



[STRATEGIC COMMERCIALIZATION]

How strategic commercialization decisions shape and guide the project portfolio in order to contribute to the growth strategy.

Strategic commercialization

*Master thesis for acquiring the title Master of Science
Programme Business Administration
Track Innovation and Entrepreneurship*

October 2011 – April 2012

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Acknowledgements

On 15 October 2011 I started my internship at Capgemini Consulting in Utrecht. I was very excited after completing the application procedure that I could start as intern in the business innovation cluster. This would give me the opportunity to be part of a large organization and to explore life in Utrecht. First of all I would like to thank the former business innovation team, our secretary Martine and especially my external supervisors Remy and Ardo, for making me feel part of the team. I really enjoyed the great working environment, the cluster meetings and, of course, the drinks and 1½ day in Maastricht.

During a masterclass innovation and entrepreneurship, I came in contact with Michel, who was very interested in the methodology I presented there. I decided to use this methodology for my master thesis and asked Michel to be my first supervisor. I would like to thank Michel for his enthusiasm, quick responses to my emails and good suggestions for improving the methodology and thesis structure.

Although the start of my research wasn't easy because Remy, Ardo and I all had different expectations for the research, I came up with a literature framework by the end of December. Thankfully we could meet every two weeks to have discussions on the content and align our ideas and expectations, again thank you both very much for the commitment and energetic meetings. The next step in the research, obtaining the data, went as expected. I would like to thank all the web-survey respondents for their interest and data and a special thanks to the respondents with whom I did additional interviews. The interviews gave me interesting information and the visits at the production sites were interesting and inspiring.

While working on the analysis, I presented my research at a second masterclass innovation and entrepreneurship. After the presentation, the assistant professor volunteered with Michel to be my second supervisor. I would like to thank Erwin for his interest in my research and valuable feedback on the content.

Finally I would like to thank my friends, family and girlfriend Simone for their support and encouragement. My internship and education come to a conclusion with this thesis, time for the next chapter, finding an exciting job opportunity.

Thank you all!

Edwin Grobbink

Management summary

Commercialization is not a process that starts after the launch of an innovation, besides the tactical launch decisions (the marketing mix) it is important to make strategic commercialization decisions during project development. These decisions insure a connection with the market and improve the success rate of innovations. From an innovation strategy point of view, this thesis examines which configurations of commercialization decisions contribute to the cost-effectiveness of the project portfolio.

From the literature research, the project portfolio has been defined as a collection of projects that are carried out in the same business unit, sharing the same strategic objectives and the same resource pool. Project portfolio management is the strategic selection of matured concepts, evaluation of NPD projects and the coordination of resources in the project portfolio. Prior to the project portfolio, the innovation portfolio is concerned with the development and assessment of ideas, which is the maturation of the concept. The innovativeness of a matured concept on a micro level depends on the inter-relatedness of the concept and its technologies with the current product portfolio. This defines a concept either as an incremental product improvement or as a radical new product. On a macro level the innovativeness depends on the newness or distinctiveness in the market. The challenge for organizations is to defend or challenge the position of the dominant design, or to launch a disruptive innovation that will take over this position in the target market.

The commercialization decisions consist of four main decisions, namely the business strategy, the portfolio strategy, the market strategy and inter-firm collaboration. 1. The business strategy defines the overall innovative DNA of the organization, specified with the innovation strategy and the strategic orientations and drivers for innovation. 2. The portfolio strategy defines the portfolio balance and micro level innovativeness of the portfolio. 3. The market strategy defines the target market and macro innovativeness of the portfolio. 4. Inter-firm collaboration describes the path to the market with a focus on technology sourcing methods and cooperation in the NPD process.

The innovation strategy of the organization defines how product development should contribute to the business strategy. Organizations can have a defender, analyser or innovator strategy. These strategies indicate the pro-activeness of organizations in developing technologies and pursuing market opportunities through NPD. Strategic orientations drive the innovation efforts, through these orientations portfolio managers can select the matured concepts that contribute best to the innovation strategy. The strategic orientations are the technology-, customer-, competitor-, entrepreneurial-, and networking orientation.

The findings from this research show that above average performing defenders have a core customer and technology orientation. Results from the interviews show that the portfolio strategy of the defender is focused on incremental projects, mostly product improvements and high customer involvement customization projects. The defender develops his new technologies mostly internally or in collaboration with network partners. The market strategy of the defender is focused on a market sector or niche that requires specific product features. Inter-firm collaboration is focused on long term strong relations with a small network that help the defender to gain access to complementary assets like development capabilities or fundamental technological knowledge.

The above average performing analysers have a core networking, customer and entrepreneurial orientation. The portfolio strategy of the analyser is focused on a balance in applied R&D between incremental and radical projects. The analyser stays close to the core technology and uses applied R&D to improve products and launch a high variation in concepts. The market strategy of the analyser is focused on several market segments or even different markets. Through inter-firm collaboration, the analyser gains access to new technologies. The analyser prefers license agreements or collaboration and makes use of 'technology shopping' in its large network of potential partners.

Finally the above average performing innovators have a core technology, customer and entrepreneurial orientation. The main strength of the innovator is the strong fundamental R&D capability. The portfolio strategy is focused on technology development and radical projects. The innovator diffuses new technologies in the market through the development of complementary products and additional services. The market strategy of the innovator is focused on latent demand of customers and the creation of new markets. The innovator collaborates with network partners to identify latent demand through a large and diverse ideation network. In addition the innovator engages in partnerships if another firm possesses unique development or production capabilities for complementary products and services.

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1. Introduction

Research context: Innovation is important for companies to learn and grow. In a recent global innovation and commercialization survey of McKinsey (McKinsey 2010), 84% of the executives say innovation is extremely or very important to their companies' growth strategy. An organization can innovate its processes, services and products. This research focuses on product innovation. An innovation is the product of transforming a new idea or invention, through R&D, manufacturing and marketing activities, into a profitable product by introducing it to the market. An innovation project, or new product development (NPD) project, can be incremental, like a product improvement, radical where the company introduces a new product concept in a new market, and everything in between.

The commercialization phase of a NPD project starts after the design freeze (see figure 1). Ideation has been done at this point, the idea has been developed into a matured concept for a new product. This is where the organization has to make a decision on which concepts should be selected for the project portfolio and how these concepts should be taken to the market (Teece 1986).

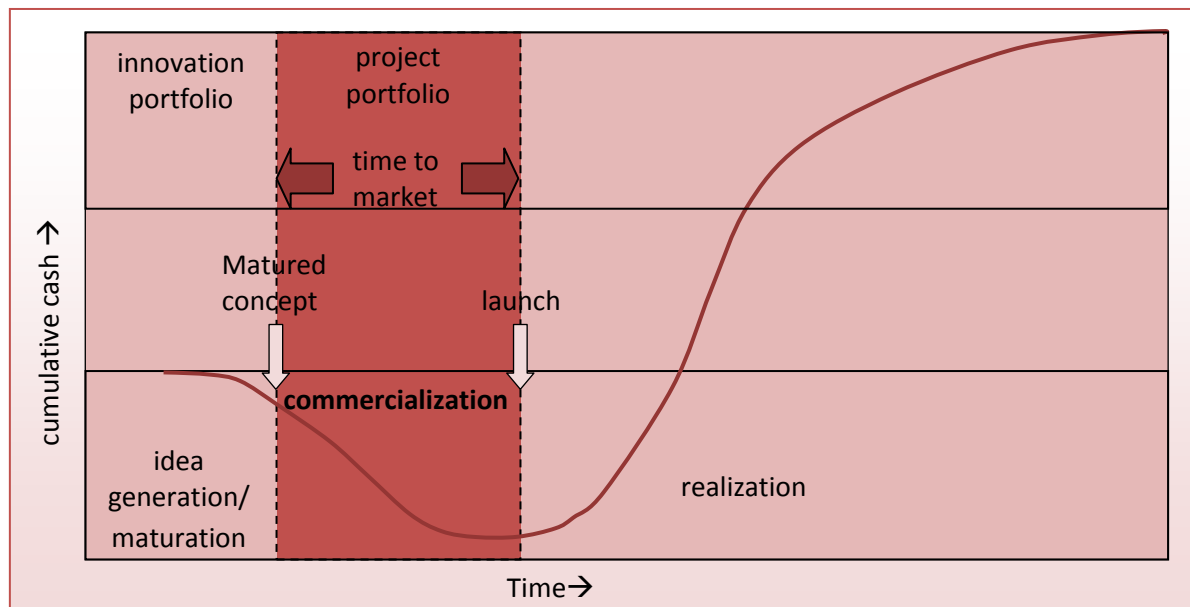


Figure 1: The cash curve, adopted from Andrew and Sirkin (2007) edited with findings of Mathews (2010)

Situation and complication: Commercialization starts at the business strategy level that describes the way in which a firm decides to compete in the market (Meskendahl 2010). According to Mu and Di Benedetto (2011) firm's successful commercialization of new products hinges upon the development of critical yet complementary sets of strategic orientations. The business innovation strategy and the strategic orientations give shape to the project portfolio composition through portfolio management. Chiesa and Frattini (2011) did a research to identify successful commercialization decisions in the project portfolio and the path to market. This thesis builds on recent literature on commercialization (Chiesa and Frattini 2011; Haeussler 2011; Mu and Di Benedetto 2011) by taking a configurational approach to commercialization decision making from an innovation strategy perspective. Where Mu and Di Benedetto (2011) focused on complementary sets of strategic orientations, disregarding the innovation strategies, this research will focus on strategic configurations of commercialization decisions combining both the business- and project portfolio level.

In the last decennium research has made significant progress in the field of innovation management but the core barriers to successful and sustainable innovation haven't changed. Innovation productivity is even declining because companies are too preoccupied with incremental projects (Cooper and Edgett 2008). The key issue for project portfolio management is still "doing the right projects, and doing projects right" (Cooper and Kleinschmidt 1995). "The area of commercialization appears to be the least developed of the issues involved in innovation management"... "this is a huge gap" (Adams, Bessant et al. 2006). This thesis will contribute in closing this gap in literature by reaching the following goal:

Goal and central research question: The goal of this research is to find which strategic decisions organizations make for the commercialization of matured concepts, in order to achieve a cost-effective project portfolio. Cost effectiveness represents the balance between efficiency and effectiveness of the portfolio. The central research question to achieve this goal is:

What are cost effective strategies for the commercialization of matured concepts in project portfolio management?

Theoretical framework: This thesis will take a configurational approach to define cost effective strategies for the commercialization of matured concepts. A theoretical research will be conducted on project portfolio management, innovation strategies and cohesive success factors in commercialization decision making, in order to find cost effective configurations of strategic decisions. The theoretical research will lead to propositions on cost effective strategic configurations. The propositions will be tested in practice by finding cost effective configurations of portfolio management activities within technological production firms. The subquestions for this thesis are:

- What is project portfolio management?
- What are strategies for innovation?
- What is commercialization and what are strategies for commercialization?
- Which strategic decisions in commercialization contribute to the cost effectiveness of the project portfolio?

Academic relevance: This research contributes to recent literature in two ways. First, this research will give more insight into strategic commercialization and successful portfolio management for the commercialization of matured concepts. It builds on recent publications by Chiesa and Frattini (2011) and Mu and di Benedetto (2011) on commercialization. Chiesa and Frattini (2011) did a research on strategic orientations and Mu and di Benedetto (2011) did a research on positioning, timing and inter-firm collaboration. This research will combine both articles from an innovation strategy point of view, the strategies of Miles & Snow (1978) of the defender, analyser and innovator. From this perspective this research will identify configurations of strategic commercialization decisions, in order to have a cost effective project portfolio. The second contribution to science is the application of a relatively new method of analysis that is becoming more and more popular, the fuzzy set Qualitative Comparative Analysis that will be discussed in paragraph 3.5.2.

Practical relevance: Although the importance of innovation is widely recognised (McKinsey, 2010), many companies still find it hard to commercialize matured concepts into a successful new products. This research will show how strategic alignment of commercialization decisions can help to improve the cost effectiveness of the project portfolio. The research will be conducted in a consultancy

environment. The combination of theory and practical feedback of consultants will push the research in a direction that is of interest for them and their clients. Most ideally this research will reveal best practices that can be used as the fundament for new service offerings.

The organization: Capgemini Consulting is a large management consultancy organization and is part of Capgemini that operates in 40 countries and has nearly 120000 employees. The main office of Capgemini Consulting in the Netherlands is situated in Papendorp, Utrecht. The national organization consists of eight practices, four based on sector expertise (industrial & consumer markets, public & health, Telecom & media and financial services) and four based on functional expertise (HRM, Finance, SCM and Digital Transformation & Innovation). A practice is a group of 60 to 90 experts within that domain. Each practice has been divided into content-clusters, teams with an average of 15 experts, together focusing on specific content. This research is being carried out for the cluster strategy and innovation; one of the four clusters of the practice DT&I. The research contributes to the content development for this cluster. The research was triggered by the words 'commercialization strategies' that were showing up more and more on the internet, for instance in linked-in groups. Research into these concepts is scarce, that is why two consultants decided to create a graduation assignment around these concepts. The first sketches for the research were still very broad and had links with almost every organizational or process aspect in new product development. Regular discussions with business innovation consultants and a broad literature study resulted in this research design.

2. Theoretical framework

The development of new products is a risky and resource consuming process. The effectiveness with which the company manages its NPD projects is often a key determinant of its competitive advantage (Bard, Balachandra et al. 1988). To manage the continuous stream of ideas and NPD projects, companies apply portfolio management. Portfolio management works as a funnel for ideas and NPD projects (see figure 3). The funnel diminishes the number of ideas and projects based on selection and evaluation criteria.

This chapter will build a theoretical framework to come with propositions at the end of this chapter on the fourth subquestion: What strategic decisions in commercialization strategies contribute to the cost effectiveness of the project portfolio? The first paragraph will present a literature overview for the theoretical framework. Paragraph 2.2 will answer the first subquestion: What is project portfolio management? Paragraph 2.3 will answer the second subquestion: What are strategies for project portfolio management? Paragraph 2.4 will give an answer to the third subquestion: What is commercialization and what are strategies for commercialization? And finally, paragraph 2.5 will answer the fourth subquestion: What strategic decisions in commercialization strategies contribute to the cost effectiveness of the project portfolio?

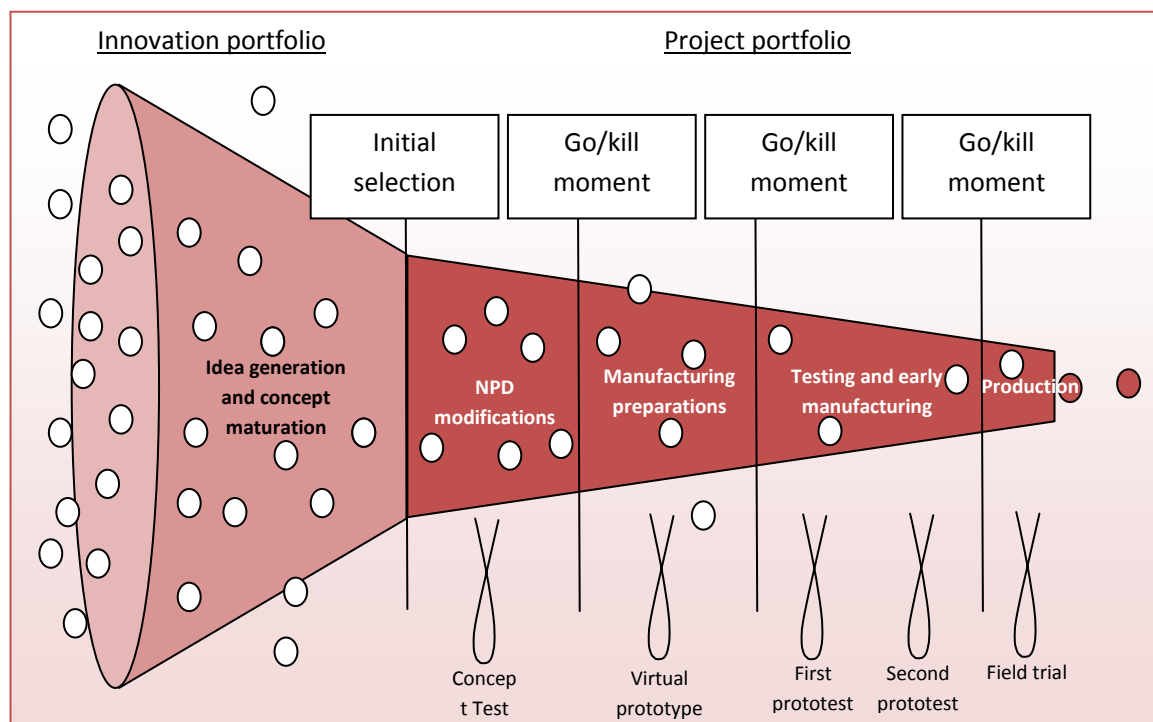


Figure 2: Portfolio management (Cooper and Edgett 2008; Mathews 2010)

2.1 Literature overview

This paragraph gives an overview of the selected literature into project portfolio management and the commercialization of matured concepts. The articles have been selected by conducting an online search for books and articles into project portfolio management (and PPM), innovation strategy, new product development (and NPD) and commercialization. The search was conducted on Web of Knowledge, the online university library and books24x7.com. After reading the titles the online search resulted into a list of 125 articles. The next step was reading the abstracts and judging the relevance of the articles by looking at the number of citations and impact factor, which reduced the

list to 48 articles. Finally the following 37 articles were selected for shaping the theoretical framework, see table 1.

For this structured overview, the concept matrix of Webster and Watson (2002) has been used. The matrix shows which articles draw conclusions on the selected concepts. The concepts for this research have been identified from the articles as the key concepts. The first concept is project portfolio management (PPM). This is the general area of research for the research questions, so it is important to make clear what the definition is of PPM. The second concept is matured concepts, this refers to the input for the project portfolio and the innovative character of these concepts. The third concept is management activities that refer to the strategic activities that the portfolio managers perform in the portfolio. The fourth chosen concept is business strategy, to identify the role of PPM in the business strategy, and to explain the composition of projects in the portfolio. The last concept is commercialization which refers to the chosen path of a project from matured concept to the target market. The first three concepts will be described in paragraph two on project portfolio management, the fourth concept of business strategy in paragraph three and commercialization in paragraph four.

Article	PPM definition	matured concepts	management activities	business strategy	Pre-launch commercialization
(Miles, Snow et al. 1978)				X	
(Teece 1986)					X
(Henderson and Clark 1990)		X			
(Hill 1992)					X
(Wheelwright and Clark 1992)		X			
(Cooper and Kleinschmidt 1995)	X	X	X		
(Hultink 1997)				X	X
(Cooper 1998)	X		X		
(Lieberman and Montgomery 1998)				X	
(Archer and Ghasemzadeh 1999)	X	X	X		
(Combs and Ketchen 1999)					X
(Cooper 1999)	X				
(Henard and Szymanski 2001)		X	X		X
(Chesbrough 2003)					X
(Gans and Stern 2003)					X
(Hart, Hultink et al. 2003)			X		X
(Cormican and O'Sullivan 2004)			X		
(Adams, Bessant et al. 2006)	X		X		X
(Slater and Mohr 2006)		X	X	X	
(Paulson, O'Connor et al. 2007)		X			
(Cooper and Edgett 2008)		X	X		
(Florice and Ibanescu 2008)			X		
(Bers and Dismukes 2009)					X
(Dyer, Gregersen et al. 2009)				X	
(Lecoeuvre and Koninika 2009)	X				
(Lee 2009)				X	X
(Sarin and O'Connor 2009)		X			
(Schmidt, Sarangee et al. 2009)			X		
(Cooper and Edgett 2010)				X	
(Belderbos, Faems et al. 2010)			X		X
(Mathews 2010)	X	X			
(Meskendahl 2010)				X	
(Chiesa and Frattini 2011)			X		X
(Haeussler 2011)					X
(Kester, Griffin et al. 2011)	X				
(Mu and Di Benedetto 2011)				X	X
(Conway 2009)				X	X

Table 1: The concept matrix (Webster and Watson 2002) for the theoretical framework

2.2 Project portfolio management

“Managing the NPD process is to a great extent a process of separating the winners from the losers” (Cooper and Kleinschmidt 1995). Cooper and Kleinschmidt conducted a research on the critical success factors in NPD. Their research was conducted at a company level, to identify success factors that overarch the NPD projects. In a later article of Cooper, he summarizes the critical success factors for the project portfolio to three cornerstones; having a high quality new product process, selecting a new product strategy for the business and making the necessary resource commitments (Cooper 1998). “The focus of portfolio management is on making strategic, technological and resource choices that govern project selection and the future shape of the organization”(Cooper 1999). This paragraph will give an answer to the question: What is project portfolio management? First a definition will be given in 2.2.1, followed by an exploration of matured concepts in 2.2.2, and this paragraph will conclude with the strategic management activities in 2.2.3.

2.2.1 PPM definition

According to the early articles of Cooper, portfolio management is concerned with managing the NPD process according to the business innovation strategy and making necessary resource commitments. Managing the NPD process consists of the selection, evaluation and termination of projects and the resource allocation (Adams, Bessant et al. 2006). The earlier articles in this research speak of the NPD process as the bundle of the NPD projects. Portfolio management is concerned with the business level management of this process. This is in line with the following definition of a project portfolio: 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 organisation (Archer and Ghasemzadeh 1999), or, a project portfolio is a collection of projects that are carried out in the same business unit sharing the same strategic objectives and the same resource pool (Lecoeuvre and Koninika 2009). Strategy plays according to these definitions an important role, the portfolio has to be in line with the innovation strategy. The following definition of portfolio management indicates that this business strategy has a long term focus on growth: Portfolio management is the set of activities that allows a firm to select, develop, and commercialize a pipeline of new products aligned with the firm’s strategy that will enable it to continue to grow profitably over the long term (Kester, Griffin et al. 2011). This is also the first definition that defines commercialization as an essential part of portfolio management.

Mathews (2010) underlined the importance of separating the portfolio into an innovation portfolio and a project portfolio. The innovation portfolio is focused on early-stage ideas whose role in the overall strategy is still evolving. The project portfolio is focused on managing products in development through a stage gate approach. The innovation portfolio connects existing ideation events, where ideas are born, and project portfolios, where matured concepts are developed into products and services (Mathews 2010). The projects in the project portfolio are in the commercialization phase of innovative projects, as defined by Cooper (1999). The commercialization phase starts after the design freeze, so where the concepts are matured. This is the transition point of the innovation portfolio into the project portfolio (Mathews 2010). The project portfolio is focused on execution and delivery, the innovation portfolio concerns itself with the development of a coherent portfolio strategy and the maturation and selection of project candidates (Mathews 2010). The balance between technological and market information shifts at the transition point from a more technological focus (concept building) to a market focus (commercialization).

From the previous definitions, the following definitions have been formulated for this research:

Project portfolio: a collection of projects that are carried out in the same business unit, sharing the same strategic objectives and the same resource pool.

Project portfolio management: The strategic selection of matured concepts, evaluation of NPD projects and the coordination of resources in the project portfolio.

This paragraph continues by defining the input for project portfolio management, the matured concepts.

2.2.2 Matured concepts

Matured concepts are the result of the ideation and idea maturation phase (the innovation portfolio), where ideas are being generated and developed into mature concepts. Concept maturation is a process that assesses and develops ideas into concepts that can be commercialized (Mathews 2010). Matured concepts should have a clear product definition and upfront homework should have been done consisting of a technology assessment (1), a market assessment (2), and a financial business assessment (3) (Archer and Ghasemzadeh 1999; Henard and Szymanski 2001; Cooper and Edgett 2008).

1. The technological assessment defines the innovativeness of the concept in relation to the current product portfolio and formulates a clear product definition. Incremental concepts are closer to current products and technologies than radical projects. Technological inter-relatedness with current or future products is beneficial for the efficiency of the project. In addition companies increase their knowledge capital by working on distinctive new products, the more radical projects (Wheelwright and Clark 1992; Cooper and Kleinschmidt 1995; Paulson, O'Connor et al. 2007).
2. The market assessment defines the market arena, the value proposition and the innovativeness of the concept in relation to existing products in the market (Cooper and Edgett 2008). Incremental projects are focused at current markets and existing customers to deliver better value for money. More radical projects are focused on emerging customers to create a new market or niche (Sarin and O'Connor 2009).
3. The financial assessment gives an indication on the costs, the Net Present Value, the Time To Value, the Time To Market and the rate of return (Cooper 1998). In general this is the hardest part of the preliminary work, risk and uncertainty make it difficult to make financial predictions.

The innovativeness of a matured concept can be indicated on three factors; the newness of the concept, the newness of the underlying technologies and the newness of the market. A product concept is a product idea that consists of linkages between technologies. The newness of a matured concept from a micro perspective (business perspective), depends on the inter-relatedness of the concept and its underlying technologies, with the current product portfolio; the products that already are in the market (Henderson and Clark 1990). A new concept has significantly differentiated its product properties from the current product portfolio. According to this inter-relatedness, the matured concepts can be divided into four categories. These categories are:

1. A reinforced concept with unchanged technology linkages (incremental project)
2. a reinforced concept with changed technology linkages (an architectural project),
3. a new concept with unchanged technology linkages (a modular project), and
4. a new concept with changed technology linkages (a radical project), see table 2.

Incremental projects are process improvements or customization projects, to improve efficiency or customer satisfaction. Architectural projects change underlying technologies and technology linkages to reinforce a concept, for instance the integration of a blu-ray player in the Sony Playstation 3. A modular project makes clever use of existing technologies and technology linkages to create a new concept, like the Apple Ipad. Finally radical projects are new concepts based on new technologies and technology linkages like the TomTom navigator. All these project types can be disruptive in nature as can be seen from the examples. A disruptive innovation disrupts the market by flattening the s-curve of the dominant design (Slater and Mohr 2006). The challenge for organizations is to launch disruptive innovations that will take over the position of the dominant design.

		Core concept	
		Reinforced	New
Linkages between core concept and technologies	Changed	2. Architectural projects	4. Radical projects
	Unchanged	1. Incremental projects	3. Modular projects

Table 2: Technological Innovation projects from a micro perspective, adopted from Henderson and Clark (1990)

This paragraph continues by going further down the funnel and defining the key management activities for project portfolio management.

2.2.3 Management activities

As defined in the first part of this paragraph, project portfolio management is focused on the strategic selection of matured concepts, evaluation of NPD projects and the coordination of resources in the project portfolio.

The management activities start with the initial selection that includes mature concepts in a list of projects to be funded (Adams, Bessant et al. 2006; Floricel and Ibanescu 2008). Adequate resources and resource commitment are important for portfolio performance (Cooper and Kleinschmidt 1995; Cooper 1998). In addition the portfolio manager wants the commercially most interesting projects for the long as well as the short term (Archer and Ghasemzadeh 1999). The portfolio manager needs to find a balance between the incremental short term projects and more radical long term projects. Balance in the portfolio results in better financial performance (Tushman and Oreilly 1996; Gibson and Birkinshaw 2004; He and Wong 2004; Lubatkin, Simsek et al. 2006; Belderbos, Faems et al. 2010).

Next to the initial selection of matured concepts, it is also important to evaluate and built in some go/kill moments in the process (Cooper and Kleinschmidt 1995; Cooper 1998; Hart, Hultink et al.

2003). According to Schmidt, Sarangee et al. (2009) the number of go/kill moments is not related to performance. The used criteria are important and especially proficiency for the evaluation (Schmidt, Sarangee et al. 2009). Evaluation can be done by testing to secure the quality of the product and to integrate the voice of the customer (Slater and Mohr 2006; Cooper and Edgett 2008). The quality of the product and customer satisfaction are important performance indicators for a NPD-project (Henard and Szymanski 2001; Szymanski and Henard 2001). Testing starts after the initial screening of the concept, with prototype testing and market trials (Hart, Hultink et al. 2003; Cooper and Edgett 2008). Integrating the voice of the customer is important because customer needs may change over time or may be solved in a radically different way (Slater and Mohr 2006). Customers can be involved in the innovation process with for instance crowd sourcing, visits or lead user analysis. Another performance indicator is the time to market (TTM). This is one of the most common performance indicators in project portfolio management. Although it is important to set due dates and monitor the project on a timeline, this performance indicator is not evenly important for all projects. If a project has more uncertainties, it is much harder to create a realistic time schedule. Problems that may occur when applying tight TTM restrictions are that radical projects are being killed or parts of the process are being skipped to save time.

The third management activity is the coordination of resources. A strong market orientation has been widely acknowledged as an important factor for coordination (Cooper 1998; Cormican and O'Sullivan 2004; Slater and Mohr 2006; Cooper and Edgett 2008). Markets can change during the innovation process due to disruptive innovations, new technologies or general trends, which influences the commercial potential of projects. By coordinating efforts between projects companies can react to these changes. In addition they should make use of their value network to recognize changes early. Commitment of resources is important for portfolio management performance. Cross-functional integration is important to combine R&D, marketing and manufacturing knowledge in the innovation process (Cooper 1998). The shortage or absence of resources can be solved through inter-firm relationships. Cooperation with network partners can increase project performance (Chiesa and Frattini 2011). More on this subject can be found in paragraph 2.4 on commercialization.

2.2.4 Conclusion on project portfolio management

The project portfolio is a collection of projects that are carried out in the same business unit, sharing the same strategic objectives and the same resource pool. Project portfolio management is the strategic selection of matured concepts, evaluation of NPD projects and the coordination of resources in the project portfolio. Prior to the project portfolio, the innovation portfolio is concerned with the development and assessment of ideas, which is the maturation of the concept. The innovativeness of the project, and the alignment with the business strategy, depends on the inter-relatedness of the concept, the underlying technologies and the market with the current product portfolio. The next paragraph will take a closer look at business strategies and their relation with project portfolio management.

2.3 The business strategy

Business strategy describes the way in which a firm decides to compete in the market compared to its competitors (Meskendahl 2010). The part of the business strategy that focuses the project portfolio is mostly referred to as innovation strategy or growth strategy. These strategies reflect an organization's innovation posture, or innovative DNA (Dyer, Gregersen et al. 2009). With regards to commercialization and launch decisions, Hultink et al. (1997) defined the innovation strategy, the

strategic orientations and drivers for innovation as the first important commercialization decisions on business strategy level. The innovation strategy and strategic orientation of the company give shape to the project portfolio composition through project portfolio management. This paragraph will continue on the variations in strategy. First the innovation strategies will be defined, followed by the strategic orientations. In the final part of this paragraph, innovation strategies and strategic orientations will be combined, to identify the gap in literature, which is the first focus of this research.

2.3.1 Innovation strategies

The most commonly referred to innovation strategies are those of Miles and Snow (1978). Miles and Snow introduce the defender, prospector, and analyser strategies. Although this theory is over thirty years old, still authors use these characterizations although they may have changed the title a bit. For instance Cooper and Edgett (2010) speak of the defender, fast follower and innovator. These three business types will now be described in order of organizational innovative DNA, with the least innovative business first.

1. The defender attempts to maintain a secure position or niche in a stable area. Defenders are focused on protecting their domain by offering higher quality or lower prices (Slater and Mohr 2006). The defender strategy is to enter the market later in the life cycle, once demand has grown sufficiently to allow significant economies of scale to be achieved. The aim is to gain cost advantage over competitors (Conway 2009).
2. The fast followers are the analysers, they carefully monitor actions of competitors and move quickly to copy and enhance upon innovators' new products (Cooper and Edgett 2010). Simultaneously, they protect a stable set of products and customers (Slater and Mohr 2006). The analyser strategy is to learn from the mistakes of the first-mover and enter the market with an improved innovation in the early stages of the life cycle (Conway 2009). The analyser is a reactive strategy that combines the strength of the defender and the innovator. In literature they also speak of the 'fast second' movers, alignment with invention and commercialization capabilities of early entrants has positive effects on the timing of 'fast second' entry (Lee 2009).
3. The innovator, or industry prospectors, value being first-in with new products and new technologies. They respond rapidly to early signals pointing to new opportunities (Slater and Mohr 2006). Being the first offers first mover advantages like gaining control of resources that followers may not be able to match (Lieberman and Montgomery 1998; Conway 2009).

2.3.2 Strategic orientations

According to Mu and Di Benedetto (2011) firm's successful commercialization of new products hinges upon the development of critical yet complementary sets of strategic orientations. Based on their extensive literature review they identified five strategic orientations. These orientations are the technological-, customer-, competitor-, entrepreneurial- and networking orientation. In their research, Mu and Di Benedetto (2011) combined the customer orientation and competitor orientation into one market orientation. Because a customer orientation indicates a proactive approach and a competitor orientation a reactive approach, this research will keep these orientations apart. In addition, Mu and Di Benedetto (2011) neglected the innovation strategies in their research and by that the innovative DNA of the organizations. This is a weak point in their research and an important gap for this research to close.

The strategic orientations are defined as follows:

1. A firm's technology orientation indicates the use of sophisticated technologies in new product development, the rapidity of integration of new technologies, and proactively developing new technologies and creating new product concepts.
2. The customer orientation refers to the extent to which a firm's business strategy is sufficiently oriented to its target customers' expressed and latent needs so as to continuously create superior value for them by providing products that fit their needs best.
3. The competitor orientation indicates the extent to which a firm's business strategy is oriented to competitor strategies and activities in order to match or exceed competitive competences.
4. The entrepreneurial orientation reflects the degree to which a firm's business strategy is oriented to the pursuit of new market opportunities and to the renewal of existing areas of operation through the introduction of innovations.
5. The networking orientation indicates the extent to which a firm's business strategy stresses effective and efficient location of network partners, management of network relationships, and improvement of network performance. The networking orientation is an important tool for firms to attain critical resources and knowledge for new product commercialization.

In addition to the innovation strategy, Cooper and Edgett speak of innovation technology strategies (Cooper and Edgett 2010). These strategies are mainly focused on the technological orientation, but in their definitions, Cooper and Edgett (2010) also refer to elements of the customer-, competitor- and entrepreneurial orientation.

Cooper and Edgett found five innovation technology strategies, after empirical research only three strategies proved to be effective, namely:

1. The low-budget, conservative strategy: lowest R&D spending of all companies surveyed, products enjoy least differential advantage, but highest technological and production synergies of all firms surveyed. This strategy has a good success rate, but a low impact program.
2. The balanced strategy: similar high-technology product focus as technologically driven companies, but much stronger market orientation and product fit. These are the top performers, best on every performance gauge.
3. The technologically driven strategy: This strategy is highly innovative, high technology, high-risk new products which don't fit the developing company's existing product lines and have no relation to each other. Firms lack market orientation. These products have a high impact, but low success rates which results in poor profitability.

These strategies appear to be closely related to the defender, analyser and innovator strategy. When reading the conservative strategy as the defender, the balanced strategy as the analyser and the technology driven strategy as the innovator, than these findings suggest that different innovation strategies require different configurations of strategic orientations to be cost effective. These three innovation technology strategies lack the networking orientation and are not specific on the two market orientations and the entrepreneurial orientation. Finding configurations of strategic orientations that support the innovation strategies, is the first step in finding cost-effective patterns of strategic commercialization decisions.

2.3.3 Conclusion on innovation strategies

Strategies for innovation originate at the business strategy level. The innovation strategy, whether an organization is an innovator, analyser or defender, defines the pro-activeness in technology development and pursuing market opportunities through NPD. This paragraph introduced the empirical findings that complementary sets of strategic orientations lead to successful commercialization (Mu and Di Benedetto 2011). In addition empirical research done by Mu and Di Benedetto (2011) suggests that different innovation strategies require different sets of complementary strategic orientations. Combining this suggestion for further research, with the closely related empirical findings of Cooper and Edgett (2010) on innovation technology strategies, implies that different innovation strategies require different strategic orientations that drive the innovation efforts. Through these orientations organizations gather information and knowledge to mature and select the new product concepts that have the best fit with their innovation strategy. There is a gap in literature in cost effective configurations of the commercialization decisions already identified by Hultink et al. in 1997. The next paragraph will take a closer look at the additional commercialization decisions identified by Hultink et al. (1997) that can be of importance for the cost-effectiveness of the project portfolio. The gap in literature that has been identified, concerning the mechanism through which the configurations of strategic orientations exerts their effects on performance, will be further discussed in the research propositions (2.5).

2.4 Commercialization decisions

Commercialization is the process of bringing a matured concept to the market, in order to make it a commercial success. The traditional view on commercialization divided the NPD process in three steps: Research, development and commercialization. Commercialization was seen as an after launch practice (Adams, Bessant et al. 2006). The difficulty with this perspective on commercialization is that innovations, projects after the launch, had no connection with the market. Innovations have a remarkable failure rate of 40–50%, and this performance has not changed much over the past 20 years (Chiesa and Frattini 2011).

The research of Chiesa and Frattini (2011) draws on an article by Hultink et al. (1997) that states that commercialization can be divided into two classes of variables, namely the strategic decisions and tactical decisions. Strategic decisions are taken prior to the launch of the innovation and consist of the overarching innovation strategy, strategic orientations that have been discussed in the previous paragraph and strategic decisions that focus on the portfolio, positioning in the market and inter-firm relationships. The tactical decisions encompass the key elements of the marketing mix, and are thus concerned with the innovation's launch and after launch commercialization (Chiesa and Frattini 2011). Both articles had a project point of view for their research, where this research has a portfolio point of view. Mu and Di Benedetto (2011) already developed measures for business level strategic orientations and drivers for innovation. In addition the other commercialization decisions have to be lifted to a portfolio level. The strategic commercialization decisions and their corresponding variables are shown in table 3. This paragraph will describe the strategic decisions for commercialization and the link with project portfolio management and will finalize with a conclusion on commercialization.

Strategic commercialization variables	Main articles
Business Strategy	
Innovation strategy	Miles and Snow (1978), Hultink et al. (1997)
Strategic orientations & Drivers for innovation	Mu and Di Benedetto (2011) (orientations adapted from Gatignon and Xuereb (1997), Song and Parry (1997), Narver and Slater (1990), Hurley and Hult (1998), Hult and Ketchen (2001), Jaworski and Kohli (1993))
Portfolio strategy	
Future product generations	Chiesa et al. (1996)
Relative portfolio newness	Calantone, Chan et al. (2006), Belderbos, Faems et al. (2010)
Resource commitment	Chiesa and Frattini (2011), Calantone, Chan et al. (2006)
Market strategy	
Target market	Hultink et al. (1997)
Positioning on product lifecycle	Hultink et al. (1997), Chiesa and Frattini (2011)
Customer involvement	Szymanski and Henard (2001), Lee (2009), Chiesa and Frattini (2011)
Inter-firm collaboration	
Network relations and cooperation	Chiesa and Frattini (2011), Mu and Di Benedetto (2011), Teece (1986), Gans and Stern (2003)
Technology management	Teece (1986), Chiesa et al. (1996), Gans and Stern (2003), Haeussler (2010)

Table 3: Strategic commercialization variables

2.4.1 Portfolio strategy

The product strategy is defined by three variables, namely the product innovativeness, the relative product newness and the cycle time (Hultink 1997). This research will take a look at the portfolio strategy, the composition of the portfolio in terms of innovativeness, newness and resource commitment. In paragraph 2.2 the innovativeness and newness of matured concepts have been described as well as the cycle time. The portfolio strategy defines the portfolio composition and innovativeness of the portfolio on a micro level.

Future product generations

The innovativeness of the portfolio depends on the portfolio composition of projects in terms of basic R&D and technological development and the balance in incremental product improvements and radical new products. The efforts in basic R&D and technological development give direction to the portfolio and the future product generations. The technology roadmap of the organization gives an indication of the long term focus and diversity in technology development (Chiesa, Coughlan et al. 1996).

Relative portfolio newness

To measure the newness of the portfolio, the portfolio has to be analysed on the balance between incremental product improvements and the more radical new products. As has been described in paragraph 2.2 a balanced portfolio contributes to financial performance (Belderbos, Faems et al. 2010). The relative newness of the projects in the portfolio gives an indication of the diversity of the projects in terms of concepts (Calantone, Chan et al. 2006). An organization can stay close to its current product portfolio or focus more on product diversity and new market opportunities.

Resource commitment

Monitoring the use of resources is important for portfolio management to ensure resource commitment and to make timing decisions. The most well-known measure for resource commitment is the TTM and cycle time reduction. This is an important aspects of launch timing but there are also other aspects that can have a large impact on the innovation performance (Chiesa and Frattini 2011). For the more radical innovations, launch timing affects the acceptability of the new concept or technology. For these innovations it is important to diffuse the new technology into the market

before the launch of the innovation. For the more incremental innovations this is less of an issue because these projects are easier accepted due to inter-relatedness and familiarity with the technology and concept (Calantone, Chan et al. 2006). In addition timing can be important if the risk of imitation is an issue, or to gain first mover or 'fast second' mover advantages.

2.4.2 Market strategy

Hultink et al. (1997) and Chiesa and Frattini (2011) both identify market targeting and positioning in the product lifecycle as important aspects of the market strategy. This research adds customer involvement in the NPD process to the market strategy as an important commercialization decision. In paragraph 2.2 the importance of customer satisfaction and commitment has been described. Where the portfolio strategy is focused on the micro level, these variables are focused on the macro level and market innovativeness.

Target market

The target market for an organization can be several markets, a mass market, market segments or a niche market (Hultink 1997). The definition of the market is defined by the number of customers and competitors where the niche market is a small market segment that requires specific product features.

Positioning on product lifecycle

Positioning in the adoption network indicates the stage of the product lifecycle where the organization positions its products at (Hultink 1997; Chiesa and Frattini 2011). Small revenues can be gained with early adopters in a new market, but a positive Word of Mouth (WoM) of the early adopters can pull the early majority and late majority over the line. This has been illustrated in figure 1 with the s-curve after the market launch. Positioning later in the lifecycle can be beneficial to monitor market response and learn from the failures of the innovator. Positioning towards other members in the adoption network can be crucial especially for content-based innovations like the blu-ray player or a gameconsole. This can be crucial for the acceptance of a new technology by customers.

Customer involvement

Customer involvement guards the target focus during the commercialization process. Innovation performance depends highly on customer satisfaction and a positive WoM of the adoption network (Szymanski and Henard 2001). By involving customers in the NPD process, or including the voice of the customer, the organization can monitor and improve the customer satisfaction (Szymanski and Henard 2001; Chiesa and Frattini 2011). Customer involvement can be done proactive by directly involving customers in the NPD process for instance with testing, by having a clear customer focus or reactive by monitoring the competition and alignment of the portfolio with the market innovators (Lee 2009).

For both the portfolio strategy and market strategy, inter-firm relationships can play a crucial role in commercialization. This paragraph continues with a focus on inter-firm relationships and their role in the commercialization of matured concepts.

2.4.3 Inter-firm collaboration

For the commercialization of a matured concept an organization needs to have access to the necessary complementary assets (Teece 1986). The complementary assets consist of technical know-

how that can be codified or tacit. Examples of complementary assets are knowledge of a certain technology (intellectual property), basic research and technology proficiency, applied research proficiency, competitive manufacturing, marketing proficiency, brand name reputation etc. The organization's share of the value created will be smaller if the innovation is less heterogeneous due to imitation, or when others control specialized complementary assets (Gans and Stern 2003).

The choice how to bring together the complementary assets depends on the speed of imitation in the market, the importance of first mover advantages, and the transaction costs of the complementary assets (Hill 1992). The organization can integrate the complementary assets to become a fully integrated innovator (Chesbrough 2003) that possesses all complementary assets for an in-house NPD process. This is the traditional research and development approach, or the closed innovation model. The advantage of being a fully integrated innovator is that the organization is in full control of the NPD process. In addition, by integration, the organization reduces the chance of imitation of their new concepts. Important disadvantages are that integration is a very time and effort consuming process and it restricts the organization to its own innovation capabilities.

Network relations and cooperation

The second option is cooperation with network partners. Chesbrough (2003) introduced the concept of open innovation, which is characterised by co-development (cooperation) and a market for concepts and technologies (licensing). Collaboration networks can speed up the process by sharing knowledge (Faems, Van Looy et al. 2005). It can also be beneficial to engage in complementary development to save costs on R&D and manufacturing (Combs and Ketchen 1999; Gerwin 2004). Partnering can also be beneficial to add value by combining technologies or complementary products in a new concept or enriched solution. Potential collaboration partners are suppliers, customers, universities, research centres, competitors and other organizations. By collaborating, organizations make use of the strengths of the organizations in their network. They make efficient use of complementary assets where other organizations are better at, so the organization can focus on their own strengths. Disadvantages of collaboration are the loss of control and the costs and difficulties that relation management brings. Research showed that 60% of all alliances fail due to knowledge spillovers, learning races, diverging opinions on intended benefits, and the lack of flexibility (Faems, Van Looy et al. 2005). Nevertheless, for network relations and cooperation in general can be said that companies should proactively search for stakeholders that can play a role in commercialization (Bers and Dismukes 2009). An organization with a diverse network is better equipped to commercialize matured concepts (Faems, Van Looy et al. 2005).

Technology management

Key issues in product innovation are the relative emphasis on basic research, applied research and development and the degree to which technology will be developed internally or sourced externally (Conway 2009). Technology management encompasses the protection and exploitation of intellectual property (IP) and technology sourcing decisions through collaboration or licensing agreements (Gans and Stern 2003; Haeussler 2011). This can be done on the intellectual property market, by sharing a technology or concept based on a contractual agreement. The downsides of licensing are the transaction costs for sourcing the complementary assets and the additional juridical costs for contracts and IP protection. For organizations with a strong emphasis on basic research and technology development, licensing can be a good commercialization strategy for technologies and concepts to receive a return on early development and to prevent imitation of the technology or

concept (Hill 1992). The results of Hill's research show that IP exploitation is not always preferable to imitation, the appropriate strategy is context dependent.

2.4.4 Conclusion on commercialization

Strategic decisions for commercialization are made by defining the innovation strategy and strategic orientations, and within project portfolio management by deciding on the portfolio strategy, market strategy and inter-firm relationships. Commercialization requires access to the necessary complementary assets. This can be done through integration, collaboration with network partners or through licensing contracts. The choice for a certain commercialization strategy depends on the speed of imitation in the market, the importance of first mover advantages, and the transaction costs of the complementary assets. Organizations should proactively search for network partners to create a diverse network.

2.5 Propositions

In this final paragraph of the theoretical framework, propositions will be made by answering the following question: Which strategic decisions in commercialization contribute to the cost effectiveness of the project portfolio? In the previous paragraphs the strategic decision making process has been described from the business strategy level down to the commercialization decisions for the project portfolio.

The innovation strategies (as defined in paragraph 2.3.1) will function as the starting point because this is the overarching strategy that defines how product development should contribute to the organizational growth. All strategic commercialization decisions have to be in line with this strategy in order to contribute to the innovation strategy of the organization. This paragraph will make propositions on the cost effective configuration of strategic decisions for each innovation strategy. Figure 3 shows the research model with the relations between the commercialization variables. In the following subparagraphs the propositions will be made starting with the defender configuration (1a-d), then the analyser configuration (2a-d), and finally the innovator configuration (3a-d).

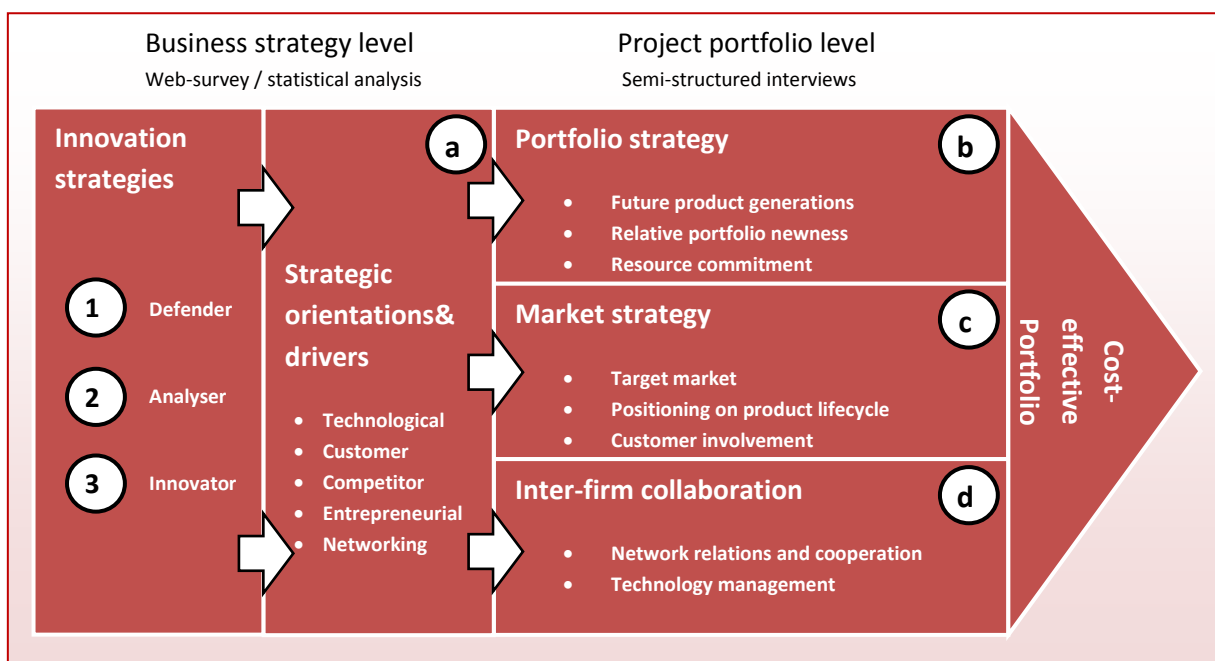


Figure 3: The research model

2.5.1 The defender configuration

Strategic orientations and drivers for innovation: The defender has a proactive but conservative focus. A strong technological orientation is necessary for a proactive development approach. The defender has a strong focus on its current products and customers. High inter-relatedness with the current product portfolio and technologies reduces the costs of risk. The defender has a small network with strong long-term relations and has a weak entrepreneurial orientation because it has a focus on the current market.

1a: The cost effective defender has a strong customer orientation, a strong technological orientation and a weak focus on the other orientations.

Portfolio strategy: The defender stays close to his current product portfolio so the innovations are inter-related with the current products. Due to this inter-relatedness, the innovations are more easily accepted in the market. The strong focus on a specific market and the strong long-term relationships with a select group of network partners, reduce the need for new complementary partners. Timing is for the defender important as a measurement instrument for efficiency and cost reduction.

1b: The defender has a technology and incremental product improvements oriented portfolio and has a strong emphasis on efficiency and cost reduction.

Market strategy: The defender has a conservative strategy and wants to defend its current market position. The defender has a clear understanding of its market and aims to keep its customers satisfied. The defender enters the market later in the lifecycle, once demand has sufficiently grown. In order to know if the NPD projects are contributing to the customer satisfaction, the defender should test the concepts with its lead customers. By doing so the organization signals that it listens to its customers and is committed to deliver better valued products.

1c: The cost effective defender positions the projects strongly towards the lead users among his current customers in a niche market.

Inter-firm collaboration: The strength of the defender is the familiarity with the market and the continuous improvements of the products. The defender has a low cost-, conservative approach to NPD with high product inter-relatedness. The defender builds on its long-term relationships with suppliers and customers to continuously improve the value proposition of the products. Integration of commercialization is the most cost-effective commercialization strategy for the defender, because the projects have a high inter-relatedness with their current product portfolio.

1d: The defender is a strong R&D integrator to save costs and to keep control over the entire process in order to be able to make future product- and process improvements.

2.5.3 The analyser configuration

Strategic orientations and drivers for innovation: The analyser has a reactive but open focus on change and differentiation. The analyser monitors the innovator's projects and early adopters. The analyser has little time for technological development because it needs to react fast to the innovator to become the 'fast second'. The analyser needs to align its commercialization capabilities with the innovator, so through the networking orientation it seeks to match or exceed the capabilities of the innovator.

2a: The cost effective analyser has a strong competitor and networking orientation and an average focus on the other orientations.

Portfolio strategy: The analyser has a portfolio focused on product improvements and radical new products. For the analyser, speed and reduction of cycle times is of the essence. The competition is already in the market and is building on its reputation as the dominant design. The analyser needs to source the new technology externally or imitate fast. For the analyser it is essential to make preannouncements, raise expectations and draw attention to the new product.

2b: The portfolio of the analyser has a strong emphasis on applied R&D and is focused on reducing the time to market to become the 'fast second'.

Market strategy: The analyser competes to the innovator and aims to position itself in the market focused on the early majority. The second mover advantage is that the analyser can integrate the voice of the early adopters in the NPD process.

2c: The analyser targets opportunities for a competitive advantage over the innovator and integrates the voice of the early adopters through a strong market orientation.

Inter-firm collaboration: The analyser has to match or exceed the complementary assets of the innovator in order to compete with the innovator. The time factor is important to gain 'fast second' advantages. Collaboration with complementary network partners is of great importance to build a strong commercialization foundation without reinventing the wheel, which consumes time. Access to new technologies will be gained through licence agreements.

2d: The analyser aligns its complementary assets with the innovator and engages in collaboration and licensing to speed up the time to market and to gain access to new technologies.

2.5.2 The innovator configuration

Strategic orientations and drivers for innovation: The innovator searches for emerging markets and customer needs. It has a strong and differentiated technological orientation and a broad network orientation to pick up emerging trends and to build a strong commercialization network. The entrepreneurial orientation drives the innovator; the innovator is constantly looking for new business opportunities.

3a: The cost-effective innovator has a strong technological, entrepreneurial and networking orientation and an average focus on the other orientations.

Portfolio strategy: The innovator has a portfolio with a long term focus on new technologies and radical new products. The innovator is more focused on market acceptance of the new product and the innovativeness or newness in the market. Diffusion of the technologies that are integrated in the new concept, to the market plays an important role in market acceptance and new product success. The innovator has to be especially careful in raising expectations and must prevent giving away too much information.

3b: The innovator has a long term focus on technological development to support the development of radical innovations where market acceptance plays an important role in timing aspects.

Market strategy: The innovator values being first-in with new concepts and technologies. The majority of the customers have the tendency to be reluctant to change and need to get familiarised with the new product or technology. A positive Word Of Mouth of the early adopters is essential to reach the early majority. Testing the concept in the market and extensive quality testing can contribute to a positive WoM, but the innovator has to be wary of raising expectations which can lead to disappointment. The innovator shall have to adopt a more closed approach to development

in comparison to its following counterpart. This approach is also beneficial against the copying behaviour of analysers.

3c: The cost effective innovator positions the projects strongly towards the early adopters among emerging customers.

Inter-firm collaboration: The innovator has a strong research and development capability and gains an early return on development by licensing technologies if the speed of imitation is high. Licensing can prevent imitations but can also reduce the head-start of the innovator. If the speed of imitation is low, it is better to not engage in licensing contracts with competitors, to gain a competitive advantage. First mover advantages are important for the innovator in order to compensate the expensive development. Licensing to commercialization partners helps in diffusing the technology in the market. Collaboration can be necessary to gain access to unique complementary assets, although the innovator would prefer to internalize these assets to secure their first mover advantages.

3d: The innovator uses licensing as a tool for technological diffusion and early commercialization and gains access to unique complementary assets through collaboration and acquisition.

The next chapter will describe the methodology to test the propositions that have been made in this paragraph.

3. Research methodology

To test the propositions from the theoretical framework in practice, this chapter will introduce the research methodology. The methodology chapter consists of three paragraphs; research method, data collection and measures and variables. The first paragraph of this chapter will introduce the scientific method that has been used to gather the data for the analysis.

3.1 Research method

This thesis consists of two methods of data gathering, first with a web-survey and second with structured interviews. The web-survey has been used to gather data on the business strategy level, in order to identify the innovation strategies, strategic orientations, cost effectiveness and the included control variables (see 3.4). The structured interviews are intended to reflect on the web-survey with business cases and the questions are based on the portfolio strategy, market strategy and inter-firm collaboration variables. These interviews are useful for deepening the qualitative information from the web-survey and making the orientations and drivers for innovation more tangible. This paragraph will continue by describing both scientific methods, starting with the web-survey.

3.1.1 Web-survey

To find cost effective configurations in strategic commercialization decision making, this research needed both a high quantity of respondents to identify patterns, and qualitative information to integrate all decision options in the research. A web-survey is a proven method for involving large groups of respondents and in the same time to gain qualitative information.

For a structured approach towards building and conducting the web-survey, the book of Dillman, Smyth and Christian (2009) has been used. In this book the authors introduce the tailored design for web-surveys. The tailored design involves using multiple motivational features in compatible and mutually supportive ways to encourage high quantity and quality of response to the surveyor's request (Dillman 2009). Using this approach safeguards the research for failure by reducing the four sources of survey error—coverage, sampling, nonresponse, and measurement (Groves 2004). Coverage will be discussed in 3.2, sampling and nonresponse in 3.3 and measurement in 3.4.

The web-survey has been placed on thesistools.com/commercialization, a neutral and simple website that increases the trust in confidentiality and is easy to access. Filling in the web-survey will take about 10-15 minutes, which is a time span that is acceptable, even for the busiest managers. The survey consists of open ended questions, multiple choice questions and scales to keep the questionnaire dynamic and increase the quality of the data. In the web-survey, the respondent is triggered to think about the commercialization decisions of the portfolio and can in addition leave some final comments or suggestions. The direct value for the respondent is that the survey shows the diverse aspects of commercialization and the results of the research can help the respondent to identify points for improvement.

3.1.2 Semi-structured interviews

To identify differences in commercialization decision making within the orientations and how the orientations affect portfolio management, additional interviews have been held. The literature research in combination with the outcomes of the web-survey defined the content of the semi-structured interviews (see appendix 7.2 for the questionnaire). Nine innovation managers have been interviewed, three defenders, three analysers and three innovators. From each of the three

respondent sectors (see figure 4) three above average performing organizations, with different innovation strategies, have been selected. This selection method improves the representativeness of the nine interviewees for the large sample group from the web-survey. By doing so, both datasets are easier to link without disregarding the strategies or respondent sector, which reduces the threats to the external validity. The selected respondents received an invitation for the interview by mail or were called if a phone number was available. Each interview took about one and a half hour and was held face to face at the organization. Being at a location gives a better view of the organization, its products and makes the interview more interactive in comparison to for instance a closed interview by mail or a phone interview. The notes of the interviews were written out the same day the interview was held.

3.2 Objects and domain

The observation objects for this research, the objects that are being measured and analysed during the data collection, are project portfolios. The required data has been gathered from managers that are involved in the strategic decision making for the commercialization of matured concepts. These can be senior managers, business innovators, portfolio managers, new business developers, R&D managers, marketing managers, or project managers. The end-conclusion of this thesis is about strategic commercialization decisions, so these are the objects of analysis. The research domain for this thesis is Dutch innovating organizations in technological manufacturing industries. This focus guarantees that organizations in the sample have an NPD process containing technological projects.

3.3 Research sample

Dillman et al. (2009) stress the importance of identifying the population that the research wants to generalize about, the sample frame which is the list where the sample is being drawn from, the sample which are the contacted potential respondents, and the completed sample which are the respondents. The population for this research is large technological manufacturing organizations. To get an overview of this population, the website company.info has been used. This website contains information on more than 2 million organizations. By adding filters, the total population of companies was reduced to the sample frame. The first filter was industries; this excluded all other organizational types like governments, banks, resellers, service firms etc. From the industries the technological industries were selected (industry codes C20-C32), which resulted in a list of technological manufacturing organizations. This list was reduced by focusing on mid-size to large organizations (+100 employees), which are most likely further advanced in portfolio management and this group contains many customers of Capgemini. Finally the wholesalers, social workplaces, financial holdings and installation companies were excluded, which reduced the sample frame to 318 technological manufacturing organizations. These manufacturing organizations produce machines (for production but also means of transportation) and devices, chemicals and ingredients (for food and pharmaceuticals), and parts and basic products (electric/metal/rubber/plastics), see figure 4. These three respondent sectors have been roughly identified to bundle organizations according to their product characteristics like the technological complexity and development process. Within this domain the project portfolios will be observed on the strategic commercialization decisions.

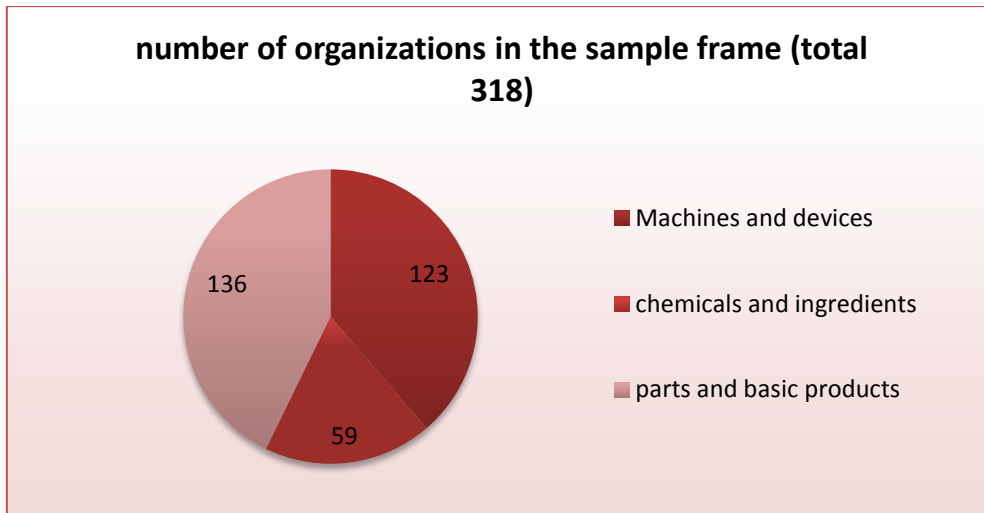


Figure 4: The sample frame for this research

Within this sample frame a representative sample group has been contacted to fill in the web-survey. This has been done over three communication channels to reach the potential respondent by more than one way. This approach creates a broad awareness of the research and additional reminders for filling in the survey. First invites for the web-survey were sent over e-mail to close contacts in the sample frame, with the request to forward the invite to friends and colleagues that were concerned with commercialization decisions in other portfolios. This could trigger a snowball effect and respondents are more eager to fill in a survey if the invite comes from someone in their personal or business network. Secondly the organizations in the sample frame were screened on the internet and called in order to form a list of email addresses of potential respondents. The initial invite was also sent to these addresses. Finally the link to the web-survey was posted in professional linked-in groups (PPM, innovation management, NPD, innovation, new business development) to create awareness of the research over the internet and social media. After the initial invite two more personalized reminders were send, with an interval of 2 weeks, to the contacts in the list of email addresses.

In total 79 organizations responded to the web-survey which is a response rate of 24.8%. After excluding the incomplete, unreliable and anonymous responses, the completed sample consists of 68 organizations, which is a response rate of 21.4% (see figure 5). The respondents come from across the country, almost from every province but most of them from one of three clusters namely Eindhoven region, Twentestad and Randstad. The respondents show large variation in the number of employees and industry sectors. More on the grouping variables can found in paragraph 3.4.3. The variation in industry sectors, geographical spread and variation in organizational size make the completed sample a good representation of Dutch technological manufacturing organizations.

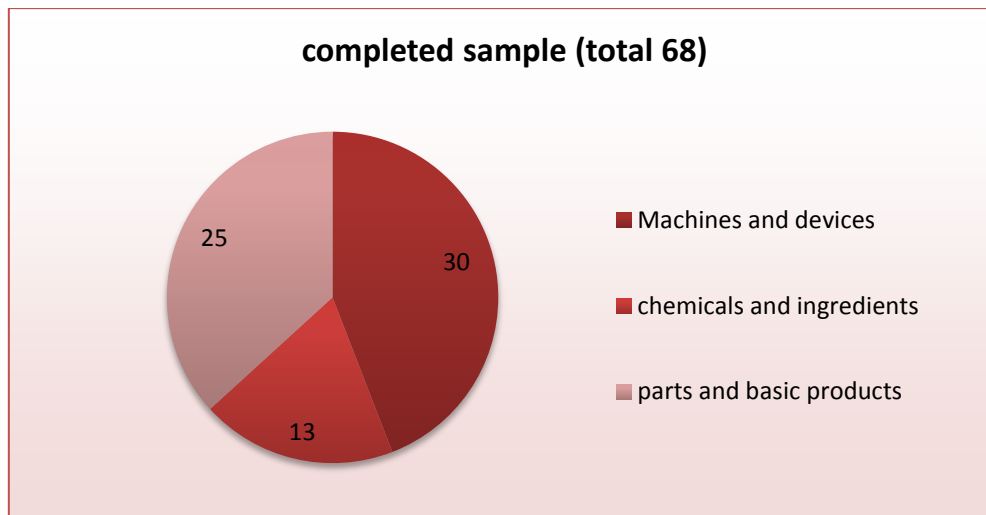


Figure 5: The completed sample

3.4 Variables and measures for the statistical analyses

This paragraph will describe the variables in this research and the measures that will be used to gather data on these variables (see table 4 for an overview and appendix 7.1 for all the measures and scales). The independent variables in this research are the strategic commercialization decisions organizations make. The first sub-paragraph will describe the strategic commercialization decisions that organizations make and their measures. The second sub-paragraph will describe the dependent variable cost effective portfolio management. In the final sub-paragraph the measures for the control variables will be described.

3.4.1 Independent variables: Innovation strategy and strategic orientations

The innovation strategy will be measured with a multiple choice question where the three strategies are described and the respondent will be asked to choose which strategy fits best with the organization.

The strategic orientations will be measured with six statements for each orientation, with 5-point Likert-scales attached, which are bi-polar in nature ranging from strongly disagree to strongly agree. The scales have been adopted from Mu and Di Benedetto (2011) and can be found in appendix 7.1. The customer and competitor measures originate from Narver and Slater (1990), the technological measures from Gatignon and Xuereb (1997) and Hurley and Hult (1998), the entrepreneurial measures from Hult and Ketchen (2001) and the networking measures have been developed by Mu and Di Benedetto (2011) through their own extensive theoretical review.

3.4.2 Dependent variable: Portfolio performance (cost-effectiveness)

The goal of this research is to identify positive causal relations with cost effective portfolio management. To measure the cost effectiveness of the project portfolio this research draws on the measures for new product advantage of Gatignon and Xuereb (1997) and Song and Parry (1997). Portfolio performance is nothing more than the sum of new product advantages. By measuring the cost effectiveness of the portfolio, both the successful projects and projects that failed are being taken into account. In addition it is important to measure over a time span of several years, because radical projects can take more than a year to develop and a wider time span gives an indication of sustainable innovation. The measures ask the respondent to compare the organizational

performance with the performance of its competitors, where the organization can score well below to well above the competition. The measures contain profitability, the speed to market, the rate of success (projects that reach the market), customer satisfaction and product quality and reliability.

3.4.3 Control variables

Four control variables have been included in the research that could have an effect on the causal relations under consideration. The first three control variables are grouping variables to control for the variation in the completed sample.

The first control variable is organizational size which will be measured based on the number of employees. Four categories have been made for this variable, namely 50-149 employees, 150-249 employees, 250-499 employees and 500> employees. These categories are based on the definitions for organizational size as defined by the European commission. The European definitions for organizational size are; small enterprises have <50 employees, medium enterprises 50-250 employees and large enterprises 250>. This research neglects the small enterprises and by adding two additional categories, this variable gives a better reflection of the sample.

The second control variable is the market sector. The sample has been roughly divided into three respondent sectors as has been described in paragraph 3.3. Teece (1986) and Chiesa and Frattini (2011) indicated that the sector could influence commercialization decision making so it is important to include this variable in the research.

The third control variable that has been included is R&D spending which indicates the investments that are being made for new product development. Because of the variation in organizational size, R&D spending has been measured by the percentage of total revenue that is being invested in R&D. Based on the data, three categories have been created; investments of <5%, 5-10% and 10%>.

In addition the control variable market dynamics has been added. The market dynamics are an important indicator to choose for a more incremental or radical balance (Adams, Bessant et al. 2006; Jansen, Van den Bosch et al. 2006; Floricel and Ibanescu 2008). Mu and Di Benedetto (2011) found a positive moderating role for environmental dynamism in the causal relation between strategic orientations and new product commercialization performance. By including environmental dynamism as a control variable this research can test the role of environmental dynamism from a innovation strategy perspective. The statements to test the environmental dynamism with scales, the same measures as Mu and Di Benedetto (2011) used, have been adopted from Jaworski and Kohli (1993). They measure environmental dynamism with the degree of uncertainty and unpredictability of technological development, customer preferences and competitive conditions.

Independent variables	Technological orientation (Cronbach α 0,93) Customer orientation (Cronbach α 0,91) Competitor orientation (Cronbach α 0,74) Entrepreneurial orientation (Cronbach α 0,89) Networking orientation (Cronbach α 0,88)
Dependent variable	Portfolio performance (cost-effectiveness) (Cronbach α 0,84)
Control variable	Market dynamics (Cronbach α 0,89)

Table 4: Variables for the statistical analyses (Mu and Di Benedetto 2011)

3.5 Method of analysis

The analysis consists of two phases; the first phase is based on the statistical data from the websurvey (4.1), the second phase is based on the qualitative data from the interviews (4.2). With the data from the websurvey the completed sample will be grouped on their innovation strategy and the other grouping control variables. The statistical analyses will identify the above average performing configurations of strategic orientations. With the second phase in the analysis the complementary project portfolio commercialization decisions will be identified to complete the strategic commercialization configurations. This paragraph will describe the methodology behind the analyses.

3.5.1 Descriptive statistics and correlations

The first analysis has been done with descriptive statistics to identify differences in commercialization decisions in the sample, based on their innovation strategy. The descriptive statistics consist of the mean, standard deviation, minimum score, maximum score, the 'N' number of respondents and finally the missing cases. These statistical analyses have been done with SPSS-software based on the data from the web-survey.

3.5.2 The fuzzy set Qualitative Comparative Analysis

To test which configurations of strategic commercialization decision making are sufficient for a cost effective portfolio, a fuzzy set Qualitative Comparative Analysis has been used. This is an analytic technique grounded in set theory that allows for a detailed analysis of how causal conditions contribute to an outcome in question. This approach is uniquely suited for analysing causal processes in typologies because it is based on a configurational understanding of how causes combine to bring about outcomes and because it can handle significant levels of causal complexity (Fiss 2011). This method is especially suited for this research because of the configurational approach to find sufficient solutions and because it is suitable for small and large N groups. The method differs from other conventional variable based methods because the fuzzy sets don't disaggregate cases into independent, analytically separate aspects but instead treat configurations as different types of cases. The fsQCA is uniquely suitable for testing typological and configurational theory because this method explicitly conceptualize cases as combinations of attributes and emphasize that it is these very combinations that give cases their unique nature.

The first step in fsQCA, creating the data matrix (see figure 5), starts with listing the cases as rows and case characteristics, the degrees of membership, in the columns (Kent 2008). The data needs to be calibrated into fuzzy sets by recoding the variable scores into a figure between 0 (not in the set) and 1 (fully in the set), with 0.5 as the crossover point where the case isn't a convincing non-member or member. The next step is the construction of a truth table (see figure 6). The researcher selects one of the characteristics as the dependent variable that he wants to explain and two or more membership scores that could possibly explain the dependent variable. The truth table now treats each case as a combination of the characteristics selected (or 'configuration' in fsQCA terminology). Only cases with exactly the same configuration are considered to be the 'same' type of case. Only cases with membership scores of 0.5 or greater are included in the truth-table by the algorithms.

Case	strategy	performance	itek dynamics	technological	customer	competitor	entrepreneurial	networking
21	1	0.66	0.08	0.73	0.92	0.92	0.82	0.95
22	1	0.66	0.18	0.62	0.92	0.82	0.73	0.68
23	1	0.73	0.46	0.78	0.95	0.95	0.85	0.62
24	1	0.27	0.75	0.78	0.78	0.44	0.5	0.38
25	1	0.79	0.5	0.68	0.94	0.88	0.68	0.78
26	1	0.5	0.5	0.62	0.56	0.15	0.38	0.32
27	1	0.73	0.41	0.38	0.5	0.22	0.44	0.27
28	1	0.66	0.25	0.78	0.56	0.5	0.5	0.5
29	1	0.73	0.41	0.38	0.5	0.22	0.44	0.27
30	1	0.66	0.25	0.78	0.56	0.5	0.5	0.5
31	1	0.5	0.5	0.27	0.73	0.78	0.38	0.32
32	2	0.47	0.25	0.78	0.9	0.82	0.56	0.73
33	2	0.12	0.46	0.62	0.18	0.27	0.44	0.56
34	2	0.5	0.5	0.56	0.73	0.44	0.32	0.44
35	2	0.79	0.55	0.62	0.62	0.68	0.44	0.5
36	2	0.58	0.32	0.38	0.68	0.5	0.38	0.18
37	2	0.42	0.41	0.08	0.56	0.44	0.68	0.56
38	2	0.73	0.64	0.22	0.78	0.56	0.73	0.82
39	2	0.5	0.59	0.73	0.85	0.78	0.85	0.56
40	2	0.34	0.25	0.1	0.78	0.44	0.5	0.1
41	2	0.35	0.5	0.78	0.73	0.38	0.5	0.78
42	2	0.73	0.32	0.82	0.92	0.82	0.62	0.82
43	3	0.5	0.68	0.73	0.78	0.44	0.56	0.05
44	3	0.84	0.59	0.85	0.73	0.78	0.82	0.44
45	3	0.66	0.32	0.95	0.88	0.88	0.78	0.62
46	3	0.42	0.5	0.78	0.88	0.68	0.82	0.5
47	3	0.34	0.32	0.95	0.56	0.9	0.68	0.85
48	3	0.34	0.64	0.56	0.82	0.62	0.38	0.12

Figure 5: The data matrix for the strategic orientations

The main analysis from fsQCA-software, which it calls a ‘truth table solution’, is a list of different combinations of causal factors that have met specified criteria of sufficiency for the outcome to occur. The procedure uses fuzzy membership scores to weight the relevance of each case; the result is more an index of consistency rather than a simple proportion of inconsistent cases (Kent, 2008).

technological	customer	competitor	entrepreneurial	networking	number	performance	raw consist.	PRI consist.	product
1	1	1	1	1	21 (51%)		0.916887	0.766702	0.702979
1	1	1	1	0	6 (65%)		0.937680	0.651475	0.610875
1	1	0	1	1	3 (73%)		0.969351	0.813187	0.788263
1	1	0	0	0	2 (78%)		0.957379	0.612717	0.586602
1	1	0	1	0	2 (82%)		0.949398	0.543478	0.515977
0	1	0	0	0	1 (85%)		0.916490	0.443396	0.406368
0	1	0	1	1	1 (87%)		0.967715	0.541176	0.523705
0	1	1	0	0	1 (90%)		0.944006	0.469388	0.443105
0	1	1	1	1	1 (92%)		0.971621	0.754839	0.733417
1	0	0	0	1	1 (95%)		0.952537	0.516667	0.492144
1	1	1	0	0	1 (97%)		0.952842	0.660870	0.629704
1	1	1	0	1	1 (100%)		0.960455	0.758241	0.728257
0	0	0	0	0	0 (100%)		0.952815	0.622516	0.593142
0	0	0	0	1	0 (100%)		0.960784	0.310345	0.298174
0	0	0	1	0	0 (100%)		0.961637	0.554456	0.533185
0	0	0	1	1	0 (100%)		0.960114	0.300000	0.288034
0	0	1	0	0	0 (100%)		0.965669	0.571427	0.551809
0	0	1	0	1	0 (100%)		0.971087	0.491228	0.477025
0	0	1	1	0	0 (100%)		0.969965	0.484849	0.470287
0	0	1	1	1	0 (100%)		0.970077	0.474576	0.460375
0	1	0	0	1	0 (100%)		0.978204	0.537038	0.525332
0	1	0	1	0	0 (100%)		0.962150	0.528303	0.508307
0	1	1	0	1	0 (100%)		0.970827	0.666667	0.647218
0	1	1	1	0	0 (100%)		0.960174	0.471154	0.452389
1	0	0	0	0	0 (100%)		0.963075	0.666667	0.642050
1	0	0	1	0	0 (100%)		0.963864	0.662069	0.638145
1	0	0	1	1	0 (100%)		0.964912	0.682758	0.658802

Figure 6: The truth table for the strategic orientations

3.5.3 Case analysis; comparing interview data

For the final analysis the commercialization configurations of nine organizations will be compared to identify patterns, based on their innovation strategy. For each innovation strategy three organizations will be compared on their portfolio strategy, market strategy and collaboration efforts. This will enrich the statistical findings by giving a more in depth view on the project portfolio level with cases from practice.

With selective coding methodology the data has been categorised and analysed. Selective coding can be defined as: 'selecting the core category, systematically relating it to other categories, and filling in categories that need further refinement and development' (Strauss 1990). Selective coding has an emphasis on integration and finding connections between categories. Where with open coding methodology the researcher derives the 'codetree' of main codes and sub codes from data, this method starts with a codetree to categorize data and to find patterns. The codetree for this research has been derived from literature, the codes are the commercialization decisions and their variables (see appendix 7.3). With the data from the websurvey the strategic orientations and drivers for innovation have been identified which give shape and content to the codetree on the business strategy level. To integrate, and further refine connections between the strategic orientations and the project portfolio level commercialization decisions, additional data has been gathered with the semi-structured interviews. All the key elements for the codes have been subtracted from the answers and combined in one large excel sheet. After thorough examination and comparison of the answers to the questions, patterns have been identified and integrated with the strategic categories.

The next paragraph will describe the statistical analyses and results for the business strategy level. Paragraph 4.3 will focus on the project portfolio level commercialization decisions based on the analyses of the interviews.

4. Analysis and results

In the previous chapter has been described how the data was gathered. This chapter will explain how the data from the web-survey and interviews will be analysed and what has been found during the analysis. The first paragraph will describe the method for the analysis, the second paragraph the statistical results on the business strategy and the third paragraph the results from the interviews on the portfolio strategy, market strategy and inter-firm collaboration.

4.1 Statistical results on business strategy

This second paragraph of the analysis shows the statistical results of this research for the business strategy variables. First the descriptive statistics and correlations will be discussed followed by the fsQCA. The drivers for innovation will be discussed in 4.2.2 and the paragraph ends with a conclusion on the business strategy variables.

4.1.1 Innovation strategy and strategic orientations

From the theoretical framework propositions have been formulated to find successful configurations of strategic orientations, from an innovation strategy perspective. In this subparagraph the subsets of innovation strategies will be discussed followed by the correlations within the subsets based on correlations analysis and the fsQCA methodology. The descriptive statistics are based on the calibrated fuzzy sets. The data from the web-survey has been calibrated with fsQCA software into fuzzy scores between 0 and 1 that indicate the degree of membership, or in other words how the respondents score on each variable. For performance the data (1 well below – 5 well above) has been calibrated with a minimum of 2, a crossover point of 3.5 (average performance) and a maximum of 5. For the strategic orientations the data (1 strongly disagree – 5 strongly agree) has been calibrated with a minimum of 1, a crossover point of 3 and a maximum of 5.

A comparison with the distribution of strategies in a research by Cooper et al. (2004) could indicate that many organizations shifted to a more proactive strategy based on their own fundamental R&D capabilities. This sample includes 31 defenders, 11 analysers and 26 innovators. In the research done by Cooper et al. (2004) under technological manufacturing organizations, the analyser strategy was the most popular strategy and the defender strategy the least popular. This could also indicate that organizations are indeed preoccupied with customer driven incremental product improvements, an issue identified by Cooper and Edgett (2008).

The descriptive statistics for the defender show a high average score for the customer orientation. The second strongest orientation is the technology orientation. The competitor and networking orientation show the largest variation in the subset with a standard deviation of respectively 0.23 and 0.25.

Variable	Mean	Std. Dev.	Minimum	Maximum	N Cases	Missing
performance	0.5383871	0.1859084	0.11	0.82	31	0
technology	0.6712903	0.1972021	0.08	0.95	31	0
customer	0.7287097	0.1690341	0.27	0.95	31	0
competitor	0.6106452	0.2311533	0.12	0.95	31	0
entrepreneurial	0.5616129	0.1848992	0.08	0.92	31	0
networking	0.5329032	0.2461994	0.05	0.95	31	0

Table 5: Descriptive statistics for the defender subset

The descriptive statistics for the analyser show a strong mean for the customer orientation and high variation in the technology (0.26) and networking orientation (0.23).

Variable	Mean	Std. Dev.	Minimum	Maximum	N Cases	Missing
performance	0.4581818	0.1958579	0.11	0.77	11	0
technology	0.5172727	0.264647	0.08	0.82	11	0
customer	0.7027273	0.195917	0.18	0.92	11	0
competitor	0.5572727	0.1812126	0.27	0.82	11	0
entrepreneurial	0.5472727	0.1523209	0.32	0.85	11	0
networking	0.55	0.2306907	0.10	0.82	11	0

Table 6: Descriptive statistics for the analyser subset

The descriptive statistics for the innovator show a remarkable strong and consistent technology orientation and a strong customer and entrepreneurial orientation. Again the networking orientation shows the highest variation in the set with a standard deviation of 0.24.

Variable	Mean	Std. Dev.	Minimum	Maximum	N Cases	Missing
performance	0.5273077	0.161711	0.24	0.82	26	0
technology	0.8246154	0.0998549	0.56	0.95	26	0
customer	0.7492308	0.1454416	0.32	0.94	26	0
competitor	0.6603846	0.1893609	0.22	0.94	26	0
entrepreneurial	0.7319231	0.1425595	0.38	0.94	26	0
networking	0.5457692	0.241106	0.05	0.85	26	0

Table 7: Descriptive statistics for the innovator subset

By use of the original data from the web-survey and SPSS software, correlations between the variables were identified. For an overview of the correlations see table 8.

Correlations		Innovation strategy	Market dynamics	Technology orientation	Customer orientation	Competitor orientation	Entrepreneurial orientation	Networking orientation
Market dynamics	Pearson Correlation	,204						
	Sig. (2-tailed)	,096						
	N	68						
Technology orientation	Pearson Correlation	,336**	,001					
	Sig. (2-tailed)	,005	,996					
	N	68	68					
Customer orientation	Pearson Correlation	,020	-,138	,255*				
	Sig. (2-tailed)	,872	,263	,036				
	N	68	68	68				
Competitor orientation	Pearson Correlation	,101	-,168	,437**	,558**			
	Sig. (2-tailed)	,414	,170	,000	,000			
	N	68	68	68	68			
Entrepreneurial orientation	Pearson Correlation	,409**	-,003	,557**	,363**	,508**		
	Sig. (2-tailed)	,001	,979	,000	,002	,000		
	N	68	68	68	68	68		
Networking orientation	Pearson Correlation	,007	-,209	,361**	,298*	,323**	,395**	
	Sig. (2-tailed)	,956	,087	,002	,014	,007	,001	
	N	68	68	68	68	68	68	
Performance	Pearson Correlation	-,026	-,120	,232	,157	,229	,287*	,300*
	Sig. (2-tailed)	,836	,331	,057	,201	,060	,018	,013
	N	68	68	68	68	68	68	68
*. Correlation is significant at the 0.05 level (2-tailed).								
**. Correlation is significant at the 0.01 level (2-tailed).								

Table 8: Correlations within the web-survey dataset

All the statistical variables can both be found in the first column and the first row. The positive or negative correlations are represented by the Pearson correlation number. The significant correlations between the variables are marked in the table with one or two stars. The table shows that the innovation strategy correlates positive and significant (at the 0.01 level) with the technological orientation and the entrepreneurial orientation, indicating that there are strong differences on these orientations when comparing the innovation strategies. This confirms the assumptions that there are differences in the orientations organizations have, based on their innovation strategy, what also can be seen from the descriptive statistics. In addition, from the table can be seen that there is no significant correlation between the innovation strategy and performance. This indicates that organizations can indeed perform above average with all three strategies.

It is interesting to see that all orientations correlate positively and significantly with each other, confirming the findings of Mu and Di Benedetto (2011) that organizations use combinations of all the orientations. In addition this table shows that all the strategic orientations have a positive correlation with portfolio performance, but only the entrepreneurial and networking orientation have a significant correlation (at the 0,05 level) when looking at the entire set. Especially finding that the networking orientation has a significant correlation with performance is interesting, because this orientation has the largest diversity of fuzzy scores in the subsets.

The control variables show no significant correlations, the only significant correlation can be found between R&D spending and organizational size, which indicates that larger organizations spend a smaller percentage of their revenues on R&D, but this has no influence on the propositions that are being tested in this research.

To see which configurations of the strategic orientations are sufficient for above average performance, fuzzy set Qualitative Comparative Analyses have been used. Tables 9-11 show the truth table solutions for respectively the defender strategy, the analyser strategy and the innovator strategy. The procedure uses fuzzy membership scores to weight the relevance of each case. “Raw coverage” measures the proportion of memberships in the outcome explained by each term of solution, while “unique coverage” measures the proportion of memberships in the outcome explained solely by each individual solution term (i.e., memberships that are not covered by other solution terms). Perfect causal sufficiency for above average performance would lead to a consistency of 1.00, the solution is sufficient if the consistency is above 0.80. The solution coverage shows the percentage of cases that are being covered with the solutions. The solution consistency is more an index of consistency rather than a simple proportion of inconsistent cases (Kent 2008; Ragin 2008). It should be taken under consideration that the N for the analyser strategy (11) is significantly smaller than the defender (31) and innovator (26). From fsQCA methodology can be learned that fsQCA works for both small samples as large samples, but works best with a sample of around 30 cases or more (Kent, 2008).

Defender strategy	Raw coverage	Unique coverage	consistency
networking*entrepreneurial*customer*technological	0.692728	0.029524	0.924818
networking*competitor*customer*technological	0.651722	0.017496	0.909230
entrepreneurial*competitor*customer*technological	0.710224	0.038819	0.872398
-networking*-entrepreneurial*-competitor*customer*technological	0.435757	0.028431	0.939858
solution coverage: 0.814653			
solution consistency: 0.872365			

Table 9: Truth table solutions for the defender strategy

The defender strategy shows above average performance with the customer- and technological orientation as core orientations. The solutions show combinations with peripheral networking, entrepreneurial and competitor orientations, but also a solution with the absence of these orientations. This indicates that the presence or absence of these orientations makes little difference, so this can be reduced to a configuration of a customer- and technological orientation. The defender needs strong capabilities towards identifying their customer needs and the development of technologies to improve their products.

Analysers strategy	Raw coverage	Unique coverage	Consistency
networking*entrepreneurial*customer*-technological	0.605159	0.027778	0.913174
networking*entrepreneurial*competitor*customer	0.757937	0.180556	0.880184
solution coverage: 0.785714			
solution consistency: 0.855292			

Table 10: Truth table solutions for the analyser strategy

The analyser strategy shows above average performance with a strong networking-, entrepreneurial- and customer orientation as core orientations. The solutions show a combination with the absence of a technological orientation and the presence of a peripheral competitor orientation. The analyser

is more external oriented and has a stronger entrepreneurial orientation. The analyser is less focused on technology development and fundamental R&D, but has strong capabilities to monitor the market and to make use of complementary assets of network partners. The analyser is a reactive strategy that makes use of its network to gain access to new technologies to follow its proactive developing competitors.

Innovator strategy	Raw coverage	Unique coverage	Consistency
networking*entrepreneurial*customer*technological	0.830051	0.059081	0.866717
entrepreneurial*competitor*customer*technological	0.907367	0.136397	0.806744
solution coverage: 0.966448			
solution consistency: 0.807434			

Table 11: Truth table solutions for the Innovator strategy

The innovator shows above average performance with a strong entrepreneurial, customer and technological orientation as the core orientations. The networking and competitor orientation are positive peripheral orientations. The innovator has a strong emphasis on developing innovative technologies and radical new products through strong technological capabilities and an entrepreneurial orientation. In addition the innovator has strong capabilities to identify latent and emerging needs of the customer to recognise new opportunities.

4.1.2 Drivers for innovation

To identify the drivers and main strengths for innovation, the respondents have been asked to select their drivers for innovation from the five strategic orientations. The results can be found in figure 7.

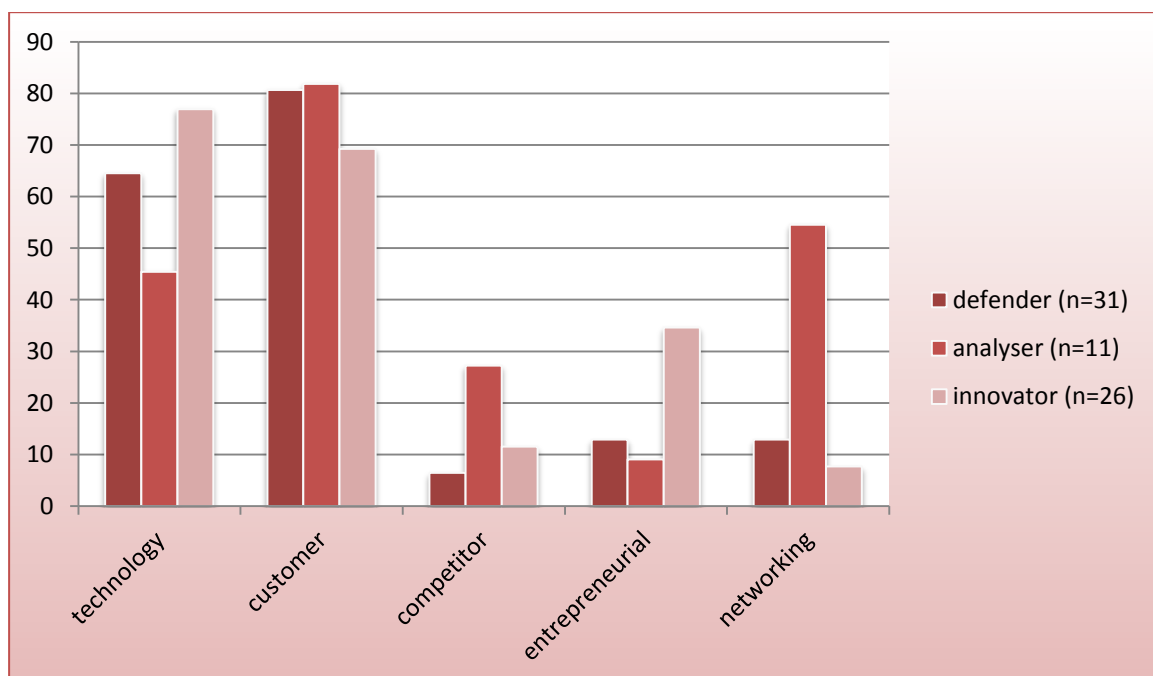


Figure 7: The drivers for innovation

The figure above shows the percentage of the respondents that indicated that the orientation is a main strength and driver for the innovation efforts. The figure shows that the defender is primarily

driven by the customer orientation (81%) and secondly by the technological orientation (64%). The analyser is driven by a strong customer orientation (82%) and (by far) the strongest networking orientation (54%). The technological orientation is a strength and driver for innovation for only 45% of the respondents, and the analyser scores highest on the competitor orientation (27%). The innovator scores highest on the technology orientation (77%) and the second strongest driver is the customer orientation (69%). The innovator also scores highest on the entrepreneurial orientation (35%).

The drivers for innovation reflect most of the core orientations identified with the fuzzy set Qualitative Comparative Analyses, except for the entrepreneurial orientation. The above average performing analysers and innovators have a core entrepreneurial orientation, but this orientation scores relatively low as a main strength and driver for innovation in the completed sample. These findings support the idea that organizations are too pre-occupied with customer driven incremental innovation, although above average performance have a more radical focus through their core entrepreneurial orientation.

4.1.3 Conclusion on the business strategy

Technological manufacturing organizations in the Netherlands can perform above average with all three innovation strategies as defined by Miles and Snow. For above average performance, these organizations use other configurations of strategic orientations from an innovation strategy perspective. The innovation strategy correlates positive with all orientations but only significantly with the technological and entrepreneurial orientation. In addition the correlation-table (table 8) shows that all strategic orientations correlate positively with each other (and significant) and with performance (only the networking and entrepreneurial orientation significant). These findings confirm the findings of Mu and Di Benedetto (2011) that organizations use combinations of strategic orientations in order to have a cost-effective project portfolio.

In order to identify cost effective configurations for above average performance, the fuzzy set Qualitative Comparative Analyses identified the sufficient solutions for each innovation strategy. This research identified the technological and customer orientation as the core orientations for the defender. For the analyser the networking, entrepreneurial and customer orientations are core orientations with either a peripheral role for the competitor orientation or a remarkable negative peripheral role for the technological orientation. For the innovator strategy the entrepreneurial, customer and technological orientation are the key orientations, with a peripheral role for either the networking orientation or the competitor orientation.

The drivers for innovation reflect most of the found core orientations, with the customer orientation as a strong driver for all innovation strategies, the technological orientation as the strongest driver for the innovator and as a strong driver for the defender and the networking orientation as the second strongest driver for the analyser. The analyser also scores highest on the competitor orientation and the innovator on the entrepreneurial orientation. The percentage of the analysers and innovators that identified the entrepreneurial orientation as a main strength and driver for innovation is remarkably low for a core orientation.

Proposition 1a: The cost effective defender has a very strong customer orientation, a strong technological orientation and a weak focus on the other orientations, is being confirmed by the

findings. The strong customer and technological orientations are being reflected by both the fsQCA (as core orientations) and the drivers for innovation.

Proposition 2a: *The cost effective analyser has a strong competitor and networking orientation and an average focus on the other orientations*, is not being reflected by the findings. The networking orientation is indeed a strong and core orientation for the analyser, but the competitor orientation is more peripheral (but the competitor orientation is recognized the most by analysers as a driver for innovation) and the customer and entrepreneurial orientations are more important than anticipated, although the strength of the entrepreneurial orientation is not being reflected as a driver for innovation in the completed sample. This could also be an indicator that the analysers in the sample hinge more towards a defender approach which confirms the worries of Cooper and Edgett (2008) that organizations are too pre-occupied with customer driven incremental innovations. The revised proposition would be: *The cost effective analyser has a strong customer, networking and entrepreneurial orientation, an above average competitor orientation and a weak technological orientation*.

Proposition 3a: *The cost-effective innovator has a strong technological, entrepreneurial and networking orientation and an average focus on the other orientations*, is also not being reflected by the findings. The innovator does indeed have the most convincing and strongest technological orientation and a strong entrepreneurial orientation which are both core orientations (The entrepreneurial orientation is recognized the most by the innovators as a driver for innovation). The networking orientation is more a peripheral orientation but is in general positively and significantly correlated with performance. Again the customer orientation shows up as a core orientation that is important for above average performance. The revised proposition would be: *The cost-effective innovator has a strong technological, customer and entrepreneurial orientation and an average networking and competitor orientation*.

The next paragraph presents the findings from the interviews to identify connections between the commercialization decisions and to further enrich the statistical data on the project portfolio level.

4.2 Results from the interviews

The data from the interviews has been combined in a large datasheet categorized according to the codetree that was defined with the theoretical framework and statistical results (see appendix 7.3). From the data, patterns and relations were identified for each innovation strategy that will be described in the following sub-paragraphs. In addition the data led to some general findings in the dataset for sector specific companies.

One of these findings is that in high-tech sectors (machines/devices) there is a stronger emphasis on the speed to market and early signalling to the market of new products in development. This can be done through pre-announcements, for instance by taking a prototype to a fair. The reason for this phenomenon is that the lifecycles of products in these sectors are much shorter than for instance in the chemicals and ingredients sector. In some cases it takes only 2-3 years before a product is outdated. In addition, due to the high complexity of technology linkages in the concept, these are in many cases long term projects.

Another finding is that for some sectors the meso-level organizational environment has a strong influence on the technology strategy and portfolio composition. The meso-level organizational

environment consists of governments, in this case local governments but also national or even international governments like the European Union. For instance in the automotive industry, regulations and financial stimulation for the production of “green” cars has a strong impact on the innovation efforts of automotive companies and their suppliers. Another example is the food sector (ingredients, but also for instance machines for food processing), where health and more environmental friendly products are being stimulated. This paragraph will continue with the findings for the individual innovation strategies starting with the defenders.

4.2.1 The defenders

Portfolio strategy:

The defender has a defined technology roadmap for the project portfolio with a horizon of 3-5 years. The technology research is focused on technologies for the next generation products and about 20% of the R&D resources are committed to fundamental technology research. The portfolio has a strong focus on the customer and customization of products is being seen as a strong customer value. About 70% of the resources are being spent on incremental product improvements and the final 10% are the more radical new product projects that are truly different products in comparison to the current product portfolio. Most diversity in the portfolio can be found in the application of technologies in the concepts to improve one or two product properties according to customer wishes. *“With our projects we constantly improve the quality of our products and the efficiency to make them. In addition we add value to our customers by taking over part of their R&D, by implementing our products in theirs.”* For the defender, short term results are important. Especially in the high technology segment (machines/devices), their products are earlier outdated than those of their innovating counterparts which leaves little time for development. The sales department is strongly involved in monitoring the projects and go/kill decision making. *“Most risky or long term projects won’t reach the project portfolio because there is a strong influence from sales and a focus on fast returns.”* Defender organizations are significantly smaller than innovators and resources are limited, but in addition they are more transparent due to their size which makes them easier to manage.

These findings are in line with proposition 1b: *The defender has a technology and incremental product improvements oriented portfolio and has a strong emphasis on efficiency and cost reduction.* The interviews reflect the core technological and customer orientation with a strong emphasis on internal development and customer collaboration and customization as a strong customer value. The strong emphasis on efficiency and cost reduction is being reflected by the importance of short term results and the high involvement of the sales department. What can be seen from the interviews is that all the organizations stress the importance of efficiency and cost reduction, regardless of their innovation strategy. Most of the interviewees relate this to the current economic climate.

Market strategy:

The defenders from the interviews are focused on niche markets or niches in mass markets, which require specific customized products and solutions. Defenders mainly search for new applications for products by altering the technological composition. In the market the defender waits for demand and growth before the defender enters the market. This is the point where the market is growing and the product is more mature. They show a clear market pull portfolio where the defender tries to differentiate their products by delivering added value to the customer. *“We don’t have the means to*

launch really radical products; we are a niche player, focused on delivering more value to our customers.” The added value the defender delivers is strong customer collaboration in the customization of products. This starts with a key position of sales and customer relationship management (CRM) in the ideation phase. Most ideas for new product concepts come from a select group of customers through close customer relations. The defender does part of the R&D work for the customer by implementing their products in those of the customers. One of the defenders, with a larger R&D capacity, even sent a team of engineers to the customer to work on a long term project for the development of a new product of the customer.

These findings are in line with proposition 1c: *The cost effective defender positions the projects strongly towards the lead users among his current customers in a niche market.* The defender is indeed a niche operator with a strong focus on specific and complex customer requests. The entire NPD process has strong connections with sales and the defender will wait for growth and maturation in the market before it will enter a market with generic products.

Inter-firm collaboration:

Next to the customer the suppliers of the defender are also of great importance in the NPD process. The defender is not actively searching for partners, but has a small network of suppliers with whom they try to build on long term relationships. Contact with partners is project based but the defender tries to make these contact moments more structural. *“We work on long term relations with a select group of suppliers but partnerships are project based and based on make or buy decisions.”* The defender also uses his suppliers R&D competences for core material research. This brings the defender in a highly dependent position on customers and suppliers, where the defender translates the customer demand to his suppliers. One of the respondents explained that they made regular use of the research facilities of suppliers to do fundamental research. The defender has a strong emphasis on internal development and has strong development and production capabilities. The defenders have more difficulties in measuring concepts and are more eager to start developing if there is an opportunity for short term results. Management of technology through Intellectual Property protection and exploitation is of less interest for the defender. Technologies and concepts are in many cases not unique and costs of these activities are simply too high.

These findings are in line with proposition 1d: *The defender is a strong R&D integrator to save costs and keep control over the entire process in order to be able to make future product- and process improvements.* The defender does indeed have a small network with long term relations and has a strong emphasis on internal development and a relatively strong technology development capability.

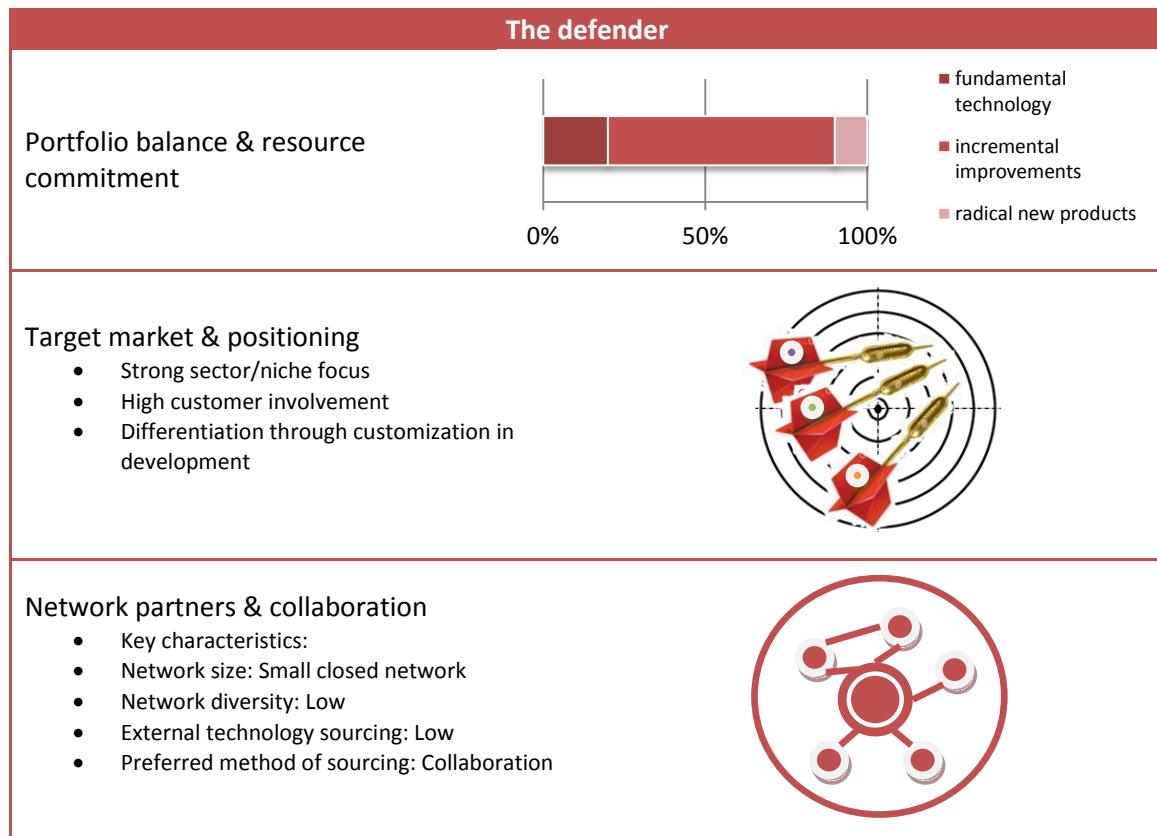


Figure 8: Project portfolio findings for the defenders

4.2.2 The analysers

Portfolio strategy:

The analyser has a less clearly defined technology strategy or roadmap, or as two respondents described it; the technology strategy becomes vague after the first year. The horizon of the analyser is 1-3 years and the analyser invests about 10% of its resources in fundamental technologies, focused on process improvements and customized large customer orders. Most fundamental research is being done by suppliers and other network partners. The other resources are being used for concept development, where the resources are ideally balanced between incremental product improvements and the radical new products. Due to the current economic crisis and pressure from customers to reduce costs, analysers are forced to give more attention to incremental product improvements that show short term financial results. *“The market is declining which results for us in a short term focus and more incremental projects.”* The products that are being produced by the analyser have a shared technological core but show large variety in concepts and small differences in product properties. The analyser uses product managers to manage the composition of the portfolio. Product managers should identify the roadmap and more radical opportunities for the portfolio, but currently at two of the interviewed analysers there is a strong focus on the time to market and short term returns, and is the sales department the leading factor in NPD.

Proposition 2b: The portfolio of the analyser has a strong emphasis on applied R&D and is focused on reducing the time to market to become the ‘fast second’, fits in general the findings for the portfolio strategy. The analyser does indeed have a strong emphasis on applied R&D and reduction of the time to market, but the time to market is more important for short term results. The issue of becoming

the 'fast second' does only play a role in the high-tech sector as described at the start of this paragraph. If the speed of development in the market is high, then the TTM becomes important to gain 'fast second' advantages. Proposition 2b has to be split in two propositions to reflect the findings: *The portfolio of the analyser has a strong emphasis on applied R&D based on a strong core technology proficiency.* The second proposition is: *The speed of development is important in high-tech markets to gain 'fast second' advantages.*

Market strategy:

The analysers are focused on the mass market but develop many variations in concepts and product collections to serve a wide variety of customer wishes and in some cases market niches with more radical solutions. Standardization in the process is important to reduce production costs and the TTM. The analyser responds to emerging demand in the market and serves relatively more market segments in comparison to the defender. The main R&D activities are driven by sales requests; identification of niches or new market segments (or even a new market) is being done by product management. The concepts of the analyser are less focused on specific customers, but more on market segments. In some cases close collaboration with customers occur, if it is a large customer and the requested product can be sold in a large volume. Discretion and contract based agreements are important for these high involvement projects. Involvement can for instance occur by testing prototypes in parallel lines of the customer (for machines and devices) or by interactive phased development.

Proposition 2c: *The analyser targets opportunities for a competitive advantage over the innovator and integrates the voice of the early adopters through a strong market orientation.* This proposition is in line with the findings on the market strategy. The analyser is open to new segments but follows the innovator and positions the products with the early adopters, where demand is emerging. This explains the entrepreneurial orientation as a core orientation. This is how the analysers in the interviews would prefer their market strategy, but the interviews and statistics show that due to the short term focus, the in-between strategy tilts more in the direction of the defender, with more incremental projects. This explains the importance of the customer orientation as a core orientation for the analyser.

Inter-firm collaboration:

The strong network orientation is clearly being reflected in the interviews with the analysers. The analysers indicate that they know all the players in the market and have a large database with suppliers. *"We know our core competences and if we need other parts or technologies to offer a solution we will search for a partner."* The analysers search for network partners, mostly from a purchasing perspective. The analyser respondents referred to terms like 'technology shopping' and 'technology licensing' for their network orientation. The respondents indicate that this is an easy way to cut costs for their short term focused portfolio. The analysers stay close to their core competences which are production, control over the core technology and selling complete solutions. Access to other technologies or products to create variations in their products or solutions is being created through collaboration with partners and licensing agreements. Rebranding partner products is an easy way to enrich the product assortment and to deliver a larger variety of solutions. The analysers make use of technology management to protect their more radical concepts, but do not exploit their concepts through direct licensing. IP protection does in general not happen very often.

Proposition 2d: *The analyser aligns its complementary assets with the innovator and engages in collaboration and licensing to speed up the time to market and to gain access to new technologies.* The findings support proposition 2d that the analyser is stronger focused on applied R&D and searches for network partners to gain access to new technologies. Collaboration and licensing are indeed a fast and effective way for the analyser to develop new products. Alignment with the complementary assets of the innovator is not being reflected in the findings. Analysers appear to be much more customer-oriented and driven by sales requests, but they do indicate that they know all the players in the market and monitor their direct competitors closely. The revised proposition would be: *The analyser engages in collaboration and licensing to speed up the time to market and to gain access to new technologies.*

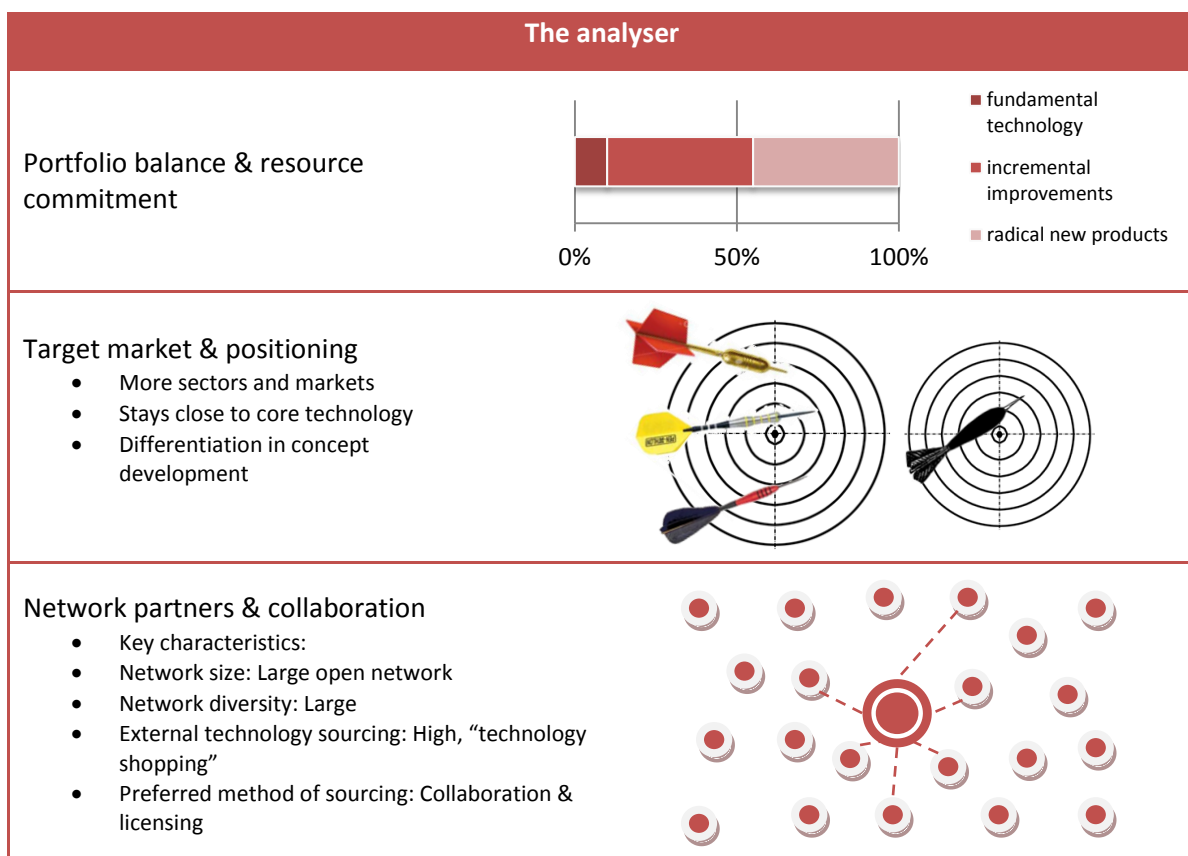


Figure 9: Project portfolio findings for the analysers

4.2.3 The innovators

Portfolio strategy:

The innovators have the most specific and clearly defined technology roadmap, with a horizon of 5-10 years. In addition the innovator invests about 40% of his resources in fundamental technology development with a focus on the second and third generation products but also on new market segments and new markets. The residual 60% consists of about 20% product improvements and 40% radical new products. Each product group has its own common technology base, but the product groups can be very distinctive. For the innovator monitoring is important due to the size of the R&D resource pool and again to keep control over costs and efficiency. The innovator has just like the defender a strong emphasis on internal development and starts preparing the market for a new product as soon as there is a physical product to show.

These findings support proposition 3b: *The innovator has a long term focus on technological development to support the development of radical innovations where market acceptance plays an important role in timing aspects*, but the findings are not entirely reflected by the proposition. The innovator has the most clearly defined long term strategy for technological development. The emphasis on radical innovations and market creation underlines the strong technological and entrepreneurial orientation and by developing a wide variety of additional services and products to support the main product, the innovator improves market acceptance. Instead of waiting for market acceptance and keeping technologies in the shelves, innovators make clever use of complementary products and services to diffuse new technologies in the market. The revised proposition would be: *The innovator has a long term focus on technological development to support the development of radical innovations, where the development of complementary products and services play an important role in the diffusion of these new technologies in the market.*

Market strategy:

The innovators in the interview sample are focused on niche markets with only a few large players. With a strong market orientation they search for new opportunities. New business development is an important strategic aspect and in most cases even a formal department in the organizational structure. The innovators have a broader market orientation than the other strategies and do major investments to create new markets and business units. All three innovators had recently invested in a new business unit, two through acquisition of another organization and the other based on a new radical product group originated from fundamental technological research. The innovators create demand and open up new markets. These are risky activities but as one of the respondents put it; “the high revenues reflect the high investments”. The organizations have a solid product portfolio, with in many cases a business unit for each product group with their own product development and sales teams. The more fundamental and new to the market R&D activities are being carried out in a separate technology department, where the respondents refer to as “the innovation cell” or “technology centre”. The innovator is strongly oriented to the customer needs and especially customer latent needs. Customer Involvement during NPD is in some cases desirable, but difficult due to the high complexity of both organizations and the long development time. It costs time and efforts to share knowledge on a development project and it is difficult to find the right person within these bulky organizations to work together with. In addition employees in these organizations change positions often. Innovators do make use of own market research, external bureaus and institutes to gain customer information and feedback, this is the preferable method for the more protective innovator. High customer involvement only occurs under complex contractual agreements with strong long term customer relations and depends on the potential sales.

The findings on the market strategy support proposition 3c: *The cost effective innovator positions the projects strongly towards the early adopters among emerging customers*. The innovator is very technology driven and focused on latent customer needs and new markets. To identify these needs they cooperate with a wide variety of network partners, but the innovator is less open to direct customer involvement. In contradiction to the defender strategy, the customer orientation for the innovator has a more indirect and less collaborative approach.

Inter-firm collaboration:

The innovator has a broad network for the ideation phase and concept maturation. They work closely together with universities, research institutes and other specialists to identify trends and future

technologies. Each concept is thoroughly assessed to prevent reinventing the wheel. The innovators prefer internal development of new products. The high tech innovators work closely together with a broad variety of partners with complementary products and services to strengthen the sales of their core products, but only after development. This occurs under complex contracting agreements or through acquisition of the other organization. Technology management is very important for the innovators. All three innovators have a legal department to protect inventions, exploit intellectual property through early licensing and to identify IP infringements in the market.

These findings are in line with proposition 3d: *The innovator uses licensing as a tool for technological diffusion and early commercialization and gains access to unique complementary assets through collaboration and acquisition.* The innovators develop a wide variety of products and services to support the diffusion of the core new technology. They also work together with partners to gain access to complementary services and products but this involves complex contract arrangements and can result in acquisitions. The innovators are the only respondents that indicated that technology management is important to protect their new technologies, and that they in time even exploit intellectual property directly through licensing.

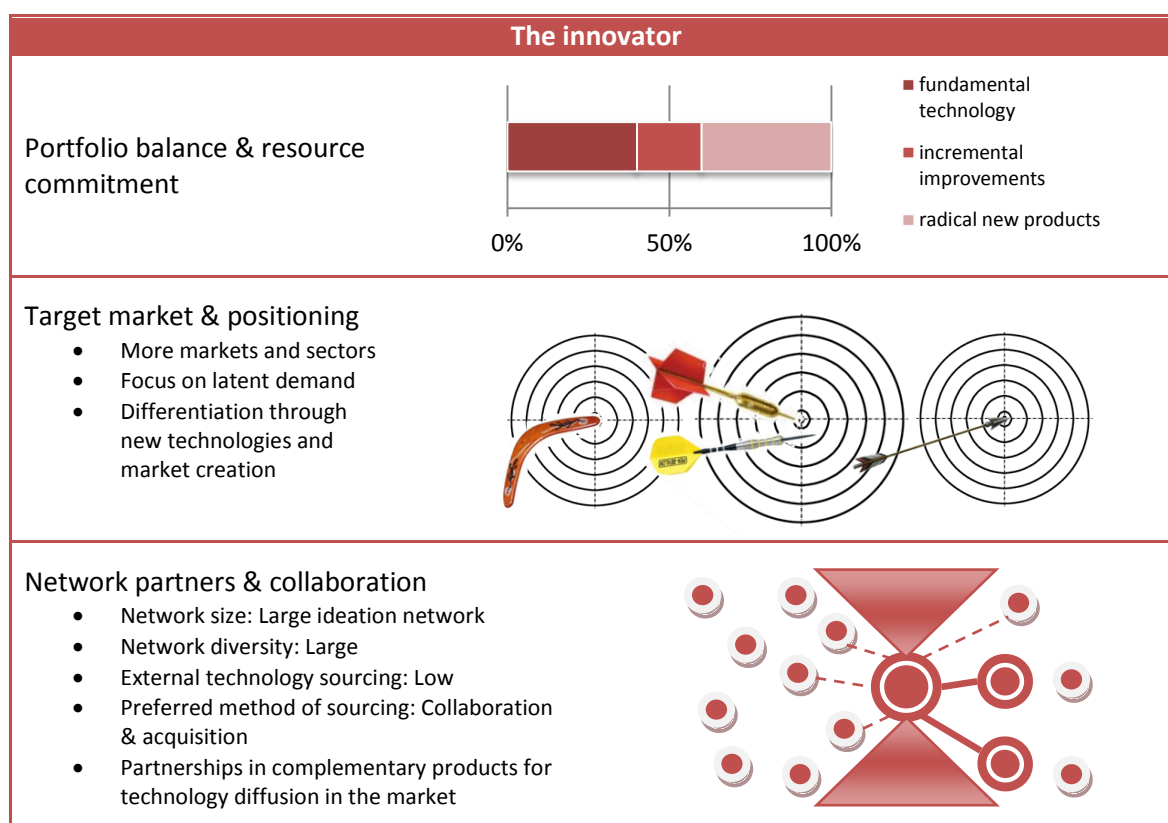


Figure 10: Project portfolio findings for the innovators

5. Conclusion and discussion

This final chapter will conclude this research by presenting and discussing the main findings. Both the implications for theory and management will be discussed, with at the end of this chapter the limitations for this research and advice for future research on the subject of strategic commercialization.

5.1 Main findings

The goal of this research is to find which strategic decisions organizations make for the commercialization of matured concepts, in order to achieve a cost-effective project portfolio. In this paragraph the goal will be accomplished by answering the main research question: *What are cost effective strategies for the commercialization of matured concepts in project portfolio management?*

This research started by building a theoretical framework to identify the strategic commercialization decisions. Strategic commercialization decisions have to be made on the business strategy level and on the project portfolio level. On the business strategy level, the innovation strategy and strategic orientations define the innovative DNA of the business strategy, which is the starting point for this research. On the project portfolio level, the portfolio strategy, the market strategy and inter-firm collaboration decisions have been identified as the strategic commercialization decisions. Together these decisions define the composition of the project portfolio and the path to the targeted market. The cost effective strategies for commercialization are the configurations or patterns of decisions that lead to above average project portfolio performance.

The statistical results show that all the strategic orientations correlate positively to the performance of the organizations in the sample. In addition the results show that the organizations use different configuration of the strategic orientations based on their innovation strategy and that some orientations are core orientations for above average performance. This supports the idea that different configurations of strategic orientations exert their effects on performance, from an innovation strategy perspective. The results from the fuzzy set Qualitative Comparative Analyses on the three individual strategies show that defenders show above average performance with a core customer and technology orientation. The analysers show above average performance with a core customer, networking and entrepreneurial orientation. The innovators perform above average with a core technology, customer and entrepreneurial orientation. Most core orientations are being reflected in the overview of the main strengths and drivers for innovation. Only the core entrepreneurial orientation for both the analyser and innovator score low in the completed sample as main strengths and drivers for innovation.

The findings from the interviews show that the main strength for the defender is broad technological knowledge for a specific market sector or niche and a strong development and production capability optimized for this sector. The portfolio strategy shows a strong incremental focus to applied R&D and high customer involvement in the development and customization of products. The above average performing defender knows the players in the niche market. Long term strong relations with a small network help the defender to keep his knowledge up to date and to be the perfect supplier for customized high involvement products.

The main strength for the analyser is a strong capability for applied R&D, market knowledge and a broad network orientation. The project portfolio is both focused on incremental product

improvements as new products. The analyser stays close to the core technology and uses applied R&D to launch a high variety of concepts. The analyser searches for new applications for the core technology in different sectors and even markets. The analyser gains access to new technologies through license agreements or collaboration to compensate the lower attention to fundamental R&D.

The main strength for the innovator is a strong fundamental R&D capability. The innovator collaborates to identify latent demand in the market and in new markets. The innovator values being first in with new technologies and radical innovations, which is being reflected by the project portfolio balance and market strategy. The innovator develops additional services and complementary products to gain support for a new technology in the market and engages in partnerships to gain access to unique resources that can support their new technology.

5.2 Discussion and theoretical implications

Hultink et al. (1997) introduced a model for launch decisions that has been the basis for many researches into commercialization, for example that of Chiesa and Frattini (2011). Chiesa and Frattini enriched the model with a case analysis on a project level. Chiesa and Frattini disregarded the business strategy variables from the model of Hultink et al. To complement the variables of Chiesa and Frattini, the model proposed in this research used the strategic orientations of Mu and Di Benedetto (2011). The combination of the commercialization model of Chiesa and Frattini and the strategic orientations of Mu and Di Benedetto (2011), completed the strategic launch decisions of Hultink et al. with the most recent findings. These articles formed the foundation for this research. In addition this research integrated another stream of research into commercialization, namely the path to the market or inter-firm collaboration. The founding father for this stream of research is Teece (1986). Recent articles that build on his work, and have been used for this research, are those of Gans and Stern (2003) & Haeussler (2011). This is the first research that links the innovation strategies of Miles and Snow (1978) directly to inter-firm collaboration and the concept of complementary assets. The integration of these theories resulted in the most complete model for strategic commercialization.

Based on this model, this research did an empirical research to find successful configurations in strategic commercialization decision making. The empirical research has been done in two phases; statistical analyses of the websurvey data, with statistical fuzzy set Qualitative Comparative Analyses, and a case comparison based on semi-structured interviews. The fuzzy set Qualitative Comparative Analysis methodology is quite recently being developed and gaining in popularity. Still, articles that make use of this method in business science are very rare. This research is one of the few researches that shows how fsQCA can be applied in business science and shows the unique possibilities of this method in configurational research. Although most of the findings are in line with the propositions that were derived from literature, there are still some remarkable differences.

Where Mu and Di Benedetto (2011) disregarded the innovation strategy, this research complements and enriches their research by taking the innovation strategies as a starting point. Mu and Di Benedetto searched for complementary sets of orientations and found that all orientations complement to each other and contribute to performance. The correlations table confirms that all orientations correlate positively with each other and correlate positively to performance. The correlation to performance is only for the networking and entrepreneurial orientation significant. But

by taking a closer look at the innovation strategies as subsets of the completed sample, this research identified successful configurations of the orientations for each strategy. The gap in literature that has been acknowledged, concerning the interplay of strategic orientations and their effects on performance from an innovation strategy perspective has been closed with this research.

Propositions 1a-d, concerning the defender configuration, are in line with the findings and fit the low budget conservative strategy of Cooper and Edgett (2010). High customer involvement and customization in a niche market are important to achieve above average performance over the competition, confirming the empirical findings of Szymanski and Henard (2001). The defenders in the completed sample are relatively small compared to the analysers and innovators. This research showed that strong long term relations in a small network stimulates development in a niche market and improves accessibility to complementary assets of development partners. By this way a defender can, with a peripheral network orientation and a small budget, improve the cost-effectiveness of the project portfolio.

Proposition 2a had to be changed according to the findings. The customer and entrepreneurial orientation appeared to be core orientations for the analyser and the competitor orientation is more a peripheral orientation. This indicates a more pro-active development strategy, where theory suggested a reactive follower strategy. These findings also influence proposition 2b and 2d. It is important to acknowledge that the subset of analysers consisted of only 11 cases and that only four of them came from the high technology sector (machines/devices). The research done by Lee (2009) which indicated that a strong competitor orientation is important for gaining 'fast second' advantages, was focused on high technology industries where the speed of development in the market is high. An explanation for the difference in findings could be that the competitor orientation is of higher importance if the speed of development is high in the market, if the speed of development is low, than the analyser is more oriented towards the customer to identify demand. Compared to the balanced strategy of Cooper and Edgett (2010) the analyser does indeed have a strong market orientation and product fit, where the speed of development in the market influences a more customer or competitor orientation. Furthermore, the analyser does indeed have a high-technology product focus, but in addition to the findings of Cooper and Edgett (2010), this implies for the analyser a focus on applied R&D, and for the Innovator a focus on fundamental R&D and technology development. The analyser has a strong core technology competence and relies on its network for new technologies. Finally the entrepreneurial orientation proves to be a core orientation for above average performance of the analyser. This orientation is important to find new applications for a core technology, and to launch these new products in new sectors and markets, confirmed in proposition 2c. This is also being reflected in the changes in proposition 2b and 2d. As the in-between strategy, the analyser portfolio should be in balance between more radical entrepreneurial projects and the incremental defensive/conservative projects, confirming the findings of Belderbos, Faems et al. (2010) that a balanced portfolio leads to better financial performance.

Propositions 3a and 3b, concerning the innovator configuration, had to be revised to reflect our findings. The networking orientation is not a core orientation for the innovator, the customer orientation is. Although the innovator has a large and active ideation network, the innovator does prefer internal development and is a bit reluctant to partnerships and collaboration. The innovator configuration shows a strong resemblance with the technology driven strategy of Cooper and Edgett (2010). The technology driven strategy shows high impact but low success rates and financial

performance. The innovator configuration differs on two aspects from this strategy, the market orientation and the product inter-relatedness. The technology driven strategy shows a lack of market orientation and new products have no relation to each other. The cost effective innovator configuration suggests a core customer orientation and a common technology base for each product group. The customer orientation is much less oriented toward customer involvement in development, like the defender does, but more towards identifying latent demand (proposition 3c is supported) and customization after development. With respect to proposition 3b this research identified that market acceptance is important for the success of an innovation, but through development of complementary products and services, the innovator diffuses new technologies in the market. Proposition 3d is fully supported by our findings. If a firm possesses unique capabilities to develop or produce complementary products or services, than the innovator would consider a partnership or acquisition. This confirms the findings of Chiesa and Frattini (2011) diffusing new technologies through complementary products and services leads to higher success rates of innovations. Early commercialization of new technologies through license agreements is being done by the above average performing innovators, supporting the findings of Hill (1992) on technology licensing for an early return on development.

5.3 Managerial implications

Strategic commercialization is important for organizations to make their main strengths and development capabilities contribute to the growth strategy. This research identified three configurations of strategic commercialization decisions that lead to above average performance and cost-effectiveness of the project portfolio. By focussing attention and allocating resources to the configurations that fit the innovation strategy, the project portfolio can contribute optimally to the business strategy and is most cost effective. The first commercialization decisions after choosing an innovation strategy are the strategic orientations.

- The defender needs a core customer- and technology orientation. The business objectives should be primarily driven by customer satisfaction. Understanding of customers' needs and how to create greater value for customers are important with respect to customer satisfaction. The core technology orientation suggests a strong emphasis on developing new technologies and integrating these technologies in new products. Management should actively seek innovative ideas and encourage people to have new ideas for product development.
- The analyser needs a core customer-, networking- and entrepreneurial orientation. A strong market orientation is important for the analyser to identify customer needs. The analyser should search widely and actively to identify network partners to gain access to complementary technologies. The analyser should pursue new market opportunities and renewal of existing areas of operations and needs capacity to react to market changes.
- The innovator needs a core technology-, customer- and entrepreneurial orientation. A strong emphasis on developing new technologies and the search for innovative ideas should drive the innovator. Identification of latent customer demand is important to identify new market opportunities. Measurement of customer satisfaction and close attention to after-sales services are important when launching new technologies. The innovator should prepare for radical industry changes and believe that wide-ranging acts are necessary to achieve objectives. The innovator initiates actions to which other organizations respond.

The second commercialization decisions concern the portfolio strategy. Managing the portfolio balance will keep the portfolio in line with the innovation strategy and shields the portfolio from market pressure and the abundance of sales and process requests. A sales driven portfolio will in many cases lead to incremental project improvements which leaves little resources for technological development for future generations and radical new products. A tool for managing the portfolio balance is strategic buckets. With strategic buckets the portfolio manager can divide the resources (in FTE or budgets) over strategic buckets that are categorised according to the innovativeness of the projects or the long term strategy and technology roadmap. The TTM and efficiency in the NPD process are very important for the technological organizations in the Netherlands these days. Due to the economic crisis many organizations have a short term focus and need short term results to keep their heads above the water. The economic climate increases the risk of innovation which makes the organizations more reluctant to engage in the more radical projects. Incremental development and short cycles contribute to the short term results of the organization, but have less chance to be disruptive in nature and lead to less profit. For some organizations it is an option to divide a radical project in incremental steps, to make the project easier to monitor and manage.

- The defender should focus its project portfolio on incremental product improvements and customization projects. Customer involvement in the NPD process contributes to customer satisfaction in high demand niche markets for specific customized products. The defender should reserve about 20% of its R&D resources for fundamental technology development with a technology roadmap and a horizon of about three to five years.
- The analyser should focus its projects on applied R&D and developing a wide variation of products based on their core technology. Balance in the portfolio between incremental improvements and radical new products results in higher performance. The analyser should reserve fewer resources for fundamental R&D, and have a new product roadmap with a horizon of one to three years.
- The innovator is driven by new technologies and radical new products. The innovator should reserve about 40% of the R&D resources for fundamental R&D and another 40% for radical new products. The innovator has a technology roadmap with a horizon of five to ten years.

The third commercialization decisions concern the market strategy. A clear market strategy defines the focus for development and makes sure that the projects keep connected to the target market throughout the development process. Customer demand and satisfaction are the strongest performance indicators and should not be disregarded. The above average performers in this research understand this and have a strong customer orientation. Identifying customer (latent) demand is one thing, actually involving them in the NPD process is something different.

- For the defender, direct customer involvement is a successful way to keep the project connected to the market and ensure a return on development. This method of high customer involvement can give a competitive advantage in niche markets. For ingredients or parts, implementation of the product in the product of the lead customer is a used method to test prototypes.
- The analyser develops many variations of products to supply a wide variety of customers and market segments. The analyser stays close to its core technology and involves customers in the ideation phase and after development in the customization of products.
- For the innovator it is important to implement the voice of the customer in the project, but through a more indirect involvement method. A strong new business development or

marketing department can get this information through for instance interviews or panels, but the organization can also make use of external institutes or bureaus.

The fourth commercialization decisions concern inter-firm collaboration. Overall the respondents agreed that making use of your own strengths and external sourcing for complementary assets contributes to portfolio performance. External sourcing can be useful to gain access to new technologies, knowledge, market support or even expensive research equipment. Each organization should search for the right complementary partners for inter-firm collaboration. This research gives the guidelines for what to source and with whom and where in the NPD process to collaborate.

- The defender should work on strong long term relations with a small network of partners. Strong long term relations improve the accessibility to complementary assets and improve the trust between the organizations which is important for partnerships to be successful.
- The analyser uses licensing and partnerships to gains access to new technologies and products to improve their products and enrich their product portfolio. Analysers should have a broad knowledge of the market and the players in the market, to select a suitable partner for a project. The respondents referred to this technology sourcing method as technology shopping.
- The innovator should have a large and diverse ideation network to generate innovative ideas for new technologies and concepts. Complementary products and services can help to build market support for the core new product. If another firm possesses unique capabilities to develop or produce complementary products or services, than a partnership under strict contractual agreements should be considered. Prototype testing with lead users (under strict nondisclosure agreements) appears to be a good method to measure customer satisfaction. If the speed of imitation in the market is high, than early commercialization through the intellectual property market can deliver an early return on development. In addition, licensing increases the support for the technology, which is beneficial for becoming the new dominant technology in the market.

5.4 Limitations

The first limitation for this research is the size of the research sample. Although the sample is large enough for a statistical analysis and additional fuzzy set Qualitative Comparative Analyses, a larger sample would have improved the statistical conclusion validity. For the defender and innovator strategy the subsets are large enough for the optimal use of fsQCA, for the analyser strategy the subset is a bit small. In addition, with a larger sample size, the successful configurations perhaps could have been found from the entire set. With this sample size fsQCA would just identify the combination of all orientations as the optimal solution. In addition, the sample size makes it hard to control for differences in industrial sectors within the technological manufacturing industry. Although the market dynamics did not differ significantly from each other between the sectors, we did find some results that suggest that the speed of development and speed of imitation are higher in the high-technology sector. The results also suggest that these external variables have an moderating effect on the relationship between commercialization decisions and portfolio performance. These suggestions should be further examined in future research.

The second limitation is the measurement of performance in this research. Although this research used a scientifically approved method for measuring the portfolio performance, the data has been drawn from a single respondent for each organization. The respondents were selected on their ability

to rate the portfolio performance with this method and many organizations do not have another manager that can do this. In addition only general financial figures were available for only half of the sample. This made a correlation check with financial figures impossible, which would also not be a very good representation of portfolio performance, because the most innovative organizations only gain about 10% to 15% of their yearly revenues from new products that were released in the past three years.

The third limitation for this research is the current economic climate. Some organizations in the sample indicated that they make decisions differently than they would prefer, just because of the short term focus for return on development. It seems that for this reason organizations, that have the capabilities and strengths to be an entrepreneurial analyser or innovator, fall back on a defender approach to NPD.

5.5 Future research

Commercialization is a research subject that has been widely used in marketing science. These researches were mainly focused at after launch commercialization, or the tactical launch decisions. This research combined the literature on strategic commercialization decisions into a research model which could be the basis for further research. The previous paragraph described the limitations of this research and already indicated some points for improvement in future research. This paragraph will present some further suggestions for future research.

The strategic orientations in this research were adopted from Mu and Di Benedetto (2011). This research showed with the analysis from the interviews that based on the innovation strategy, the strategic orientations could be interpreted differently. Each orientation has been measured with six variables, which can each be interpreted differently from the different innovation strategy perspectives. More diverse and specific variables for the orientations would give an even more detailed configuration for the strategic orientations and a sharper view on commercialization decision making on the business strategy level.

For the portfolio strategy it would be interesting to further investigate the effects of managing the portfolio balance and technology roadmap on performance. There are already some studies on portfolio balance and performance ((Tushman and Oreilly 1996; Gibson and Birkinshaw 2004; He and Wong 2004; Lubatkin, Simsek et al. 2006; Belderbos, Faems et al. 2010), but not from an innovation strategy perspective.

For future research it would be interesting to see if the configurations hold for specific industrial sectors, or in other industries. It would also be interesting to see if there are differences in commercialization decision making based on cultural differences. Mu and Di Benedetto (2011) focused their research on Chinese organizations, which has a much larger high technology sector than the Netherlands. In addition a research on the effects of the meso-level environment on portfolio management and NPD could perhaps enrich the commercialization model that has been introduced in this research. Several respondents indicated that the meso-level environment, the governments, play an important role in defining their portfolio strategy. Haeussler (2011) identified the effects of the institutional system (legal, labor market, company law and financial system) on IP protection and building important complementary capabilities, but the effect of the direct effect on the institutional system on the portfolio strategy has not been researched yet.

Furthermore a research into measuring portfolio performance and finding an optimal balance in these measures in efficiency and effectiveness would be an interesting topic for future research. The performance measures in this research were restricted to six measures for both efficiency and effectiveness adopted from Gatignon and Xuereb (1997) and Song and Parry (1997). Although these measures have been used in several researches, they can be more specific on both effectiveness and efficiency. In addition it would be better if performance could be measured with organizational figures. A model based on organizational figures, that integrates both efficiency and effectiveness variables would also make performance easier to measure by portfolio managers in practice.

As a final suggestion it would be interesting to further investigate which innovation strategy leads to high performance, based on the main strengths and core assets of the organization and the market dynamics. This would suggest further integration of the theory by Teece (1986) on the different complementary assets with strategic commercialization. Organizations or business-units of organizations have the tendency to change their innovation strategy over time, for instance due to maturation of the organization or changes in market size. It would be interesting to investigate what changes in the core assets, complementary assets and market dynamics trigger these strategy shifts and when these shifts are successful.

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7. Appendix

7.1 Questions for the web-survey

Welcome!

This survey is part of a master dissertation into the commercialization of technologies and new product concepts. In the following three pages you will be confronted with a diversity of statements concerning strategic commercialization decision making. The survey has been developed in close collaboration with the school of Management and Governance at the University of Twente and Business Innovation consultants of Capgemini Consulting.

This research is focused on technological manufacturing organizations with an emphasis on innovation and New Product Development (NPD). Company specific or personal data from this survey is confidential and will only be seen by the student. Hopefully this survey and the research results will help you to rethink your commercialization decisions.

General information:

Name:

Email:

Function:

Organization:

Number of employees:

Project portfolio product/market description:

R&D spending as percentage of revenue:

Innovation strategy:

Our Innovation Strategy fits best with:

1: Our strategy is focused on maintaining a secure position or niche in a stable area, is proactive in defining customer needs in our market and is focused on protecting our domain by constantly improving and evolving our products.

2: Our organization carefully monitors actions of competitors and moves quickly to copy and enhance upon competitors new products. Our strategy is reactive and open to new concepts and markets but in addition protects a stable set of products.

3: Our organization values being first-in with new products and new technologies. Our strategy is proactive, focused on differentiation and responds rapidly to early signals pointing to new market opportunities.

1. Portfolio performance:

The products that were introduced into the market in the past three years compared to that of your competitor: well below, below, average, above, well above the competition in six aspects:

1.1 New product profitability

1.2 New product speed to market

1.3 Rate of success of new product (that reach the market)

1.4 Customer satisfaction with new products

1.5 New product quality

1.6 New product reliability

2. Market dynamics:

(strongly disagree, disagree, neither, agree, strongly agree)

- 2.1 It was difficult to forecast technology developments in our industry
- 2.2 The technology environment was uncertain
- 2.3 Technological development was unpredictable
- 2.4 The technology environment was complex
- 2.5 Customer needs and preferences changed rapidly
- 2.6 Product demands and preferences were uncertain
- 2.7 It was difficult to predict change in customer needs and preferences
- 2.8 Market competitive conditions were unpredictable

Strategic orientations:

To what extent is your organization in line with the following statements: (strongly disagree, disagree, neither, agree, strongly agree)

3. Technological orientation:

- 3.1 We have a strong emphasis on developing new technologies
- 3.2 We have a strong emphasis on integrating new technologies in our products
- 3.3 Technical innovation based on research results is readily accepted
- 3.4 Management actively seeks innovative ideas
- 3.5 Innovation is readily accepted in project management
- 3.6 People are encouraged to have new ideas for new product development

4. Customer orientation:

- 4.1 Our business objectives are driven primarily by customer satisfaction
- 4.2 We constantly monitor our level of commitment and orientation to serve customers' needs
- 4.3 Our strategy for competitive advantage is based on our understanding of customers' needs
- 4.4 Our business strategies are driven by our beliefs about how we can create greater value for customers
- 4.5 We measure customer satisfaction systematically and frequently
- 4.6 We give close attention to after-sales service

5. Competitor orientation:

- 5.1 Our salespeople regularly share information within our business concerning competitors' strategies
- 5.2 We monitor competitive strategies and actions
- 5.3 We rapidly respond to competitive actions where we see opportunities
- 5.4 Top management regularly discusses competitors' strengths and strategies
- 5.5 We target customers where we have an opportunity for competitive advantage
- 5.6 Through NPD we match or exceed competitive competences

6. Entrepreneurial orientation:

- 6.1 We pursue new market opportunities
- 6.2 We pursue the renewal of existing areas of operations
- 6.3 We have built capacity to react to market changes

6.4 We prepare for radical industry changes

6.5 We believe that wide-ranging acts are necessary to achieve objectives

6.6 We initiated actions to which other organizations respond

7. Networking orientation:

7.1 We search widely and actively to identify network partners

7.2 We know how to screen network partners

7.3 We assess and analyse our relationships with partners so that we know what adjustments to make

7.4 We set up routines to manage our network relationships

7.5 We make appropriate relationship-specific investments for the network development

7.6 We assign competent personnel to manage the network relationships

What orientation(s) is/are the main strength(s) and driver(s) for your innovation portfolio?

- ☐ The technological orientation
- ☐ The customer orientation
- ☐ The competitor orientation
- ☐ The entrepreneurial orientation
- ☐ The networking orientation

Room for remarks or suggestions:

Thank you very much for filling in this questionnaire, the results of this research will soon be available, I'll keep you posted.



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Strategic commercialization decisions

1. **General information**

Name:

Email:

Function:

Organization:

Number of employees:

Project portfolio product/market description:

R&D spending as percentage of revenue: 0 %

2. **Our Innovation Strategy fits best with:**

☐ Our strategy is focused on maintaining a secure position or niche in a stable area, is proactive in defining customer needs in our market and is focused on protecting our domain by constantly improving and evolving our products.

☐ Our organization carefully monitors actions of competitors and moves quickly to copy and enhance upon competitors new products. Our strategy is reactive and open to new concepts and markets but in addition protects a stable set of products.

☐ Our organization values being first-in with new products and new technologies. Our strategy is proactive, focused on differentiation and responds rapidly to early signals pointing to new market opportunities.

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9. **Networking orientation:**

	strongly disagree					strongly agree
We search widely and actively to identify network partners	☐	☐	☐	☐	☐	☐
We know how to screen network partners	☐	☐	☐	☐	☐	☐
We assess and analyze our relationships with partners so that we know what adjustments to make	☐	☐	☐	☐	☐	☐
We set up routines to manage our network relationships	☐	☐	☐	☐	☐	☐
We make appropriate relationship-specific investments for the network development	☐	☐	☐	☐	☐	☐
We assign competent personnel to manage the network relationships	☐	☐	☐	☐	☐	☐

10. **What orientation(s) is/are your main strength(s) and driver(s) for your innovation portfolio?**

☐ The technological orientation

☐ The customer orientation

☐ The competitor orientation

☐ The entrepreneurial orientation

☐ The networking orientation

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7.2 Questions for the semi-structured interviews

Strategic commercialization	
Business Strategy	
Innovation strategy	Defender/Analyser/Innovator
Strategic orientations	Technological/Customer/Competitor/Entrepreneurial/Networking
Drivers for innovation	Technological/Customer/Competitor/Entrepreneurial/Networking
Portfolio strategy	
Future product generations	Does the organization have a long term strategy for future products, what is the horizon (technology roadmap)?
	Does the organization have an emphasis on basic R&D and technology development, how does this relate to the NPD projects?
Relative newness of the portfolio	How is the portfolio composed in terms of incremental product improvements and radical new product development?
	How would you describe the newness of the products in relation to the current product portfolio? And to products in the market?
Resource commitment	Is the organization actively working on cycle time reduction and efficiency in the TTM? Why or why not?
	Does the organization monitor the use of resources (time/costs/investments)? How does this play a role in go/kill decisions?
	What actions does the organization perform to prepare the market for a new product and when are these actions taken? (think of pre-announcements or partnering with organizations)
Market strategy	
Target market	Would you describe your target market as a niche or as a mass market?
	Does the organization stay close to current markets or is it actively seeking for new opportunities and market expansion?
Positioning on product lifecycle	Does the organization create demand, respond to emerging demand or wait for demand confirmation and growth?
	How does the organization cope with new ideas (new to market/world) and risk taking? (position in market s-curve)
Customer involvement	How does the organization identify customer demand?
	Does the organization involve customers in NPD, how and at what point(s) in the NPD process?

Inter-firm collaboration	
Network collaboration	Which partners in the network play a role in the NPD process and how important is that role?
	Does the organization actively seek for network partners with complementary assets and how does this work?
	Does the organization work on long term relations or project based relations and why?
Technology management	Does the organization apply technology management (IP protection and exploitation) and how much attention does it get?
	Does the organization source technology externally and if so, what is the balance between external sourcing and internal development?
	When and how is the decision being made to either develop or source technology externally?

$1/3$ Strategic commercialization | 7. Appendix 66

Market strategy	We are in a mass market but try to identify niches and focus on these through technology development. Our product managers search for new opportunities in the market. We stay close to our current market but we try to differentiate our products by focusing on niches in our market. • niche/mass target market • number of segments	We target a niche market, with a strong focus on the European market. We stay close to our current market but we are looking for market expansion in the same segment on a global scale. 95% is current segment 5% new segments.	We operate in a niche market. We stay close to our current market segments but try to identify new applications for our products in other segments. Entry to new market segments is always initiated from our core competencies and another application of a product. In time (5 years) we could launch a new product group based on our technological development.	A mass market, many customers globally but not many competitors.	It is a mass market, we have over 8000 customers, but in the Netherlands we are one of the three largest organizations and have a marketshare of 60% in one of our two market segments. We are not actively seeking for new opportunities and market segments anymore. We have a strong focus on two segments, but we do take signals from the market seriously and if opportunities in new segments appear we will invest in radical projects.	We operate in a mass market where we search for niches in our five segments. We look for new opportunities in our existing segments by offering specific and high demand products. We look for growth and expansion on a global scale within these segments.	Niche. We are seeking for opportunities and expansion, a bit difficult as daughter-company. Officially only possible if the board approves, they define the technology roadmap. Our business unit seeks international market expansion to Asia and Southern America.	It is a mass market but we don't have many competitors, there are 4 large players in our business and we have a strong focus on identifying their strategies and development activities. We are actively searching for new opportunities and market expansion but our market is growing fast.	As a niche market. The research department focuses on basic research but also on new business expansion and technology. Recently a new business unit was created based on basic research from the research department.
• Position on s-curve Positioning on product lifecycle	We wait for demand confirmation and growth. We mainly develop the technologies we use and this takes time so our products go to market in the early majority stage. We have radical ideas, even ideas that are new in the market but these ideas do not reach the portfolio because the time to value would be too long and we feel a strong pull from the market and our sales department.	We wait for demand confirmation and growth. Our product is not very suitable for innovation and our strategy is focused on a clearly defined customer segment, which leaves little room for large changes. But if the current segment will decline and growth will drop then we will take a serious look at other segments.	We enter a segment where we see growth and where the number of players (competitors but also customers) in the market is small. We don't have the means to launch really radical products, we are a niche player, focused on delivering more value to our customers.	We are looking for market expansion in our segment on a global scale and seek new opportunities by making our machines more efficient. We have seen that our largest competitor is expanding its activities to other segments, probably we will follow in the future but for now growth in our segment is still strong. Automation is becoming more and more interesting in foreign growth markets like Asia and South America.	We mostly respond to emerging demand in some strategic defined niches but overall we wait for demand confirmation by reacting to customer demand. Monetarily we are very short term focused and so we are reluctant to really radical projects. In the future we want to become more proactive in defining market demand through product managers, but momentarily sales is more important.	We respond to emerging demand in some strategic defined niches but overall we wait for demand confirmation by reacting to customer demand. Monetarily we are very short term focused and so we are reluctant to really radical projects. In the future we want to become more proactive in defining market demand through product managers, but momentarily sales is more important.	Currently the tendency is to wait for demand, I personally think that is not enough. Not really appreciated by the board, although officially stimulated in practice only the board has budget to actually invest in a new area.	We create demand but also respond to emerging demand with new products. We invented new and disruptive products, but we also create customised products for specific requirements. Competition is fierce and we want to be first so we have to take a lot of risk and invest large shares of our revenues in R&D, but this is reflected in the share of revenues that come from innovations.	We create demand by developing new products to give customers new options, but we also respond to emerging demand if we for instance identify another use of our products with a customer. We screen these in Idea Fit phase, and develop a business case, which is evaluated and if positive, resources are allocated and a project or programme started with a business lead.
• Customer involvement	Many projects come directly from the sales department, other more radical projects come from the product managers that identify the technology roadmaps from the product manager in our product development, which is our internal customer, but not the customer that pays. We do test the concepts for customer specific projects and very sporadically we do a beta test with customers.	Through close customer collaboration, brainstormings and customer platforms. We involve customers in ideation and after the basic research if the first prototype is ready, in addition we do customer specific projects, for instance we have currently 12 engineers working at a customer's plant to help engineering a new product for them. We customize our products there and implement them in their new product. This is a strong added value for the customer because we help in designing the platform, and it gives us sales security for at least three years. In addition we position our activities close to those of our customers. We are soon opening a new fabrication site close to a new site of a large customer.	Through close customer relations and a central role for product development. Yes we work closely together with customers but this depends on the geographical distance and how much insight we get in their processes and products. In many cases we adjust and implement our products in their processes to test the new product. By doing so we do part of their R&D and can show directly during development how our products can enrich theirs.	By working closely together with customers, doing customer research and interviews. Yes from the beginning till the end. We do research and interviews to test and create ideas, all concepts and prototypes are being installed in parallel lines of customers to test the machines and gather feedback. It is a high involvement cooperative process which results in the final product. We make use of contracts to ensure customer discretion with new technologies.	Through sales requests, if we see a pattern in requests for a new product, then we will make a business case for this product. With more radical projects we test the concepts with some key customers, if they are enthusiastic then we have a promising indication for a return on our investments. In most projects not, only in the radical projects, then we test the concepts. For actual market trials we wait for the physical product to be ready for production and then we send some examples to customers and start the marketing machine with campaigns, visits at fairs etc.	Through sales and customer relationship management, customer innovation platforms and frequent brainstormings with some large customers. We have sales and engineers abroad to identify demand in foreign countries and to customize products to their needs at location. Yes we have some pilot initiatives with customers that are being involved in the development process, these are stepwise processes to collaboratively develop a specific product for this customer. Most other projects start with a concept test, a contract agreement on the product specifics and a customer quality test after development before sales.	We make use of independent testing institutes and customer panels but in addition we do pilots directly with customers. This is a direct contact between our R&D department and customer groups. This does not happen often, only with customers where we have a long term relation with (15 years) and after signing thick secrecy agreements. But we do test our products in panels after development.	We apply CRM (customer relations management) and Key Account Management, close relations with our customers are essential in our business (b2b). 40% of the projects are customer specific and 60% are general projects. Each business unit has its own marketing, sales and development department. Yes we involve the customer throughout the NPD process, the extent of the (exclusive) involvement depends on the relationship and the potential.	

Inter-firm collaboration											
Network collaboration	We do not actively seek for network partners, we mostly use our own capabilities, but in many cases we have to work with partners because this is a high-tech product and sometimes is more efficient to buy than to make. We work mainly together with suppliers, in almost 50% of the product development projects we make use of technology or products made by other organizations in our solutions. We work on long term relations with a select group of suppliers but partnerships are project based and based on make or buy decisions. Partnerships from ideation have not lead to new projects. • Network size • Duration of relation • Manner of partnership in NPD process	Mainly customers and suppliers, we translate the wishes of our customers to our suppliers. Network relations are also becoming more important. A conversation like this one would not have been possible 5 years ago. We are talking more with universities and network partners. No we are not actively searching for network partners. We have a strong emphasis on internal development and have selected a strong network of suppliers. We work on long term relations with our network partners. We are strongly dependent on our customers and suppliers for development.	Next to our customers we sometimes work together with our suppliers. Our suppliers have the equipment for development that are too expensive for us. By using their equipment we can develop more products and they sell more resources to us. In addition we sometimes collaborate with other partners in the ingredients business to develop a new concept. In these projects the combination of our technologies create a new concept. Yes complementary assets like expensive machinery for development or technologies for a new concept. But we do not seek actively for network partners or a diverse network. Our relations are project based but we try to make these relations structural by returning to those customer. If somehow	We work closely together with partners in our network that have technologies that we don't have or that we can't develop. 20-30% of our projects are cooperative. We don't actively scout for technologies, we search for partners in projects if we don't possess the complementary assets. We operate in a very transparent niche market, we know all the players in the market. We work on long term relations with partners, development of a new product can take up to 4 years, and then we start earning money through cooperative sales and marketing efforts. We work on long term relations with most of our partners but most contact is project related.	We source technology externally, we stay close to our core competences and additional technologies or products are being sourced through collaboration or licences. This depends on our core competences.	We work closely together with suppliers of raw materials, machines and even buy licenses some times. For new technologies, we rely on our network, we are strong in controlling the technique and the processing of a single raw material, to deliver complementary products. We search for complementary assets if we need them for a project. We know our core competences and if we need other parts or technologies to offer a solution we will search for a partner. Most relations are project based but we do have long term relations with partners. Yes we actively seek for network partners, mostly through our purchasing department, if we need a complementary product or technology we search for a fitting partner.	Suppliers and complementary partners are important. We generally shop in the market for the best partners, we have a large database of suppliers and complementary partners. We search for complementary assets if we need them for a project. We know our core competences and if we need other parts or technologies to offer a solution we will search for a partner. Most relations are project based but we do have long term relations with partners. Yes we actively seek for network partners, mostly through our purchasing department, if we need a complementary product or technology we search for a fitting partner.	Yes we source but mostly through collaboration. In some cases we source entire products and rebrand it with our label. Initially by product management, but also during the development process. For the later both product management as the Board have to be consulted. Main issues in these decisions are yield and profitability.	We'll have the TACIT method where we try to source products or components. For instance we work closely together with an organization in India that develops complementary organizations. We actively seek network partners through business development purposes, for instance we help resellers in the development of new products. We engage in business partnerships with many smaller organizations that could contribute to our customer value. But we keep a close eye on our percentage in their revenue, if this gets above 50%, we insist that these organizations find other customers or we buy the organization. We already have about 8 organizations in the Netherlands that don't carry our name. Mostly long term relations which is an advantage.	We work closely together with universities and specialists to identify new technologies and demand and we work together with strategic crucial complementary network partners through business development purposes, for instance we help resellers in the development of new products. We engage in business partnerships with many smaller organizations that could contribute to our customer value. But we keep a close eye on our percentage in their revenue, if this gets above 50%, we insist that these organizations find other customers or we buy the organization. We already have about 8 organizations in the Netherlands that don't carry our name. Mostly long term relations which is an advantage.	Yes, this is a need-driven process but we do most of the research and development by ourselves. During ideation we work together with customers, institutes and suppliers, but only the customers are continuously involved in the NPD process, especially with customer driven development. We work on long term relations, mostly through ideation networks. The kind of collaboration can vary over time but it is essential to have a broad market perspective.
	External technology sourcing	95% of the technology is being developed internally, only 5% is being sourced externally, we have strong development and production capabilities and prefer making use of them. This is a make or buy decision that is being made after concept testing. Due to difficulties in measuring ideas and changing them into a concept we mostly go for internal development. Yes we source about 30% of our used technologies, but in many cases if we can develop it, we will develop it ourselves. These decisions are based on make or buy decisions. • Collaboration • Licensing	Most of the technologies have been developed by ourselves and we don't make much use of technological sourcing. We just develop if we see an opportunity for short term financial returns, we don't make much use of external technology.	Yes we source technology externally through collaborative development. This depends on how far the technology is from our own competences.	Yes we source technology externally, we stay close to our core competences and additional technologies or products are being sourced through collaboration or licences. This depends on our core competences.	Yes we source but mostly through collaboration. In some cases we source entire products and rebrand it with our label. Initially by product management, but also during the development process. For the later both product management as the Board have to be consulted. Main issues in these decisions are yield and profitability.	Yes technology management is very important for us. We are very active in protecting our inventions and technologies. We are less active in direct exploitation of our intellectual property, it is important to protect our closed door development.	Sometimes but we do most development ourselves. I would say that the balance would be 1/99. This is a capability based process, we don't want to reinvent the wheel so we do a thorough assessment of each technology and concept, also financially, to see if it would be better to source/develop the technology.			
	IP protection technology management	No we do not apply technology management. Most of our technologies are not unique and already have a subsidiary in the market. • IP protection • IP exploitation	No, most of our technologies are 140 years old, our technology development efforts are not radical or innovative enough to make technology management worthwhile. We sometimes have a very good idea, but in these cases we just sign a contract with our partners or customers.	Yes, we post 10-20 patents a year but we are not actively involved in the exploitation of these patents. The patents are more important to protect our technologies for the competition.	We do apply technology management if we have a radical new concept, but it happens sporadically (4 patents in the last 10 years). In addition we do market scans on our competitors to identify patent infringement. We are IP exploiters.	We apply technology management, last year we posted 6 patents, but we do not exploit our patents. We make use of non disclosure agreements with our suppliers that we develop with.	Yes technology management is very important for us. We are very active in protecting our inventions and technologies. We are less active in direct exploitation of our intellectual property, it is important to protect our closed door development.	Yes but not enough. In our business it is really hard to identify if a competitor has violated our intellectual property, because our products are being processed by our customers in other products. Thorough competitive analysis would be too expensive.			