

## MASTER

### On the creation of alignment between research and development

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# **On the creation of alignment between research and development**

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in partial fulfilment of the requirements for the degree of

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in Innovation Management**

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## Abstract

In order to increase the effectiveness of research and development (R&D) activities, as markets pose increasing demands on new product development efforts due to shortened life cycles, rapid technological change and globalization, organizations have increasingly separated research from development in order to profit from increased focus and control over each individual activity, consequently aiming to increase the performance of research and development. However, as research and development become more distinct and separated, an effective link or alignment should be established between them to ensure that knowledge and projects can be shared effectively between research and development, in order to benefit from these advantages. As opposed to previous research, which primarily has addressed the alignment *between* departments, this research therefore focuses on the establishment of alignment *within* a department, specifically between research and development, and aims to provide insights on the factors and mechanisms that influence the creation of alignment between research and development. By applying a literature review on the determinants of alignment currently addressed in scientific literature, and consequently translating these determinants to a context of R&D, a model containing four propositions is derived for creating alignment and facilitating knowledge transfer between research and development. These findings consequently have been contrasted to a case study, for which the R&D process of an automotive company based in the Netherlands, which applies the separated view of research and development, has been analysed in order to provide either evidence for or against the derived propositions. The results show that organizations should ensure that a holistic view of R&D is maintained, by ensuring that strategic plans for research and development are linked (to create shared goals), that employees are structured to work cross-functionally in order to effectively share knowledge and create transparency, acceptance and commitment, and that both research and development receive adequate structural and personnel capabilities in order to effectively adjust and execute internal processes and activities. By facilitating these mechanisms, research and development can effectively work towards matched processes and activities in line with holistic R&D goals. Organizations however should be wary of cultural influences, and therefore ensure that these influences are mitigated through either structural or strategic decisions. This research moreover provides several tools to facilitate the creation of alignment between research and development.

## Preface

This report is the result of my master thesis project, which represents the path I have taken during the last 6 months. Although the master thesis project is a relatively personal journey, not only serving as the partial fulfilment of the degree of Master in Innovation Management but perhaps more importantly as a next step in my personal development, I could not have achieved this without the help of some people, to which I would like to express my sincere gratitude.

I would like to thank my supervisors at the University of Technology Eindhoven, Bob Walrave and Fred Langerak, for their support, feedback and positive contribution. Bob, thank you for given me the opportunity to create my own project, and giving me the responsibility to approach the project in my very own way. Your enthusiasm and supportive feedback and insights have challenged and motivated me to make the most out of this project, and to think critically about the decisions I made within this project. Fred, I would like to thank you for joining in as the second supervisor and especially for the efforts you've put in in the absence of Bob by temporarily taking on the role as first supervisor. I duly appreciate your constructive insights and feedback, both on a theoretical as well as practical level.

Moreover, I would like to thank all colleagues at the case company for helping me during my internship at the company and giving me a pleasant stay. In particular, I would like to thank my company supervisor Jack Martens. Jack, the discussions we had helped me to create a good understanding of the process at the company, but you also encouraged and motivated me to make the most out of both the project as well as myself.

As this project concludes my time as a student, I would like to thank all of the people that made my time as a student enjoyable and more importantly as an unforgettable experience. Specifically, I would like to thank all my friends, both from my time in high school, my time in Eindhoven as well as my exchange semester in Valencia. I hope we can make sure that more great memories can be created.

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# 1. Introduction

This chapter will introduce this research by expressing the value of research and development (R&D) for the survivability and profitability of organizations in the current marketplace, as R&D can provide the basis for new product innovations. Next, this chapter will delve into the important trends to improve the effectiveness of R&D, specifically on improving research-related activities. One such trend is to separate *research* from *development*, in order to create focus and control for each individual process. However, alignment and an effective link is needed between both processes to effectively benefit from this separation. As this form of alignment currently seems unaddressed, this research will focus on how this can be established. This chapter is concluded by expressing the research questions, the research goals and the structure of the remainder of the report.

## 1.1. Importance of R&D in current markets

Markets are increasingly becoming more dynamic due to globalization, global competition and rapid technological change (Nobelius, 2004). As a consequence, product life cycles are shortened, requiring organizations to sustain product innovations and increase new product development investments (Slater, Mohr, & Sengupta, 2014). Organizations should be able to effectively generate or acquire market knowledge and translate this information into valuable new ideas or inventions (Damanpour & Schneider, 2006). Briefly speaking, as markets become more and more dynamic, stronger emphasis is placed on the absorptive capacity of organizations to sustain product innovations (Cohen & Levinthal, 1989; Berends, van der Bij, Debackere, & Weggeman, 2006).

Within the larger product development process, research and development (R&D) activities typically are aimed at generating, collecting or acquiring knowledge from technologies, markets and customers, in order to transform this knowledge into new product concepts (Cassiman & Veugelers, 2006). R&D activities moreover can identify important trends in the market and consequently provide the organization with opportunities for new product innovations (Cassiman & Veugelers, 2006). Research has shown that increasing the capabilities of R&D leads to an increased innovative performance of the organization, as R&D is able to acquire and transform knowledge more effective and efficiently (Artz, Norman, Hatfield, & Cardinal, 2010; Rosenbusch et al., 2011). Increasing the performance of R&D activities can therefore stimulate organizations towards sustaining product innovations, allowing organizations to cope with dynamic market factors.

## 1.2 Trends towards increasing R&D performance

As market developments require organizations to increase new product development spending but also to maintain control on new product development, companies have more and more sought after opportunities to increase the effectiveness and efficiency of its R&D activities, whilst maintaining control on investments and resources (Nobelius, 2004). As a consequence, organizations increasingly have started orienting R&D activities outside the boundaries of the organization. In recent years, concepts have emerged as *open innovation*, allowing knowledge to cross the boundaries of the organization, in order to profit from both internal and external knowledge development and collection (Hung & Chou, 2013). Moreover, organizations have started to actively collaborate research efforts with suppliers, customers and even competitors, in order to benefit from reduced costs and increased capabilities to generate or acquire new knowledge (Berchicci, 2013). Concepts as R&D labs or R&D ecosystems allow organizations to effectively share and transform knowledge to inventions with partners and to profit from collaboration in terms of investments and capabilities, whilst maintaining core product development activities in-house (Berchicci, 2013). Consequently, organizations may even form strategic alliances or joint ventures, further integrating R&D activities and stimulating the benefits of partnership in terms of capabilities and investments (Haeussler, Patzelt, & Zahra, 2012).

### 1.2.1. Separating Research from Development

As organizations gradually orientate research activities more cross-functionally and these activities become more wide-spread, a greater need for focus and control has emerged to coordinate these activities (Nobelius, 2004). Similarly, as product life cycles are shortened, organizations have a greater need for control on their development activities, in order to timely introduce new product innovations appropriate to market demands (Slater et al., 2014). Moreover, as development activities increasingly become more expensive in late stages of the project, organizations desire to decrease uncertainty in order to decrease failure of projects (Langerak, Hultink, & Robben, 2004). To decrease uncertainty within development activities, and to increase both focus and control for both research and development activities, organizations increasingly have started separating research-oriented activities from development-oriented activities (Nobelius, 2004). As a consequence, organizations can more effectively manage and control each individual process, increasing the performance of both research and development. Moreover, uncertainty can be decreased in the development process, allowing organizations to develop products more efficiently and introduce new products more timely (Nobelius, 2004).

### 1.3. Need for alignment between Research and Development

Whereas the separation of research and development allows organizations to increase control and focus over each process, an effective link should be created between research and development in order to benefit from these advantages (Nobelius, 2004). Projects in research serve as valuable input for development, and therefore should be transferred effectively. Moreover, research related activities should fit new product development, ensuring that concepts from research can be adopted in new product development projects. Organizations should be able to create alignment between research and development to facilitate the effective transfer of projects and knowledge, as well ensure that both processes strive towards the same product goals connected to business needs (Nobelius, 2004).

#### 1.3.1. Existing forms of alignment for R&D

Research has given considerable attention to creating alignment between R&D and internal departments of the organization to facilitate knowledge transfer. For instance, the alignment between R&D and marketing has been discussed significantly, expressing the value of marketing knowledge and the need for adequate transfer of this knowledge to R&D, to better connect product concepts to business needs (Ernst, Hoyer, & Rübсаamen, 2010; Acur, Kandemir, & Boer, 2012). Creating alignment between R&D and marketing consequently can facilitate this flow of marketing information (Ernst et al., 2010). Alignment between R&D and marketing can be established by either cross-functional collaboration (Zhou, Kim, & Tse., 2005 ; Acur et al., 2012) or cross-functional integration of activities (Hempelmann & Engelen, 2015). Emphasis for creating alignment is consequently placed on creating a similar or shared process for which mutual understanding, shared goals and support are central (Ernst et al., 2010). Similar needs for creating alignment have been found for R&D and sales (Ernst et al., 2010), finance (Hempelmann & Engelen, 2015) and even patent functions (Ernst & Fischer, 2014).

As R&D moreover increasingly is oriented cross-boundary, the need for creating alignment between external parties has also received significantly more attention in research, expressing that creating alignment between R&D and external partners is moreover influenced by the technical and functional diversity of the partner (Haeussler et al., 2012) as well as the match between technological capabilities (Slowinski, Sagal, Williams, & Stanton, 2015).

#### 1.3.2. Alignment between Research and Development

Even though the concept of separating activities between research and development is increasingly becoming more wide-spread, scientific research seems to be lacking on the need for alignment

between research and development, as well as the factors that facilitate or influence the creation of alignment between research and development. Whereas the concept of separation is discussed in research by Nobelius (2004) and Backman, Börjesson, & Setterberg (2007), empirical evidence seems lacking on the need for alignment between research and development to facilitate knowledge transfer, as well as the factors that influence the establishment of alignment. Moreover, the creation of alignment between research and development may differ from for instance the alignment of R&D and marketing, as in contrast to R&D and marketing, research and development operate as two units *within* the same department, contributing to the same departmental goals and performance. This form of alignment may require different determinants for creating alignment than currently addressed in alignment literature. Therefore, this research will aim to address this gap in scientific literature.

#### 1.4 Research Question

As the concept of separating research from development, in order to gain more focus and control over each individual process, becomes more wide-spread, the need for creating an effective link between research and development, in order to facilitate effective knowledge sharing between these processes, becomes more and more important, as the performance of R&D depends on the effective contribution of both research and development. As this topic currently seems unaddressed in literature, the research question therefore can be expressed as:

**‘How can alignment be created between *research* and *development*, in order to establish effective and efficient knowledge transfer between *research* and *development*?’**

The research question will be approached by answering the following sub questions:

- ‘What determinants for alignment can be identified in current scientific literature?’
- ‘How can these determinants be translated to a research and development environment?’
- ‘How do these translated determinants hold in a practical setting?’
- ‘What theoretical and practical implications for creating alignment between research and development can be found?’

#### 1.5 Research goals

The theoretical goal of this research is to provide scientific literature with insights on the creation of alignment *within* a department, specifically the alignment between research and development, presenting initial empirical support on which determinants are important for the creation of alignment between research and development, and how these insights compare to insights from current alignment literature. Moreover, this research aims to provide empirical evidence for the need for alignment between research and development, in order to facilitate the effective transfer of projects from research to development.

The practical goal of this research is to provide insights to organizations on which factors may influence creating alignment between research and development, creating awareness for organization on how alignment between research and development should be established, in order to allow organizations to increase (or maintain) the performance of R&D and consequently new product development. This research moreover will present practical solutions which can help organizations create this effective link between research and development.

#### 1.6. Methodology of the research

This research aims to provide answers for the proposed research question by applying both a desk research as well as a field research. The desk research will be conducted as a literature review, which is aimed at building a deeper understanding of the concept of alignment, as well as which determinants

influence the establishment of alignment (currently addressed in scientific literature). Consequently, these insights are translated to propositions for the creation of alignment between research and development. The desk research will therefore serve as the basis for deriving propositions on creating alignment between research and development. The methodology for the literature review is described in **appendix I**.

In order to validate whether the findings from the desk research actually hold for a R&D context, the propositions will be tested in a field research. The field research will be conducted as a case study at a company for which the separation between research and development is present. This should yield practical findings and insights on determinants for creating alignment between research and development, either providing support or adjustments for the propositions derived in the desk research. Consequently, based on both theoretical (desk research) and practical (field research) insights, this research aims to provide an adequate answer for the research questions.

### 1.7 Structure of the report

The structure of the report is as follows. Firstly, the desk research will be expressed in chapter 2, which entails a literature review on the determinants for creating alignment. This will yield a model with propositions for creating alignment between research and development. The model, along with its propositions, will consequently be tested in a field research, which entails a case study at a company for which a separation between research and development is present. Chapter 3 will describe the methodology for the case study, expressing what type of case study is conducted as well as how data is obtained and analysed. Chapter 4 will discuss the findings of the case study, expressing how the findings should be interpreted and how the findings compare to findings from literature. The results will be discussed in chapter 5, providing moreover the theoretical as well as practical implications of this research. Chapter 6 will conclude this research.

## 2. Literature review

This paragraph will describe the main findings in literature with regards to the concept of alignment, as well as which determinants influence the creation and establishment of alignment between separate units. Firstly, the concept of alignment will be clarified as well as the general determinants identified in literature for creating alignment. Next, the model for creating alignment between research and development, along with its associated propositions, will be introduced. For each proposition, the associated determinants for alignment, which have been found in scientific literature, will be described as well as how these determinants should hold or be translated for creating alignment between research and development. This will consequently provide background and support for the propositions in the theoretical model, and conclude the desk research.

### 2.1. Concept of alignment

Alignment can be defined as the degree to which the needs, demands, goals, objectives and/or structure of one component are consistent with the needs, demands, goals, objectives, and/or structure of another component (Cao, Baker, & Hoffman, 2012). Creating alignment therefore implies predicting, matching and adjusting actions to keep tempo with the relevant stakeholders (Dibrell, Fairclough, & Davis, 2014). Alignment is often seen from an organizational perspective, and can be characterized as fit (Porter, 1981) integration or linkage (Henderson & Venkatraman, 1993) or entrainment (Dibrell et al., 2014), emphasizing connections within or across organizations (Alagaraja & Shuck, 2015). Moreover, activities as coordination and cooperation are considered to fall under the concept of alignment (Hanson, Melnyk, & Calantone, 2011). Most commonly, alignment is seen as 'strategic alignment' (Chan & Reich, 2007; Hanson et al., 2011; Cao et al., 2012). The concept of strategic alignment can be defined as aligning functional activities and goals to allow that units or departments meet business goals, in order to increase the performance of the organization (Hanson et al., 2011; Cao et al., 2012). Therefore, alignment mostly concerns that organizations, departments or individuals achieve strategic goals by aligning their activities to the desired state or stakeholders (Alagaraja & Shuck, 2015). From a resource-based view, if activities are aligned, implementing new strategies and procedures should be more effective and efficient, therefore increasing organizational performance (Hung, Yang, Lien, McLean, & Kuo, 2010). Empirical research shows that establishing alignment, therefore matching organizations, units or departments in terms of structure, strategy and processes to the goals and objectives of the context, leads to increased innovative and business performance, considering both the internal and external context (Cao, Baker, & Hoffman, 2012; Dibrell et al., 2014).

### 2.2. Determinants for alignment

Referring to scientific literature on creating alignment, three distinct determinants can be identified for creating alignment in organizations, namely the importance of linking or sharing strategic goals between units (Kathuria, Joshi, & Porth, 2007; Hanson et al., 2011), the need for mutual acceptance and understanding of processes and activities between units (Preston & Karahanna, 2009; Hanson et al., 2011) and the adequate distribution of resources and capabilities to facilitate the correct execution of internal processes, as well as to allow units to effectively create a link between them (Kathuria et al., 2007; Cao et al., 2012). These concepts will now be discussed in more detail, emphasizing how these concepts contribute to the establishment of alignment.

#### 2.2.1. Importance of shared goals

Large consensus is present in scientific literature with regards to the importance of linking or creating shared goals for alignment, both in IT literature (Chan & Reich, 2007; Preston & Karahanna, 2009), strategic and operational literature (Kathuria et al., 2007; Hanson et al., 2011; Cao et al., 2012) and

human performance management literature (Alagaraja & Shuck, 2015; Ayers, 2015). Setting goals, either as an organization, department or individual, drives behavior, as the performance of employees, stakeholders or units is evaluated on the degree to which the goals set by the organization have been reached (Hanson et al., 2011). Goals provide information to both internal and external stakeholders as to what one desires to achieve, as well as communicate this desire. Goals moreover control and scope behavior: appropriate actions and behaviors will have to be undertaken to achieve these goals, whereas undesired behavior should be omitted (Hanson et al., 2011). As goals drive behavior, organizations can set appropriate strategic goals for units to match the business strategy or business needs (Cooper & Kleinschmidt, 2007; Cao et al., 2012). Moreover, if organizations link and connect functional goals (or set shared goals), behavior of functional units will be directed towards the desired organizational performance (Ayers, 2015). Therefore, in order to establish alignment between functional units (and ensure that internal processes between units match), organizations should ensure that the goals set are either linked or shared. Moreover, as the alignment of goals can be present on multiple levels within the organization, ranging from individual goals (Maheshwari, Kumar, & Kumar, 2012), functional or departmental goals (Kathuria et al., 2007; Hanson et al., 2011), and organizational goals (Cao et al., 2012), organizations should be able to effectively coordinate strategic goals throughout the organization (Kathuria et al., 2007). Lastly, as strategic goals are either matched to business needs or strategy, and are therefore aimed at reaching functional or organizational performance, organizations should ensure that these goals are accurate and supported (Cooper & Kleinschmidt, 2007).

### 2.2.2. Need for shared understanding and acceptance

Setting the right goals to drive behavior will not always directly lead to alignment to strategy or alignment between functional units. Research puts emphasis on, next to aligning goals, the creation of acceptance and shared understanding for strategic goals as well as mutual activities (Kathuria et al., 2007). Shared understanding is conceptualized as the degree to which departments understand the goals set by the organization, or understand the value and importance of an alignment partner (Kathuria et al., 2007; Preston & Karahanna, 2009). For instance, in an IT domain, Preston & Karahanna (2009) emphasize that shared understanding is important for strategic alignment of IT, and show a positive relationship between shared understanding and strategic alignment. Hanson et al. (2011) enlarge the concept of shared understanding by adding acceptance (of goals) and linkage (the degree to which the required effort is linked to the desired goals), additional to understanding. Setting goals may for instance not lead to the desired behavior, as employees do not understand the proposed goal (understanding), do not understand how the proposed goal should be achieved (linkage) or simply do not accept the proposed goal (acceptance) (Hanson et al., 2011). If consequently the desired behavior is not achieved, performance may be misdirected, resulting in a lack of fit to other functional units or strategy. Similarly, if employees do not accept, understand or see the linkage of behavior, activities or processes from alignment partners, performance of these partners may be omitted or adopted poorly, decreasing the overall performance. Moreover, without acceptance, employees may be reluctant to adjust internal activities to alignment partners. The need for linkage can also be found in research by Ayers (2015), emphasizing that employees need to see the link between behavior and goals or objectives. Following theory from Locke & Latham (2002), unclear goals or infeasible goals decrease commitment and motivation, resulting in decreased or misdirected performance.

### 2.2.3. Adequate distribution of resources and capabilities

Diverting away from goals and understanding and acceptance of goals and practices, an essential part of creating alignment for organizations is to provide the necessary capabilities to units to allow processes to be executed effectively, and to allow alignment to be established. For instance, Kathuria et al. (2007) argue that effectively creating alignment depends on whether the functional areas to be

aligned, ranging from organizations, departments and individuals, have or receive the capabilities and resources to do so. For instance, if a fit was obtained between (strategic) capabilities and (strategic) planning, this resulted in a better overall link and organizational performance (Kathuria et al., 2007). Similarly, Cooper & Kleinschmidt (2007) stress the importance of having an adequate amount of resources to achieve the product goals set by portfolio management. Failing to do so resulted in poor product development performance (Cooper & Kleinschmidt, 2007). In an IT-domain, Maheshwari et al. (2012) find that a misalignment of technical and social capabilities hinders team alignment, consequently decreasing team performance. Since creating alignment is a process of change, structures and processes within organization should change as well (Chan & Reich, 2007). As alignment requires actions to match desired partners or goals, capabilities should allow this behavior to adapt (Dibrell et al., 2012). Therefore, the organization should ensure that both the personnel and structural dimensions of capabilities (thus both employees, systems, structures and organizational decisions and support) are adequately distributed and matched in order to effectively allow alignment to be established (Chan & Reich, 2007).

### 2.3. Theoretical model for creating alignment in R&D

The determinants for creating alignment presented above should be translated and made specific to a R&D context in order to be applicable for a scenario between research and development. As a result, this report presents the following model for creating alignment within R&D, which is depicted in figure 1. The model incorporates three propositions (**P2**, **P3**, **P4**) for creating alignment within R&D, based on the previously described determinants for creating alignment. Therefore, if a proposition is lacking or inadequately applied, this will hinder the effective alignment of research and development. Moreover, the model proposes (**P1**) that if alignment is created between research and development, the transfer of knowledge and projects from research to development will be more effective, resulting in an increased R&D performance (as the processes operates more holistically). Lastly, the model incorporates feedback loops (**FL**) to ensure that the state of alignment (and thus its propositions) should continuously be coordinated and re-established in order to maintain R&D performance over time. The argumentation and theoretical basis for the propositions will now be discussed in more detail.

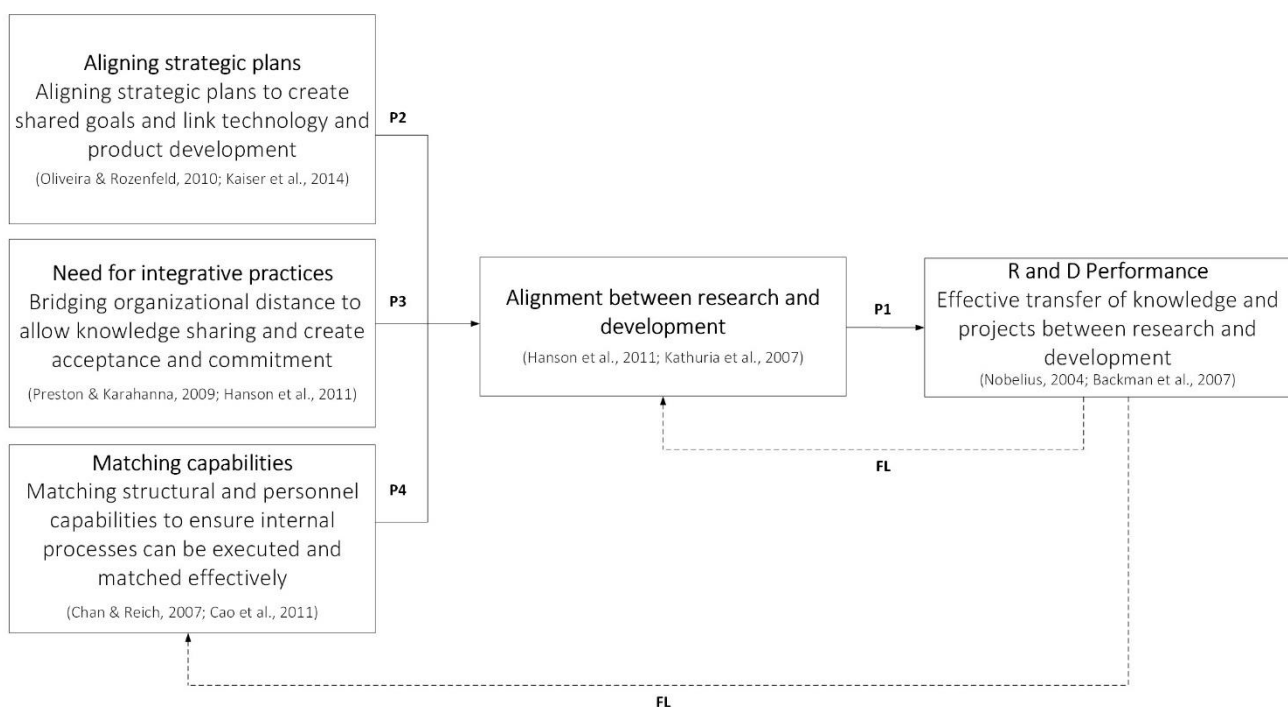


Figure 1: Theoretical model for creating alignment in R&D



### 2.3.1. Alignment and transfer effectiveness

Literature on aligning R&D and marketing (Zhou et al., 2005) or sales (Ernst et al., 2010) emphasize that as distinct units become more aligned and connected, knowledge transfer between these units is more effective, as through integration or collaboration efforts employees from distinct units are brought together (bridging the organizational distance). Employees can therefore traverse functional boundaries and distribute and share information where needed. Moreover, as units become more aware of the need for information at certain stages within the R&D process, whereas the process is more transparent, either marketing and sales can more adequately distribute this information (Ernst et al., 2010). Moreover, as processes and structures are more aligned, changes within units can be matched by predictable actions in order to ensure that the link between both units is maintained (Leenders & Wierenga, 2002; Ernst et al., 2010).

Even though research and development become more separated, efforts from both processes holistically contribute to new product development and consequently the performance of newly developed products. Knowledge or concepts developed in research should therefore adequately be transferred to development, but should also fit the current development processes as well as connect to business needs in order to achieve this performance. Activities in development moreover should be able to adequately adopt new knowledge or concepts from research, and should be able to facilitate the transfer of projects or knowledge from research to development (Nobelius 2004). As establishing alignment between research and development ensures that strategic goals are met, acceptance is created and capabilities are adequately distributed throughout the process, as well as can create an effective link between research and development, processes across R&D will be matched and be more transparent, allowing knowledge to be more effectively shared between research and development (Ernst et al., 2010). Moreover, as research and development work together more holistically towards business goals, and therefore better understand which knowledge or concepts are required, the knowledge transferred will better connect and be more adequate to the needs of the mutual partner.

*Proposition 1 (P1): Creating alignment between research and development can facilitate effective knowledge and project transfer between research and development.*

### 2.3.2. Alignment of strategic planning measures

Achieving the strategic goals set can be structured by applying strategic planning (Cooper & Kleinschmidt, 2007; Acur et al., 2012) or by setting up adequate performance and measurement systems (Kaplan & Norton, 2006; Hanson et al., 2011). Instead of solely setting long-term large goals, these mechanisms can more effectively steer behavior through intermediate planned activities, sub-goals or milestones (Hanson et al., 2011). The structures therefore consequently are responsible for motivating behavior consistent and supportive for the strategic goals. As a consequence, organizations can maintain more control over the desired behavior and more adequately steer behavior where necessary to meet strategic goals (Hanson et al., 2011). As research and development become more separated, both functional units will strive for different functional goals. For instance, research will more strongly focus on technology development and the exploration of new opportunities, whereas development will focus on product and customer requirements and product completion (Nobelius, 2004). In order to effectively steer behavior, research will most likely apply technology roadmaps to structure technology development (Phaal, Farrukh, & Probert, 2004). Similarly, development will most likely apply product portfolios to drive product development and to connect products to business needs (Cooper & Kleinschmidt, 2007). It is however important that these strategic goals are aligned in order to create alignment between research and development, whereas technology development should fit



product development (and vice-versa) in order to effectively develop new products and achieve R&D performance (Cooper & Kleinschmidt, 2007).

As strategic planning and performance measurement structures can steer behavior towards strategic goals, these mechanisms should be linked or integrated to facilitate the creation of linked or shared goals (Oliveira & Rozenfeld, 2010; Kaiser, el Arbi, & Ahlemann, 2014). Therefore, management should ensure that activities executed for research fit and can be applied in development. For instance, the planned development of a new technology should adequately be linked to a new product application, whereas new customer requirements can be satisfied through the application of new technologies. (Oliveira & Rozenfeld, 2010). By connecting planned activities across strategic plans, the strategic goals for research and development become more aligned, as activities in development may depend on the successful execution of a research activity and vice-versa (and thus both share the same functional goal). As the goals are shared, behavior will be steered to better connect to the needs of the alignment partner, allowing internal processes and activities to effectively be adjusted to ensure that the shared goals will be achieved (and allowing research and development to become more aligned). Moreover, if adequate business goals are set for R&D, this will allow newly developed products to better connect to business needs, increasing the performance of R&D (Oliveira & Rozenfeld, 2010). The link or connection between these strategic measures however should continuously be re-established in order to cope with dynamic changes in the market, as goals for either research and development may change over time (Hanson et al., 2011). Therefore, strategic plans or measurement structures for research and development should be adequately linked and re-established to create integrated or shared goals, and consequently facilitate the establishment of alignment.

*Proposition 2 (P2): Creating alignment between research and development requires the alignment of strategic planning measures between research and development.*

### 2.3.3. Need for cross-functional integration of activities

Distinct units can stimulate acceptance and shared understanding by distributing internal knowledge on the current goals, activities and processes (Preston & Karahanna, 2009; Hanson et al., 2011). Consequently, distributing internal knowledge can create awareness for external units, and allows external units to form or renew their current perspectives on the process, as well as the contribution of the unit towards the holistic process (Preston & Karahanna, 2009). Consequently, units can work towards a shared understanding of the processes, as well as can adjust or re-align activities to match the external partner (Preston & Karahanna, 2009). Moreover, uncertainty and ambiguity can be removed, allowing the process to be more transparent, making it more clear how mutual behavior will contribute to strategic goals and functional performance (Chan & Reich, 2007). Functional goals or planned activities are often ambiguous, allowing multiple interpretations and views for managers (Chan & Reich, 2007). By communication expectations and adequately sharing knowledge, this uncertainty can be removed, increasing the means for acceptance between parties (Hanson et al., 2011).

The separation of research and development however creates more distinct processes between both units, increasing the organizational distance between research and development, making it more difficult to effectively share knowledge and create transparency for activities and processes. Employees are often bound to internal activities and are required to achieve internal goals, making it more difficult for employees to create transparency and effectively share knowledge with external partners. Organizations should therefore ensure that even though research and development are more separated (in terms of organizational structure), an effective link between both processes is maintained and to allow knowledge to be shared.

Scientific literature argues that practices of integration can facilitate knowledge sharing between distinct functional areas (Leenders & Wierenga, 2002; Ernst et al., 2010; Liu, Keller, & Shih, 2011). Moreover, empirical analysis on project transfer by Cohen, Keller, & Streeter (1979) emphasizes the need for integration between distinct processes in order to facilitate effective project transfer between research and development. If employees are structured through practices of integration to cross functional barriers, either through participation, collaboration or integration, the organizational distance is bridged between functional areas, allowing employees to participate and share knowledge externally, and consequently allowing units to more effectively communicate and share knowledge (Ernst et al., 2010). For instance, if cross-functional collaboration is applied, members from different departments are brought together to work on an activity and consequently can share knowledge within the project or activity (De Luca & Atuahene-Gima, 2007). Moreover, as employees function as a liaison, knowledge can be distributed within external units, increasing awareness and allowing the process to become more transparent (Leenders & Wierenga, 2002; Liu, Keller, & Shih, 2011). Consequently, this increases the means for creating shared understanding and acceptance, as stated earlier, and can allow external units to match processes and activities to alignment partners. Furthermore, if employees are allowed to participate in external projects, commitment and acceptance may intrinsically increase, as employees feel responsible for the execution of the project (Ehrhardt, Miller, Freeman, 2014). As research and development therefore become more separated, the organization should structure employees to cross the boundaries of the functional unit, by applying practices of integration to allow internal knowledge to be shared, transparency to be created, and consequently facilitating the creation of acceptance between research and development.

*Proposition 3 (P3): Creating alignment between research and development requires practices of integration to distribute shared knowledge and create acceptance between research and development.*

#### 2.3.4. Adequate distribution of capabilities

As research and development will operate as more separate functional units, both the structural as well as the personnel dimensions of capabilities will change. For instance, as research is more strongly oriented on technology development, employees within research predominantly have specific technological knowledge. Similarly, as development more strongly concerns product development, employees within research will predominantly have knowledge considering product characteristics and customer requirements (Nobelius, 2004). It is important however that both processes possess the personnel capabilities to effectively incorporate input from both research and development (Maheshwari et al., 2012). For instance, if specialized technological knowledge is lacking in development, development engineers will be unable to adequately incorporate a technological concept into a new product. Stock, Totzauer, & Zacherias (2014) argue that in order to facilitate the effective cooperation between research and development, both research and development should match in terms of adequate training. Similarly, if technological concepts do not fit product development, as product knowledge is lacking in research, excessive rework and costs are required in development to incorporate these concepts, leading to inefficient processes. Analogously, considering structural capabilities, if research does not receive the resources it needs to correctly execute technology projects, or technology concepts are do not receive adequate management support, then research efforts most likely will not effectively contribute to new product development (Cooper & Kleinschmidt, 2007), hindering the establishment of alignment. Similarly, a lack of resources can prevent units from adapting processes to match the activities of alignment partners. It is therefore important that organizations ensure that both research and development also match in terms of structural capabilities. Organizations should therefore adequately distribute and match both personnel and structural capabilities across both functional units in order to allow internal processes to be executed effectively, to allow processes to be matched, and consequently to facilitate alignment (Chan & Reich, 2007;

Maheshwari et al., 2012). Organizations can for instance increase the personnel capabilities through training of employees (Stock et al., 2014) or transfer of project members with projects (Cohen et al., 1979), whereas structural capabilities can be increased through management support (Mosavi, 2014; Stock et al., 2014) and increased resources for project execution and completion (Cooper & Kleinschmidt, 2007), providing either employees or teams with the resources to effectively execute processes across units.

*Proposition 4 (P4): Creating alignment between research and development requires the adequate distribution and matching of personnel and structural capabilities between research and development.*

#### 2.4. Conclusion on literature review

The model presented in Figure 1 is the result of a literature review on the determinants for alignment and knowledge transfer, translated to a context of research and development. The model includes four propositions related to either how alignment can be facilitated within R&D (**P2, P3, P4**) as well as the influence of alignment on knowledge transfer between research and development (**P1**). Moreover, the model includes feedback loops (**FL**), implying that knowledge transfer can only remain effective if alignment, and consequently its predecessors are continuously readjusted in order to cope with market, organization and customer changes. In order to validate the propositions of the model, a field research will be conducted, aiming to provide either support for the derived propositions or to find insights which require adjustments or extensions to the current propositions.

### 3. Field research methodology

In this chapter, the methodology for the execution of the field research will be discussed. The field research will entail a single-case study at a company based in the Netherlands, for which research and development operate as separate units for product development. However, to a less detailed extent, two additional benchmark have also been conducted in order to yield more practical insights. This chapter will first describe the type of study as well as briefly the context and process for the selected case company and benchmarks. Next, the sources of information will be discussed, as well as how data was collected. Lastly, this chapter will describe how the data was analyzed and which methods were applied to account for validity and reliability of the results.

#### 3.1. Type of study

The model presented in Figure 1 includes four propositions with regards to either the creation of alignment as well as the influence of alignment on project transfer between research and development. To validate whether these propositions hold empirically, and to provide either initial support or adjustments for these propositions, an exploratory case study approach has been conducted (Yin, 2013). The exploratory case study approach was opted for as the separation of research and development is relatively contemporary and not widely described in scientific literature. The theory therefore lacks clear, tested conceptualization of constructs. It is therefore valuable to analyze the developed theory for creating alignment in a real-life setting to provide insights and understanding for the dynamics of this phenomenon.

#### 3.2. Case study design

A holistic single case study design has been applied for this field research. The results from the field research therefore are largely based on the holistic analysis of the process and its characteristics for the selected case company. However, to provide practical insights for improvement for the case company, two additional benchmarks have been analyzed. These benchmarks were conducted at different companies which applied a similar separation between research and development, and primarily focused on which mechanisms or tools had been applied to facilitate alignment, consequently project transfer between research and development. The selected case company and benchmarks will now be discussed in more detail.

##### 3.2.1. Single case company

The case study has been conducted at an automotive company based in the Netherlands, which applies the separated view of research and development. The company desired to maintain control over its development activities to be able to more timely introduce new products. Moreover, the company desired to decrease uncertainty and risk for development activities as development activities become increasingly more expensive as projects approach the launch phase. This has driven the company to separate research from development, as activities in research in essence are more riskier.

The current process for the company is presented in Figure 2. Projects in research largely concern the exploration of new technologies and the development of technology applications for future products. Typically, research has to work with a scope of 5 to 10 years, implying that concepts are relatively risky and uncertain. If research projects are successfully completed and are accepted / selected for a new product concept, the project is transferred to development, which consequently incorporates the technological concept, as well as internal demands and customer requirements into a product project, aimed at developing a new product ready for series of production (S.O.P.). One should note that a product project does not require the input from research to start, depending on the desired launch (for instance if no valid or acceptable technology concept is presented as input). The product project has a scope of 0 to 5 years.

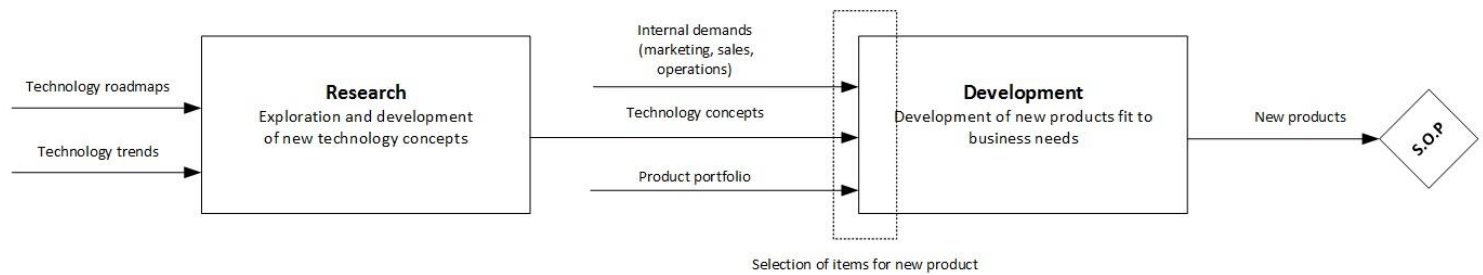


Figure 2: Case company R&D process

Currently, the company did not perceive the process to be working effectively. Relatively few concepts or elements of new products could directly be indicated as the result of research projects (as opposed to the dedicated resources for research), implying that projects did not seem to transfer effectively from research to development. The company therefore desired to gain insights for its current research and development process, specifically whether the transfer of projects from research to development was working effectively, and which factors influenced the effective transfer of projects from research to development. Moreover, the company desired to obtain practical recommendations for improvement for the current development process.

### 3.2.2. Benchmark companies

The single case company operates in a market which is characterized by a relatively slow technological change in the market, implying that technology development is often incremental and that the adoption period for new technology is relatively long. These market factors have implications for how both research and development activities will be strategized and conducted. To contrast the findings for the single case company, as well as to provide more varying practical insights, two companies have been selected which operate in a market characterized by either very slow or rapid technological change, to see how these companies cope with challenges placing few or high demands on technology development in research and consequently the need for effective project transfer, and which tools and mechanisms they apply to effectively facilitate and control the new product development process.

Concluding, Table 1 expresses the sources of data used for the field study, as well as for what goal the source of information has been used.

Table 1: Sources of information

Source of information	Type of data	Goal for research
Case company	Interviews Documents (as background for process structure)	Validation of propositions
Benchmarks	Interviews	Practical solutions for improvement

### 3.3 Data collection

For the single case company, 13 stakeholders of the R&D process have been interviewed. The number of interviews was decided by the contribution of new valuable information for each interview, in order to gain a comprehensive and detailed perception of the current R&D process. Therefore, when interviews stopped contributing valuable new information (the data became saturated), the interview sessions were terminated. The 13 stakeholders originated from both research related and development related activities in order to obtain a comprehensive view of the current process, incorporating both perceptions in the analysis of the process. Moreover, stakeholders originated from different

organizational levels, including both operational, functional and managerial stakeholders for the current process. The list of interviewees is depicted in Table 2, separating between research, development and external functions which provide input for the current R&D process, related to the decision making for either the contents or execution of a new product project.

For the selected benchmarks, two interviews with technology managers were sufficient to understand how these companies coped with the current R&D challenges and what tools and mechanisms were applied to provide structure to their R&D process and ensure that both technology and product developments were incorporated in new product development.

Table 2: List of interviewees case company

<i>List of interviewees for single case study</i>		
<b>Research</b>	<b>Development</b>	<b>External</b>
3x research project manager	2x development engineer	1x project planner
1x research functional manager	2x development project manager	1x project controller
	2x development functional manager	1x project property owner

### 3.2.1. Semi-structured interviews

The interviews have been taken in a semi-structured approach, in order to ensure that subjects were directed towards relevant areas of information, whereas the respondent was given freedom to answer in detail and potentially divert to elements which, although unaddressed by the interview questions, might be of high value for the research (King, Cassell, & Symon, 1994). 11 of 13 interviews have been recorded, expressing that results were handled anonymously and would not be used outside of this research. Furthermore, sensitive information was treated confidentially. By recording the interviews, information could be handled more accurately and have more value for both the company as well as the case study. Each interview lasted 30 to 40 minutes and was conducted using the same interview questions to gain responses on consistent subjects. Note however that not every questions was asked in every interview, depending on how the subject developed. Important was that the respondent could answer and identify causes and relationships relatively freely, even if these were not addressed by research questions. The interview questions were based on the model depicted in figure 1, addressing factors on shared goals, acceptance and adequate capabilities, and consequently the mechanisms which have been theorized to lead to these determinants for alignment. These interview questions are presented in **appendix II**.

### 3.3. Method of analysis

The interviews started with a general discussion about the current problematics at the organization, to allow respondents to identify which causes they perceived as most important for the current situation. The general question posed in each interview considered whether the respondent considered the transfer of projects from research and development to be effective, and what causes underlie ineffectiveness and inefficiencies for this process to obtain a comprehensive view of the characteristics of the current R&D process, and to gain insights on which factors might influence an ineffective transfer of projects, specifically whether factors as shared goals, acceptance and capabilities were being facilitated.

#### 3.3.1. Insights for theoretical propositions

Consequently, the interview questions were aimed at providing valuable insights for the previously derived propositions, either as the insights provided support for these propositions or provided evidence for adjustments. By verifying if the mechanisms presented for the propositions were also applied at the case company and were working effectively towards either shared goals, acceptance or

adequate capabilities, this should present the propositions with significant empirical evidence for or against them.

In order to do so, respondents were explicitly asked whether they felt that an effective link or integration was present between research and development (in terms of matching activities, match of plans, transparency), whether research and development operated holistically towards business goals, and consequently whether this influenced the transfer of projects from research to development (corresponding to proposition 1). Moreover, if alignment between research and development was perceived to be absent, then the determinants for alignment between research and development (proposition 2, 3 and 4) were expected to be absent as well in order to validate the theoretical model.

Similarly, interview questions were aimed at the presence of a link or integration between the strategic plans, and whether this link contributed to the alignment of strategic goals for research and development, consequently leading to processes within research and development working towards the same business needs, or whether different mechanisms facilitated shared goals (or were not facilitated at all).

Analogically, to provide insights for proposition 3, respondents were asked whether integrative approaches (as participation or cross-functional collaboration) were applied, and whether this contributed to the creation of transparency and awareness, consequently acceptance and commitment for activities, processes and projects from research or development (as employees could more effectively share internal knowledge). Moreover, respondents were asked to indicate whether these practices of integration were sufficient.

Lastly, in order to yield empirical evidence for proposition 4, questions were aimed at the presence of structural and personnel capabilities, inquiring whether both processes received adequate support in terms of management support, resources and specialized knowledge, and whether the organizational structure facilitated these capabilities. Importantly, respondents were moreover asked whether the distribution of capabilities over both research and development matched, to allow projects to be effectively transferred.

### 3.3.2. Triangulation

To ensure that the responses and quotes to be used were valid and reliable, triangulation was used, by incorporating responses from previous interviews in new interviews and verifying whether these responses were true and correctly interpreted. If important quotes did not receive confirmation in different interviews, its impact for the analysis decreased, whereas the causes of a lack of confirmation were assessed (i.e. wrongful interpretation, non-valid responses). Moreover, for some cases for which the quote seemed misinterpreted or invalid after triangulation, the respective respondents were briefly (informally) asked again whether the response was correctly interpreted. Therefore, quotes were used which received confirmation and acceptance across interviews to increase both reliability and validity, whereas the field research aimed to mitigate misinterpretation errors.

### 3.3.3. Content analysis

To analyze the responses from the interviews, content analysis has been used (Krippendorff, 2012). The procedure for content analysis was as follows. Firstly, As most of the interviews were recorded, transcripts could be made, allowing responses and quotes to be coded. This was done manually without the aid of computer software. Next, open coding was applied to gain a better understanding of the transfer effectiveness and the factors involved for the current process of the case company, by highlighting which factors were named frequently across interviews and representing these factors through interview quotes to facilitate readability. Open coding moreover facilitated the derivation of

also practical insights relevant for the company (as opposed to theoretical insights). Consequently, theoretical coding was applied by matching these quotes to the propositions presented for the model, presenting either evidence for or against these propositions. If the quote presented to be relevant for the mechanism underlying a certain proposition, the quote was matched to this proposition. Finally, based on the corresponding support for each proposition (across interviews), conclusions were drawn.

### 3.4 Conclusion of methodology

This chapter has described which methodology has been applied for the field research, which serves to provide empirical evidence for or against the results from the desk research. As stated before, the field research has been structured as a holistic single case study, aiming to provide empirical evidence for the derived model on creating alignment, by analyzing the current research and development process of the case company. In order to do so, relevant stakeholders have been interviewed to obtain both practical and theoretical insights, aiming to provide both valid and reliable output. Through content analysis consequently, these interviews have been analyzed. However, as the case company desired to obtain practical insights as well, two benchmarks have been analyzed moreover in order to provide opportunities for improvement.



## 4. Results of case study

This chapter will describe the results which have been derived from the interviews with the relevant stakeholders for the R&D process of the case study company. For every proposition, this chapter will describe whether the proposition is supported, based on evidence from the responses of stakeholders, or whether the proposition is not (fully) supported and requires to be adjusted or left out for the theoretical model for creating alignment between research and development. Moreover, this chapter will present interview quotes, derived from the interviews, to show why a certain proposition is supported, and how the interview quote is connected or provides support to the relevant proposition. The chapter will conclude by presenting a table in which the main results can be found, showing which propositions from the theoretical model have been supported.

### 4.1. Proposition 1 – Need for alignment to facilitate effective project transfer

Proposition 1 describes that establishing alignment (and therefore the creation of an effective link) between research and development should facilitate the effective transfer of projects between research and development, as alignment should ensure that mutual processes become more connected and produce adequate and expected behavior, in line with the objectives for mutual partners. When asked whether an effective link or integration was present between research and development, respondents agreed that the current process for the case company was relatively disconnected, operating as ‘two worlds of interest’, with no transparency nor an effective link for cross-functional activities.

*‘It is a game of two worlds for research and development. Everyone seems focused on solving their own problems within their own departments instead of adopting a wide view of the process. Functional managers are always busy discussing what can be approached differently instead of actively making decisions together’ (project manager research).*

*‘I do not understand why some activities in research are started, given future requirements in development. An effective link is missing between research and development in order to match these activities. We should work towards an integral approach for product development in the organization’ (functional manager development).*

Consequently, following the proposition, as alignment was felt to be absent, the effective transfer of projects between research and development is expected to be ineffective or inadequate. Respondents therefore were asked whether they perceived the transfer of projects from research to development to be effective. The responses from the interviews showed that project transfer from research to development indeed was ineffective, expressing that a large amount of research projects failed to be adopted, as the projects did not fit in development, were poorly timed for a new product development project or generally could not be adopted as concepts were either perceived to be too risky or lacking robustness, or other alternatives (for instance from suppliers) had been chosen. The fact that research and development did not seem to be integrally approached accounted for this.

*‘Technology concepts from research projects often lack the applicability to be effectively adopted for a new product project. This creates a gap between research output and development input, causing an ineffective transfer of projects’ (engineer development).*

*‘Due to a lack of an integrated approach for R&D, it often does not become clear what value a research project may have, even though the project does live up to the standards for a product project. Consequently, development chooses for alternatives to fill up the gap. The current procedures therefore do not facilitate the effective transfer of projects’ (project manager research).*

Based on these results from the case company, it can be concluded that proposition 1 is supported, as respondents indicated that alignment was absent, as both research and development operate as 'two worlds of interest' consequently causing an ineffective transfer of projects from research to development.

#### 4.2. Proposition 2 – Alignment of strategic measures for creating shared goals

Proposition 2 (P2) emphasizes the need for aligning the strategic measures for research and development, which motivate and coordinate activities within each individual unit, for creating alignment between research and development. The alignment of strategic measures can ensure that the strategic goals of both research and development (and thus the holistic goal of R&D) match and are connected, allowing internal processes to become more aligned. As alignment seemed to be absent for our case company, it is therefore expected that, based on proposition 2, the alignment of strategic measures will be absent or inadequate as well. When asked whether strategic plans, such as technology roadmaps for research and product portfolios for development, were integrated or aligned and whether this contributed to the creation of shared or holistic goals for R&D, respondents emphasized that the connection between these strategic measures was absent. For instance, respondents indicated that the strategic plans were established separately, without participation of either research or development respectively to allow strategy, plans and activities across units to be expressed and linked. As a consequence, respondents indicated that objectives for technology development (generally the goals for research) are not linked to nor incorporated in plans for product development, therefore not facilitating the creation of shared or integrated goals for research and development (which respondents felt were absent, as a lack of an holistic approach was emphasized). This led to research projects generally being *bottom-up pushed* through the organization, as the goals of development did not ask for it nor require it.

*'Both research and development establish their strategic plans secluded, without coordination and communication of strategy. There is no link between both plans'. (engineer development).*

*'Meetings with stakeholders from research are scarce. In general, when research presents their technological prospects, this generally only serves as information instead of actual fertilization of the product portfolio. The product portfolio remains largely unchanged'. (product planner).*

*'There is no integrated document which connects research to development. It is however not facilitated that we participate in the development of the product portfolio. Therefore, we are looking in research for solutions which are not even connected to an existing problem. It is generally a bottom-up push of new technological concepts'. (project manager research).*

*'If the connection between either roadmaps and portfolios is lacking, then the chances of adoption are low, as the goals of the department do not require it'. (project manager development).*

The results from the case company show that the lack of connection between strategic measures leads to a lack of shared or holistic goals for R&D (consequently making it difficult for projects to be transferred effectively, as technology development is not required from goals). It can thus be concluded that proposition 2 is supported.

#### 4.3. Proposition 3 – Need for integrative practices to create acceptance

Proposition 3 describes that for facilitating the creation of acceptance and commitment between research and development, practices of integration, either through cross-functional collaboration, cooperation or integration of activities or processes, should be present in order to do so (by creating transparency and awareness, bridging the organizational distance and facilitating knowledge-sharing). Again, as alignment seemed to be absent for the case company, it is expected that, based on the

proposition, that the application of integrative practices at the case company between research and development should be absent, ineffective or inadequate as well.

Respondents indicated that participation of development in research projects does sometimes occur, and moreover that these projects often seemed to have a higher chance of being adopted, as through transparency and knowledge sharing, acceptance and commitment could be created early. Respondents emphasized that these projects were usually coordinated through multi-functional teams working on the final stages of a research project.

*'The success stories are those projects for which engineering (of development) has participated early in the development of a technology concept, allowing early acceptance and commitment to be created, whereas resources can be dedicated to steer these projects into the right direction. (project manager development).*

Respondents however emphasized that participation of development was not effectively facilitated or structured by the organization. Stakeholders indicated that no procedures or pre-defined approaches (by management) were present to structure or facilitate participation, implying that participation boiled down to whether development or research could effectively show the value of a certain product or concept in order to motivate participation, and whether internal activities were transparent.

*'Engineering (development) does not want to or cannot participate in research projects as it does not have resources to do so. If internal demands are high, these internal activities logically receive priority.'* (project manager research)

*'The current structures do not require development to participate in research projects. Therefore, if the value of a research concept is not clear or transparent, development will be reluctant to participate'.* (project property owner).

Moreover, more surprisingly, respondents indicated that (early) participation did not always lead to the desired acceptance, and consequently adoption of these research projects, as cultural influences intrinsically decreased acceptance for concepts emerging from research. Interviews noted the presence of both risk-averse behavior when selecting items for new product projects as well as the strong presence of the not-invented-here syndrome (Katz & Allen, 1982). As research concepts did not originate from functional units in development (causing external stakeholders to not have responsibility over the concept), and research projects in essence were more risky and therefore more likely to fail (as they have to predict over a larger scope of time), practices of integration could not always create the acceptance and commitment required for adoption, or even that these practices of integration were not even started at all.

*'Not-invented-here is strongly present within product development. Managers are aiming to strive for personal goals and make choices which favor their own projects. Declining external initiatives moreover takes away responsibility, leaving resources available for personal activities.'* (project planner).

*'If departments have not participated early in a research project, they cannot take responsibility for the successful participation, and are therefore reluctant to participate later or accept it.'* (project manager research).

*'The company has a strong focus on diminishing risk. The development phase is characterized by control and a tightly managed approach. As managers desire to complete product projects, demands for technology concepts in terms of decreasing risks keep on increasing, in order to ensure that the product project will be successful. These demands often become unattainable'.* (project manager research).

The results show that for the case company, the practices of integration are generally not structured or facilitated, implying that this mechanism is inadequately applied and as a consequence does not facilitate the creation of acceptance and commitment between research and development (which provides support for the proposition). The opposite situation also occurs at the company, as respondents indicate that projects receive the acceptance and commitment they need when multifunctional teams are applied, resulting often in the successful adoption of the concept. However, what should be emphasized is that respondents indicate that this participation *does not always* lead to the desired acceptance and commitment, as cultural influences (in this case, risk-averse and not-invented-here behavior) can intrinsically decrease acceptance for research projects. Practices of integration therefore do not always effectively contribute to acceptance and commitment, implying that organizations should also account for or mitigate cultural influences between research and development. It can therefore be concluded that proposition 3 is partially supported.

#### 4.4. Proposition 4 – Adequate distribution of capabilities to facilitate processes

Proposition 4 emphasizes the need for an adequate distribution and match of both structural capabilities (as management support, resources and organizational structures) and personnel capabilities (as specialized skills, knowledge and training) for research and development to ensure that processes within both research and development can be executed effectively, allowing activities to be matched, and that projects and knowledge from research can effectively be processed or adopted in development. Analogically to the previous proposition 2 and 3, it is expected that for the case company these capabilities are inadequately distributed or matched.

When asked whether the organization ensures that the structural capabilities are adequately distributed and matched, respondents indicate that a gap in capabilities is present between research and development, and that in general research requires additional support (in terms of resources) from development in order to ensure that uncertainties and risks are reduced whereas the concepts can be made more robust. As participation of development is not always facilitated whereas the cross-functional integration of activities is not structured, respondents consequently indicated that research was unable to effectively execute all projects and activities planned. Moreover, management support aimed at dedicating the required resources to research, especially when a concept proved to be valuable, seemed to be absent (a kind of support which product projects in development did receive, as these projects directly generated business).

*'There is gap between what research can deliver in terms of mature and conceptualized technologies and what development desires in terms of input for new product development. The current staff and resources in research are too few to cope with the current project pressure. As a result, projects from research are sometimes too risky to adopt.'* (project manager development)

*'It occurs often that for research concepts not all uncertainties can be diminished. In such cases the project in essence is too risky which hinders project transfer. However, research projects in such cases often do not receive support from higher management to ensure that a concept is adopted, even though the value is acknowledged, as the technology concepts do not directly drive business.'* (project manager research)

Stakeholders emphasized for the distribution and matching of personnel capabilities that specialized knowledge, for instance related to a new technological concept, is often only present at either research or development, making it more difficult to adequately transfer knowledge or adopt new concepts. Moreover, stakeholders indicate that employees (and therefore the tacit skills and knowledge) do not transfer with projects in order to ensure these personnel capabilities are adequately distributed. As a consequence, transferred projects require rework and relearning at the start of development, creating

inefficiencies within the development process, sometimes causing development to not choose for a certain research project.

*'The capabilities in terms of technological knowledge in development are relatively low. It occurs frequently that either new research in development is needed to relearn what has been done in research or that the project is not adopted. The lack of these capabilities hinders the transfer of projects.'* (project manager research)

The results show that for the case company, both the structural and personnel capabilities are not adequately distributed over research and development, as either the resources (as time, monetary resources and management support) lack for research to effectively execute projects ready for development, whereas development lacks the personnel capabilities to effectively handle concepts from research, causing inefficiencies for the start of new product projects. It can therefore be concluded that proposition 4 is supported. The final results of the field research are shown in Table 3.

Table 3: Results of field research

<b>Theoretical propositions</b>	<b>Support from case company</b>
P1: R&D alignment – project transfer	Supported
P2: Strategic plan alignment - shared goals	Supported
P3: Practices of integration - acceptance	Partially Supported
P4: Distribution of capabilities – capabilities	Supported

## 5. Discussion

This paragraph will discuss the findings from the field research as well as how these findings match to the previously derived model and propositions from the desk research presented earlier. Moreover, this chapter will describe which contributions this research has yielded, both from a theoretical perspective, by providing insights for current and future scientific research on the creation of alignment in organizations (as well as specifically between research and development), and from a practical perspective, by providing organizations insights on how alignment between research and development can influence R&D performance, as well as how this alignment should be established. Lastly, for the case company, tools and approaches will be presented for improving their current R&D process which best fit the current organizational structure, culture and processes present at the company.

### 5.1. Theoretical implications

Existing research has focused on the need for creating alignment between R&D and internal organizational departments as marketing (Zhou et al., 2005) or sales (Ernst et al., 2010) as well as the alignment of R&D with external factors as suppliers (Emden, Calantone, & Droge, 2006) or markets (Acur et al., 2012), in order to match processes and activities across organizational units, allowing knowledge to adequately be shared and consequently to strive for a higher R&D and business performance. Contrary to existing research, which primarily has focused on the creation of alignment **between** departments, this research has focused on the creation of alignment **within** departments, providing initial evidence which emphasizes the need for alignment between internal units of a department. The performance of R&D, and consequently new product development, depends on the efforts and input from both research and development, although both units may internally be more distinctly separated and operating differently (Nobelius, 2004). As opposed to existing research which aims to increase R&D performance by aligning R&D to internal or external units, this performance may be less effective or not even be achieved at all if its internal units (as research and development) are not aligned as well, as the R&D process becomes disconnected. This research therefore provides theoretical implications for the necessity of creating alignment within R&D as well, especially for cases for which research and development are separated more distinctly.

#### 5.1.1. Influence of alignment on project transfer

The results have shown that, similar to research on the need for alignment (Kathuria et al., 2007; Chan & Reich, 2007; Ernst et al., 2010), without an effective link or alignment between research and development, the R&D process becomes less transparent and does not holistically approach business goals, causing internal activities and projects across research and development to be misaligned and consequently making it difficult to effectively transfer knowledge or projects between units. The results from this study show that for the case company, the absence of alignment between research and development resulted in research concepts being inadequate for future products as they lacked the robustness, generally did not fit or were in essence too risky to be adopted. Development however had no clear view of which research activities were applied and did not (pro)actively participate or provide resources to support these research activities. As a consequence, newly developed products often lacked technological input and concepts from research, putting pressure on the R&D performance for the case company. It is therefore important that alignment is established between research and development to ensure this performance is achieved and maintained, and to allow projects to be transferred effectively (Nobelius, 2004).

### 5.1.2. Mechanisms for creating alignment between research and development

Existing research on creating alignment has shown the need for creating shared goals (Kathuria et al., 2007; Hanson et al., 2011), creating acceptance (Preston & Karahanna, 2007; Hanson et al., 2011) and adequately distributing capabilities (Kathuria et al., 2007; Cao et al., 2012) in order to ensure that the holistic goal is sought after, processes are matched and accepted and units receive the support and resources to do so. The case study shows that these prerequisites for creating alignment also are important for a context of R&D. Translating these prerequisites to an R&D environment and expressing the mechanisms which can facilitate these prerequisites, the results present support for the need to align strategic plans or measures in order to facilitate the creation of shared goals, and consequently ensure that both research and development work holistically towards business needs (Oliveira & Rozenfeld, 2010; Kaiser et al., 2014). The strategic plans drive behavior for both research and development, planning internal activities and setting objectives for respectively technology and product development. Without a link between plans, or a connection between planned activities, the case study showed that development was reluctant to dedicate resources to or adopt concepts from research, even more specifically when internal demands were high. If product portfolios do not incorporate objectives on technology development or adoption of new technologies, employees will often not be motivated nor structured to adopt concepts emerging from research given a lack of resources or high internal demands (Hanson et al., 2011).

Similarly, providing support to the need for an adequate distribution of capabilities, both structural and personnel capabilities should be distributed and matched in order to ensure that both processes in research and development can effectively be executed (Chan & Reich, 2007; Maheshwari et al., 2012). The case study showed that without management support in terms of resources, research in general was unable to effectively execute its activities planned, requiring research to either cut projects (and potentially choosing the wrong technological trend) or to transfer projects which are risky and lack robustness, causing projects to often fail to be adopted. Similarly, as development lacked the personnel capabilities in terms of specialized skills and knowledge to adequately adopt technological concepts, whereas project members from research were not facilitated to transfer with their project to development, technologies had to be relearned or researched again at the start of new product projects, causing inefficiencies at the start of the development process.

An interesting finding from the case study is that practices of integration did not always seem to facilitate the creation of acceptance, as cultural influences for research and development were present which intrinsically lowered the acceptance for research concepts. Existing research argues that the application of practices of integration, for instance cross-functional collaboration or participation, allow employees to share knowledge by bridging the organizational distance and moreover as departments are allowed to steer behavior and take responsibility, acceptance and commitment can be created (Leenders & Wierenga, 2002; Ernst et al., 2010). The case study provides initial support that this link or relationship is potentially influenced by the presence of cultural factors, either mediating or moderating the effectiveness of practices of integration. This may present new insights as a basis for future research. Moreover, it is valuable to see that even though research and development in theory should operate holistically to allow products to connect to business needs (and therefore should share similar perspectives), a separation between research and development can still create sub cultures within the R&D process.

## 5.2 Managerial implications

As markets become more demanding in terms of technological and product development, organizations increasingly separate research from development in order to create a stronger focus and control over each process, potentially increasing its effectiveness. The case study shows that in order

to achieve and maintain this performance, organizations should ensure that the R&D process is approached holistically, and therefore that the efforts of both research and development contribute towards reaching the business goals set for the development of new products (Kester et al., 2014). Without alignment between research and development, processes, activities and decisions may be misdirected and harm the performance of either research and development, consequently harming the overall performance of R&D. Moreover, as either research and development do not perform, this can put pressure on internal demands and resources. Organizations should therefore aim to create shared goals between research and development which contribute to business needs, and consequently facilitate that the internal processes are transparent and can effectively be executed. Even though research and development are more distinctly separated, organizations should ensure that the flow of knowledge and projects is maintained.

### 5.2.1. Management implications for case company

The case study shows that for the case company, the current transfer of projects from research to development is perceived to be ineffective, as concepts from research often do not fit product projects, lack robustness, are too risky, or simply lack acceptance which causes these concepts to not be adopted in development. Respondents indicated that a lack of an effective link between research and development can be seen as the main cause, creating two worlds of processes which however both should contribute to the development of products which connect to business needs. It was strongly noted that research projects which were successful often received support and resources through participation of development, moreover facilitating the creation of alignment. However, as the strategic plans were not linked, participation or integration was not structured by the organization, capabilities seemed inadequate and cultural influences were present, participation was often lacking, whereas concepts from research did not meet the (high) standards of development. It is therefore important for the case company that the need for technology is created within the organization to motivate participation, or that participation is structured in the organization to allow research projects to have a stronger chance of succeeding, and to ensure that new products can connect to business needs.

As described before, two benchmark studies have been executed at companies which similarly apply a separation between research and development. The companies however differed in terms of need for technology development, operating in markets either characterized by low or high technological change. The benchmarks have yielded several opportunities for improvement, which will briefly be described below.

#### 5.2.1.1. Application of a CTO

The benchmark company which operated in a market characterized by low technology change approached the need for both technology and product development and balance between them by ensuring that strategically both the need for technology and product developments were represented. The company achieved this through the application of a CTO on a similar hierarchical level as the CEO, making collaborative decisions on respectively technology and product developments for R&D. The CTO is responsible for monitoring technological change and trends in the market and has the experience and knowledge to make the right decisions on technology development. Consequently, if a certain technology emerges which is expected to be highly valuable, the CTO can through its authority ensure that this concept receives the resources and support it needs. The CTO therefore can *pull* the concept through the organization if necessary, and ensure that new products connect to business needs.

#### 5.2.1.2. Pre-development process

The benchmark company which operated in a market characterized by high technology change approached the need for a structured integration between research and development by applying a



pre-development process, which allows mature concepts from research to be developed further through a structured participation (in multi-functional project teams) of both research and development. Employees of both research and development therefore actively work together (and bring together specialized knowledge) in the pre-development process to ensure that the technology is robust, has reduced risks and can fit in new product projects. As employees from research and development moreover are brought together, knowledge can effectively be shared and transparency can be created. The concept of the pre-development process is shown in Figure 3.

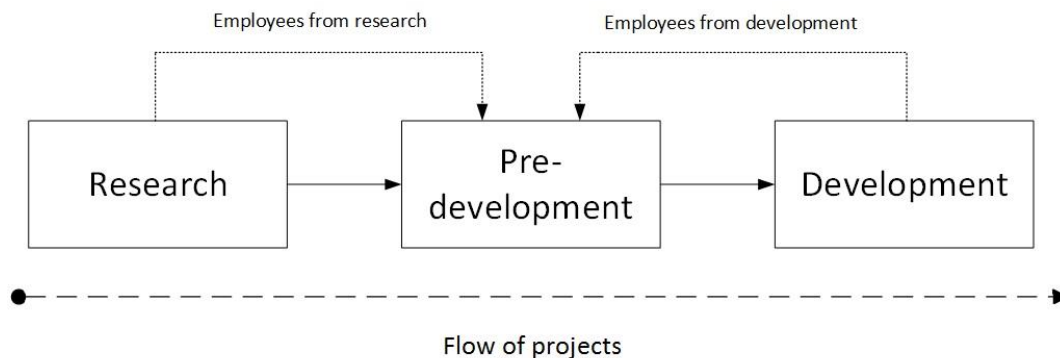


Figure 3: Concept of pre-development process

#### 5.2.1.3. Job rotation

A final finding from both benchmark companies, which has also received attention in scientific literature (Leenders & Wierenga, 2002; Liu, Keller, & Shih, 2011), is the concept of job rotation or team-member exchange in order to ensure that capabilities are adequately distributed over both research and development, which consequently allows projects to be transferred more effectively. By applying employees from research in development projects and vice-versa, the benchmarks aimed to ensure that a better understanding of both technology and product development was created for employees, whereas it provided the means for training in different settings of R&D. Moreover, exchange or rotation of jobs allowed employees to traverse organizational barriers and to function as a liaison, allowing knowledge-sharing to be more effective.

#### 5.2.1.3. Operational options

Respondents moreover indicated in interviews several operational options aimed at improving the current transfer of projects for the R&D process of the case company, which will be described shortly:

- **Clear transparent deliverables** for research projects in order to ensure that when a research concept reaches these deliverables, it has a high chance of being adopted. Consequently, development can more accurately provide feedback and support for research projects.
- Research projects in the final phases of the project **should more easily be able to obtain the resources** needed to decrease risks, either by dedicating more resources in these phases or freeing up resources elsewhere.
- **The contents of a product project should be selected more earlier**, in order to create more transparency and awareness for projects in research. Consequently, the value of a certain concept may become more clear, motivating participation of development.

Based on the fact that cultural influences are strongly present for the case company, it is more difficult to motivate acceptance and participation of development. Therefore, it is important that the need for technology is more structured and required throughout the organization. Therefore, the recommendations for the case company is to apply the CTO, to ensure that technology development is strategically pulled, and to apply the pre-development process to structure development participation.

## 6. Conclusion, limitations and future research

This chapter will conclude this research, by reviewing whether an adequate answer has been provided for the research question and whether the goals of this research have been reached. Furthermore, this chapter will express the limitations associated with the current research approach and design. Lastly, based on the conclusions of this research, indications for future research will be presented.

### 6.1. Review of this research

An increasing trend for organizations has emerged to separate research from development, in order to gain more control and focus over each individual process, allowing research for instance to engage more effectively with its environment in order to grasp the benefits of open innovation, whereas development can be managed more precisely as uncertainty and risk within the development process can be decreased. As research serves as a valuable input for development, the separation of both processes requires an effective alignment and link between them, in order to actually benefit from separation advantages and to ensure that the performance of R&D is maintained. However, the creation of alignment within a department, specifically between research and development seemed unaddressed in scientific literature. To gain insights in the creation of alignment between research and development, the following research question has been presented:

**‘How can alignment be created between *research and development*, in order to establish effective and efficient knowledge transfer between *research and development*?’**

‘The results of this research show that in order to create alignment, organizations should ensure that a holistic process is created for R&D, establishing alignment between research and alignment through linking the strategic plans, which drive the strategic goals of research and development, adequately providing both structural and personnel capabilities to research and development, and ensuring through practices of integration that the organizational distance is bridged and transparency, acceptance and commitment can be facilitated. These efforts should allow research and development to match processes and activities across units, consequently allow research and development to effectively share knowledge and projects between units, which should allow newly developed products to connect to business needs. Organizations should however mitigate potential cultural differences between research and development, which may hinder acceptance.’

The results of this research have been obtained by performing a desk and field research, and consequently matching these results in order to present clear implications. The desk research served to find the main determinants or prerequisites, supported in literature to create alignment between organizational units. These consequently have been translated to mechanisms which can be applied to the context of research and development, yielding propositions for validation in a practical setting. The propositions consequently have been tested in the field research applied at a company which applied a similar separation between research and development, yielding the results expressed above.

#### 6.1.1. Review of research goals

At the start of this research, the research goals were to provide valuable insights to current literature on the creation of alignment, specifically the creation of alignment within departments, whereas to provide empirical support for the need for alignment between research and development in order to facilitate project transfer. Moreover, practical implications for organizations should be presented, as well as specific recommendations for the case company central for the field research. This research emphasizes, as opposed to current literature, that alignment should also be present between units within a department in order to generate performance, especially when units within departments become more separated. Without alignment, performance may be misdirected, leading to suboptimal

performance for the holistic department. Considering the propositions, this research provides support for existing literature, however indicates that the influence of culture should be taken into account for creating acceptance across units, potentially as a mediator or moderator variable (and therefore important for creating alignment).

Lastly, this research presents organizations with the implications that even though research and development are separated, the process should be approached holistically, ensuring that efforts from research and development contribute to business needs. Without an effective link between research and development, the flow of knowledge and projects within R&D is disconnected, potentially leading to misdirected efforts. Organizations should therefore ensure that the separation of research and development is matched by the establishment of an effective link and alignment between research and development, whereas this research has provided several tools and mechanisms to facilitate this link.

## 6.2 Limitations

The findings of this research have been based on only one case study. It is therefore difficult to generalize results as organizations can strongly differ in terms of structure, culture and processes. Furthermore, a different market environment may yield different results. Whereas a single-case study can provide insights for scientific development, the research should be reserved when drawing conclusions. This also applies for the implicit relationships presented in the theoretical model.

Moreover, as qualitative interviews have been used, subjectivity and a lack of clear conceptualization may be issues for interpreting the results. Although conclusions have been drawn on the basis of multiple interviews by applying triangulation, thus creating more generalized results, respondents may have expressed factors or causes unclearly or vague, which leaves room for interpretation for the researcher. As the research is conducted by only one researcher, others might have different interpretations for quotes or interview elements which have currently been used. This research however aimed to mitigate for these interpretation errors by checking whether responses, which seemed invalid, were correctly interpreted (by briefly and informally posing these quotes once more).

The selection of important stakeholders for interviews aimed to include both stakeholders from research and development, preferably on different organizational levels, but for the remainder was based on the availability and commitment of stakeholders to participate. Therefore, even though the desired spectrum of stakeholders was largely obtained (from various areas within R&D) the selection occurred relatively arbitrary. No choices were made on participation of gender, age and tenure (although employees tended to work longer than five years at the organization).

## 6.3 Future research

As this research is approached as a single-case study, it is valuable to gain more empirical insights to strengthen the current findings. Future research can therefore examine the establishment of alignment between research and development in different industries, or apply multiple case studies to generalize the findings. Moreover, future research can focus on clearly conceptualizing which determinants influence the establishment of alignment within departments. Lastly, as this research found that the culture in development influenced the relationship between practices of integration and creating acceptance and commitment between departments, future research can focus on how culture may influence this relationship, potentially as a mediator or moderator variable.

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## 8. Appendix I

### Methodology for literature review

To obtain answers to the research question expressed previously, a literature review has been performed concerning the creation of alignment and its link towards R&D. The search for scientific literature has been structured by applying the search engine Web of Science and by searching for either *determinants or antecedents of strategic alignment, capabilities, goals, portfolio management, roadmapping, knowledge sharing, cooperation*, preferably in a R&D environment. However, (the creation of) strategic alignment has received significant attention from an IT perspective, but also from a human resource perspective, which may present interesting results for creating strategic alignment in a R&D environment. Therefore, findings from an IT domain as well as an HR domain have also been reviewed.

Table 4 below shows the results for specific combinations of search queries in Web of Science. Firstly, only those articles that focus on (creating) alignment within organizations were considered (as opposed to medical alignment). Therefore, articles should be related to creating alignment within organizations (preferably related to R&D). Furthermore, articles should be published after 2000 to yield more up-to-date results.

Secondly, if a high number of search results was obtained, a focus was put on either publication date or number of citations. For sorting results on publication date, emphasis has been placed on selecting articles which have been published in relevant journals to the problem area (i.e. Journal of Product Innovation Management, International Journal of Project Management, R&D Management). This search method was often applied to find empirical articles with up-to-date data. This requirement however was eased (though still preferred) for sorting results on citations (however often yielded similar results). This search method was often applied to find general consensus in literature on antecedents of alignment.

Lastly, if a small number of search results was obtained (<50), these results allowed to be reviewed more manually. Still, a preference was placed on articles which either have been published more recently or have received significant citations in scientific literature. The selected articles are shown in Table 4 as well.

Table 4: Literature review results

Search Queries	#	Selected articles
Strategic alignment + antecedents	81	(Alagaraja & Shuck, 2015); (Kaiser, El Arbi, & Ahlemann, 2014); (Kester, Hultink, & Griffin, 2014); (Preston & Karahanna, 2009); (Chan & Reich, 2007); (Cohen, Keller, & Streeter, 1979)
Strategic alignment + NPD	10	(Acur, Kandemir, & Boer, 2012)
Strategic alignment + meta-analysis	9	(Cao, Baker, & Hoffman, 2012); (Dibrell, Fairclough, & Davis, 2014)
Strategic alignment + literature review	200	(Chan & Reich, 2007); (Kathuria, Joshi, & Porth, 2007)
Strategic alignment + goals	336	(Hanson, Melnyk, & Calantone, 2011); (Kaplan & Norton, 2006); (Ayers, 2015)
Strategic alignment + portfolio management	142	(Cooper & Kleinschmidt, 2007); (Kaplan & Norton, 2006); (Kester, Hultink, & Griffin, 2014)
Strategic alignment + roadmapping	12	(Loyarte et al., 2014); (Phaal, Farrukh, & Probert, 2004) (Oliveira & Rozenfeld, 2010)
Strategic alignment + capabilities	306	(Maheshwari, Kumar, & Kumar, 2012); (Chan & Reich, 2007); (Hung, Yang, Lien, McLean, & Kuo, 2010)
Cooperation + antecedents + R&D + knowledge sharing	30	(Stock, Totzauer, & Zacharias, 2014); (Leenders & Wierenga, 2002); (Lin, Wang, & Kung, 2015); (Ernst, Hoyer, & Rübсаamen, 2010); (Ehrhardt, Miller, & Freeman, 2014); (Liu, Keller, & Shih, 2011)

## 9. Appendix II

### Case study – interview questions

1. What is your current function at the organization and how does this relate to research or development?
2. What do you think of the performance of the current process in terms of project transfer?
3. What causes technology projects to not be adopted?

### Shared goals – alignment of strategic plans

4. What do you think is the organizational goal for either research or development? How are these goals related?
5. Do you think that research is strategically linked to development?
6. How and why are new projects started? What drives these activities?
7. How are technology and product activities related and managed?
8. What strategic plans are used? How are these strategic plans related?

### Acceptance – shared knowledge and integration

9. Do you understand the value of projects and activities in research or development?
10. How is communication between research and development structured? Is the process transparent?
11. Does the organization work with integrated / multi-functional teams? How is this structured?
12. Are activities connected or integrated? How is this achieved?
13. How is acceptance created for research project? Is feedback or steering given?

### Capabilities – Adequate capabilities and resources

14. How is management support structured? Is management highly involved?
15. How is knowledge transferred? Do employees transfer as well?
16. How are technology concepts effectively incorporated in projects (in terms of skills and knowledge)?
17. What can you say about the resource distribution to projects in late stages of maturity?

### Conclusion

What additional factors do you think are important, which have not yet been addressed?