrukh, & Probert (2004), relating to graphical format:

- (a). Multiple layers: This is the most common format of technology roadmap comprising a number of layers (and sub layers), such as technology, product and market. The roadmap allows the evolution within each layer to be explored, together with the interlayer dependencies, facilitating the integration of technology into products, services and business systems. Fig. 33a shows a Philips roadmap, used to support integration of product and process technologies to the development of functionality in future products.
- (b). Bars: Many roadmaps are expressed in the form of a set of bars, for each layer or sub layer. This has the advantage of simplifying and unifying the required outputs, which facilitates communication, integration of roadmaps, and the development of software to support roadmapping. Fig. 33b shows a Motorola roadmap, relating to the evolution of car radio product features and technologies.
- (c). Tables: In some cases, entire roadmaps, or layers within the roadmap, are expressed as tables (time vs. performance or requirements). This type of approach is particularly suited to situations where performance can be readily quantified, or if activities are clustered in specific time periods. Fig. 33c shows a tabular roadmap, including both product and technology performance dimensions.
- (d). Graphs: Where product or technology performance can be quantified, a roadmap can be expressed as a simple graph or plot—typically one for each sublayer. This type of graph is sometimes called an experience curve, and is closely related to technology S-curves. Fig. 33d shows how products and technologies coevolve.
- (e). Pictorial representations: Some roadmaps use more creative pictorial representations to communicate technology integration and plans. Sometimes metaphors are used to support the objective (e.g., a tree). Fig. 33e shows a Sharp roadmap, relating to the development of products and product families, based on a set of liquid crystal display technologies.
- (f). Flow charts: A particular type of pictorial representation is the flow chart, which is typically used to relate objectives, actions and outcomes. Fig. 33f shows a NASA roadmap, illustrating how the organization's vision can be related to its mission, fundamental scientific questions, primary business areas, near-, mid- and long-term goals, and contribution to U.S. national priorities.
- (g). Single layer: This form is a subset of Type A, focusing on a single layer of the multiple layer roadmap. While less complex, the disadvantage of this type is that the linkages between the layers are not generally shown. The Motorola roadmap is an example of a single layer roadmap, focusing on the technological evolution associated with a product and its features (the graphical roadmap matrix is supported by additional documentation and software is used to link together roadmap layers).
- (h). Text: Some roadmaps are entirely or mostly text based, describing the same issues that are included in more conventional graphical roadmaps (which often have text-based reports associated with them). The Agfa white papers support understanding of the technological and market trends that will influence the optics sector.



Figure 33: Examples of technology roadmaps types (format): (a) multiple layers; (b) bars; (c) tabular; (d) graphical; (e) pictorial; (f) flow chart.

9.2 EXAMPLES OF TECHNOLOGY ROADMAP TYPES BY LEE & PARK (2005, p. 575)

Lee & Park (2005, p. 575) examined a set of approximately 8 roadmaps based on time frame, information source (internal or external) and scope of the map (product or technology).



Figure 34: Examples of Technology roadmap types Lee & Park (2005, p. 575)

9.3 CONTENT IN A STAGE-GATE SYSTEM (COOPER, 1990, PP. 51-53)

Idea - The new product process is initiated by a new product idea, which is submitted to Gate 1, Initial Screen.

Gate 1: Initial Screen

Initial screening is the first decision to commit resources to the project. If the decision is Go, the project moves into the Preliminary Assessment stage. Thus Gate 1 signals a preliminary but tentative commitment to the project: a flickering green light.

Gate 1 is a "moderate" screen, and amounts to exposing the project to a handful of key "must meet" and "should meet" criteria. These criteria deal with strategic alignment, project feasibility, magnitude of the opportunity, differential advantage, synergy with the firm's core business and resources, and market attractiveness. Financial criteria are not part of this first screen. A checklist for the "must meet" criteria and a scoring model (weighted rating scales) for the "should meet" criteria are used to help focus the discussion and rank projects in this initial screen.

Stage 1: Preliminary assessment

This first and inexpensive stage has the objective of determining the project's technical and marketplace merits. A preliminary market assessment is one facet of Stage 1 and involves a variety of relatively inexpensive activities: a library search, contacts with key users, focus groups, and even a quick concept test with a handful of potential users. The purpose is to determine market size, market potential, and likely market acceptance.

Concurrently, a preliminary technical assessment is carried out, involving a quick and preliminary in-house appraisal of the proposed product. The purpose is to assess development and manufacturing feasibility, and possible costs and times to execute.

Stage 1 thus provides for the gathering of both market and technical information at low cost and in a short time, so the project can be reevaluated more thoroughly at Gate 2.

Gate 2: Second screen

This gate is essentially a repeat of Gate 1: the project is reevaluated, but in the light of the new information obtained in Stage 1. If the decision is Go at this point, the project moves into a heavier spending stage.

At Gate 2, the project is again subjected to the original set of "must meet" and "should meet" criteria used at Gate 1. Here, additional "should meet" criteria are considered, dealing with sales force and customer reaction to the proposed product, the result of new data from Stage 1. Again, a checklist and a scoring model facilitate this gate decision. The financial return is assessed at Gate 2, but only by a quick and simple financial calculation (for example, the payback period).

Stage 2: Definition

This is the final stage prior to product development. It is the stage that must verify the attractiveness of the project prior to heavy spending. And it is the stage where the project must be clearly defined. Here, market research studies are undertaken to determine the customer's needs, wants and preferences that is, to help define the "winning" new product. Competitive analysis is also a part of this stage. Another market activity is concept testing, where the likely customer acceptance of the new product is determined.

At Stage 2, a detailed technical appraisal must focus on the "do-ability" of the project. That is, customer needs and "wish lists" must be translated into technically and economically feasible solutions. This might even involve some preliminary design or laboratory work, but it should not be construed as a complete development project. An operations appraisal can be a part of Stage 2, where issues of manufacturability, costs to manufacture, and investment required are investigated. If appropriate, detailed legal/patent/ copyright work is undertaken. Finally, a detailed financial analysis is conducted as an input to Gate 3. This financial analysis typically involves a discounted cash flow approach, complete with sensitivity analysis.

Gate 3: Decision on Business Case

This is the final gate prior to the Development Stage, the last point at which the project can be killed before entering heavy spending. Once past Gate 3, financial commitments are substantial. In effect, Gate 3 means "go to a heavy spend."

The project is once again subjected to the set of "must meet" and "should meet" criteria used at Gate 2. Next, the qualitative side of this evaluation involves a review of each of the activities in Stage 2, checking that the activities were undertaken, the quality of execution was sound, and the results were positive. Finally, because a heavy spending commitment is the result of a Go decision at Gate 3, the results of the financial analysis are an important part of this screen.

A second part of Gate 3 concerns definition of the project. At Gate 3, agreement must be] reached on a number of key items before the project proceeds into the Development Stage. These items include target market definition; definition of the product concept, specification of a product positioning strategy, and delineation of the product benefits to be delivered; and agreement on essential and desired product features, attributes, and specifications.

Plans that chart the path forward the development plan and the preliminary operations and marketing plans are reviewed and approved at this gate.

Stage 3: Development

Stage 3 involves the development of the product and (concurrently) of detailed test, marketing, and operations plans. An updated financial analysis is prepared, and legal/patent/copyright issues are resolved.

Gate 4: Post-development review

The Post-Development Review is a check on the progress and the continued attractiveness of the product and project. Development work is reviewed and checked, ensuring that the work has been completed in a quality fashion. This gate revisits the economic question via a revised financial analysis based on new and more accurate data. The test or validation plans for the next stage are approved for immediate implementation, and the detailed marketing and operations plans are reviewed for probable future execution.

Stage 4: Validation

This stage tests the entire viability of the project: the product itself; the production process; customer acceptance; and the economics of the project. A number of activities are undertaken at Stage 4:

- In-house product tests: to check on product quality and product performance;
- User or field trials of the product: to verify that the product functions under actual use conditions, and also to gauge potential customers' reaction to the product;
- Trial or pilot production: to test and debug the production process, and to determine more precise production costs and rates;
- Pretest market, test market, or trial sell: to gauge customer reaction, measure the effectiveness of the launch plan, and determine expected market share and revenues;
- Revised financial analysis: to check on the continued economic viability of the project, based on new and more accurate revenue and cost data.

Block 2: Development

Gate 5: Pre-Commercialization Decision

This final gate opens the door to full commercialization. It is the final point at which the project can still be killed. This gate focuses on the quality of the activities at the Validation Stage and their results. Financial projections play a key role in the decision to move ahead. Finally, the operations and marketing plans are reviewed and approved for implementation in Stage 5.

Stage 5: Commercialization

This final stage involves implementation of both the marketing launch plan and the operations plan.

Post-Implementation Review

At some point following commercialization, the new product project must be terminated. The team is disbanded, and the product becomes a "regular product" in the firm's line. This is also the point where the project and product's performance is reviewed. The latest data on revenues, costs, expenditures, profits, and timing are compared to projections to gauge performance. Finally a post-audit--a critical assessment of the project's strengths and weaknesses, what we can learn from this project, and how we can do the next one better is carried out. This review marks the end of the project.

Block 3: Commercialization

9.4 SEMI-STRUCTURED INTERVIEW

Goal: Expose the planning processes at Sport5 at different levels of business and outline the decision process from strategic level to operational level of Sport5.

Attendees: Commercial Manager and Marketing & Communication Coordinator.

- How would you describe the overall product planning processes and skills of Sport5?

Operational

"A stage-gate is both a conceptual and an operational model for moving a new product from idea to launch. It is a blueprint for managing the new product process to improve effectiveness and efficiency. Although conceptually quite simple, as we shall see later, the details, design, and operationalization of stage-gate approaches are considerably more complex."

- How does Sport5 manage her (product) projects?
- Which tools are used?
- Sketch the process from Idea to Launch?

Tactical vs. Operational

- What criteria are used to make Go/Kill decisions considering collections?
- What are the functions of a collection meeting?
- Is this a multi-functional meeting? Or is it more a product design department meeting?
- What happens when a project is a GO?

Tactical

"Portfolio Management is dynamic process in which the portfolio of active projects is reviewed and updated periodically. During the process, current projects are reviewed and cancelled and new projects are assessed, selected and prioritized."

- How does Sport5 manage her Portfolio?
- Which tools are used?

Strategical vs. Tactical

- How ensures Sport5 that the various portfolio projects within a brand fit the business strategy?
- Does the portfolio fit business strategy?
- Which criteria are used to make decisions among (product) projects?

Strategical

"Technology Roadmap as a visual representation of the organization's strategy and Technology Roadmapping as a strategic planning tool that allows organizations to link their technology strategies, a.o their resources, with their business strategies."

- Within Sport5, how is strategic planning organized?
- Which tools are used?
- Decisions are made on which criteria (purely financial?)?
- How many years is Sport5 planning ahead?

Improvement possibilities

- What do you think should/can be improved?
- What about the influence of the current re-organization, culture at Sport5?
- How can we make Sport5 ready for functional groups, project teams?