THE EFFECTS OF CROSS-FUNCTIONAL INTEGRATION MECHANISMS AND CUSTOMER CHARACTERISTICS ON THE OUTCOMES OF NEW PRODUCT DEVELOPMENT PROJECTS

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CERTIFICATE OF ORIGINAL AUTHORSHIP

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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ABSTRACT

Over the past numbers of years, the important role of new product development (NPD) has been acknowledged by both academics and practitioners. NPD is not only a crucial means for the survival and renewal of organizations, but also a valuable source of competitive advantage and prosperity of firms. New products have been found to account for up to 50% of sales and 50% of profits of firms. Firms, however, have to confront the high failure rates of new products, which range from 40% to 50%. The importance of NPD, coupled with the poor performance of new products, motivates us to look for the drivers of new product success.

The literature suggests that cross-functional integration mechanisms and customer involvement in NPD projects are crucial for new product success. Nonetheless, there is lack of research on the direct impact of cross-functional integration mechanisms and customer characteristics on NPD performance. Therefore, we aim to identify which cross-functional integration mechanisms and which customer characteristics directly affect NPD outcomes.

To this end, based upon the information processing perspective and resource dependence theory, we proposed a conceptual model and developed hypotheses of the relationships between cross-functional integration mechanisms, customer characteristics, and NPD outcomes. Data was collected from marketing managers, sales managers, product managers, brand managers, and the like who have been working in Australian firms and have been involved in NPD projects. The hypotheses were tested by employing variance-based structural equation modeling (PLS-SEM).

We find that five mechanisms, namely co-location, superordinate goals, the use of information and communication technology, cross-functional training, and joint reward systems have a positive impact on NPD outcomes (i.e. NPD speed, new product advantage, and new product success), whilst three other mechanisms, namely job rotation, the use of cross-functional teams, and informal coordination do not. Concerning the customer side, customers with product expertise, customers with lead user characteristics, and financially attractive customers can help firms enhance NPD speed, new product advantage, and new product success. Nevertheless, innovative customers and customers with price expertise have no influence on these three NPD outcomes.

Our study adds to the limited research on the direct effects of cross-functional integration mechanisms and customer characteristics on NPD outcomes, and provides a more comprehensive picture of the factors driving NPD performance than existing studies in the research stream. Our findings also enable firms to select the effective integration mechanisms as well as the right customers for NPD projects, thereby maximizing the success of new products.

CHAPTER 1 INTRODUCTION

1.1 Background to the research

1.1.1 The importance of new product development (NPD)

Over the past numbers of years, both academics and practitioners have acknowledged the important role of new product development (NPD). It is a crucial means for the survival and renewal of organizations because it permits organizations to diversify, modify, and reinvent themselves to correspond with rapid changes in the market and technology (Brown & Eisenhardt 1995; Cooper 2013; Cormican & O'Sullivan 2004). NPD is also considered as a valuable source of competitive advantage and prosperity of firms (Brown & Eisenhardt 1995; Cooper 2013).

Pessemier & Root (1973) reported that new products could account for up to 50% of company sales across a wide range of industries. The study of American Productivity & Quality Center (APQC) and Product Development Institute (PDI) revealed that new products introduced during the period 2008-2010 accounted for 27.3% of annual sales and 25.2% of profits (Cooper & Edgett 2012). But the results from top 25% performers in this research were more imposing: 36.3% of annual sales and 30.5% of profits come from new products (Cooper & Edgett 2012). The Comparative Performance Assessment Study (CPAS) conducted by the Product Development & Management Association (PDMA) also illustrated that the percentages of sales and profits from new products launched in the period 2007-2011 were 31.1% and 30.8% respectively (Markham & Lee 2013). With regard to the top-performing 25% of firms, new products accounted for 47.9% of sales and 48.5% of profits (Markham & Lee 2013). The figures from these

two recent studies highlight that new products are playing an increasingly significant role in the future growth of firms.

New products can help firms enhance ‘sales, profits and competitive strength’ (Sivadas & Dwyer 2000, p. 31), and a new product that is successful will do ‘more good for a firm than anything else’ (Crawford & Di-Benedetto 2015, p. 6). This is the reason why nearly 20 billion dollars were spent yearly on new product research and development 40 years ago (Pessemier & Root 1973). Nowadays, more than 100 billion dollars are spent annually on just the technical development stage, and incalculable numbers of new products are introduced into the marketplace every year (Crawford & Di-Benedetto 2015).

1.1.2 The high failure rates of new products

Given that new products are important and many firms heavily invest in NPD, the high failure rates of new products are still a challenge that firms have to confront. Approximately 50% of new products developed every year fail (Sivadas & Dwyer 2000). Barczak, Griffin & Kahn (2009) found that the success rates of new products in 1990, 1995, and 2004 were 58%, 59%, and 59% respectively. This finding implies the new product failure rate in the 1990-2004 period is about 40%. The aforementioned study of APQC and PDI documented that about 50% of new product projects attained their financial objectives regarding profitability, sales volume, and market share (Cooper & Edgett 2012). This also means that 50% of these projects do fail to achieve their goals. Crawford & Di-Benedetto (2015) state that the new product failure rate is not 90% as we usually hear, but is around 40%. We can see that the failure rates of new products, which range from 40% to 50%, are still alarmingly high (Hoffman, Kopalle & Novak 2010). This leads to the need to diminish NPD failure rates. Nonetheless, it

should also be noted that firms do not need to reduce these failure rates to zero because of two reasons. First, the success of new products at a 100% rate is an ideal and impossible in nature. The empirical evidence from the contemporary CPAS study mentioned above disclosed that the highest success rate of the top 25 % performers just reached 82.2 % (Markham & Lee 2013). Second, a very low failure rate implies that 'the firm is playing it too safe with close-to-home innovations, while missing out on the (risky) breakthroughs' (Crawford & Di-Benedetto 2015, p. 7).

It is clear that the importance of NPD, coupled with the poor performance of new products, leads to the call for the research stream of looking for the drivers of new product success (Cooper 2013). In line with this, the present study will examine factors that affect the outcomes of NPD projects.

1.1.3 The primary focus of the research

According to Brown & Eisenhardt (1995), an NPD project can be seen as a multiplayer game in which the actions of every player will impact on new product performance. These players are the NPD project team, project leaders, senior management within the firms, and external participants including suppliers and customers. Practitioners believe integration among different functional areas within their firms is vital, and academics also provide evidence that internal integration can lead to success (Griffin & Hauser 1996). However, to be successful, firms cannot go it alone any more due to the turbulent competitive market and the rapid changes in technology (Hillebrand & Biemans 2003; Tether 2002). They need to cooperate with external partners, and Tether (2002) suggested two reasons for that. The first explanation is that firms do not have enough essential internal resources for innovation (e.g., finance, technology, knowledge). The second explanation Tether offers is that firms wish to diminish the risks associated with

innovation (e.g., technological spillovers, customers' ignorance of innovation). Accordingly, our research will focus on both internal factors of firms and their external partners that potentially affect NPD outcomes.

With respect to internal factors, we will concentrate on cross-functional integration during the NPD process. The first rationale behind this is that cross-functional integration will help the discussions and controversies of NPD team members to be conducted constructively, thereby reducing misunderstanding and enhancing cooperative work atmosphere among team members (Atuahene-Gima 2003; Hoegl, Weinkauf & Gemuenden 2004). Second, cross-functional integration permits the combination of expertise and resources of different functional areas (i.e., specialist departments) such as Marketing, Sales, and R&D, thereby enriching the knowledge base for firms. Team members can tap into these diverse information and resources to cope with their problems during the NPD process (Atuahene-Gima 2003; Keller 2001). This can speed up problem solving and reduce the time to market for new products. Third, cross-functional integration allows the overlap of various NPD stages, which also increases the speed of NPD (Imai, Ikujiro & Takeuchi 1985, cited in Brown & Eisenhardt 1995, p. 362). Finally, cross-functional integration has been well documented as critical success factor of NPD projects (Ernst 2002; Evanschitzky et al. 2012; Olson, Walker & Ruekert 1995; Pattikawa, Verwaal & Commandeur 2006; Troy, Hirunyawipada & Paswan 2008).

Regarding the external partners, we will focus on customer involvement during NPD projects for several reasons. First, the significant role of internal players (i.e., project team, project leaders, and senior management) in the NPD process have been well documented in the literature. The involvement of customers in this process, however, is

still not clear (Brown & Eisenhardt 1995), and no one can 'definitively determine the advantages of customer integration into product development' (Ernst 2002, p. 31). Thus, a greater concentration on customers enhances our understanding of the relevance of customers to the NPD process. Second, listening to the voice of customers can help producers get closer to their customers' needs. As a result, producers can diminish the risks of new product failure and enhance the financial performance of new products with respect to profitability, sales volume and market share (Hoffmann 2012). Finally, in comparison with other relationships that firms have such as the relationships with suppliers, distributors, retailers, and so forth, their relationship with customers is the most important factor to generate profit (Gupta, Lehmann & Stuart 2004; Srivastava, Shervani & Fahey 1998). Hence, a close relationship with customers may lead to the better financial performance of new products.

As discussed earlier, introducing new products into the market is indispensable to the profitability and growth of firms (Booz, Allen & Hamilton 1982; Markham & Lee 2013), yet the new product failure rates are still high. We also discussed the benefits of cross-functional integration and customer involvement to NPD projects. As stressed by Crawford & Di-Benedetto (2015, p. 20), 'product development is truly multifunctional, where all functions (and, increasingly, the customer as well), work together on a cross-functional team to accomplish the required tasks'. Therefore, the primary focus of this study is the factors related to cross-functional integration and customer integration that potentially impact on NPD outcomes. The next section presents the specific research problems and objectives of our research.

1.2 Research problems and objectives

Research on cross-functional integration has mainly focused on the relationship between achieved cross-functional integration and new product performance (e.g., Ayers, Dahlstrom & Skinner 1997; Gupta, Raj & Wilemon 1986; Hempelmann & Engelen 2015; Lamore, Berkowitz & Farrington 2013; Leenders & Wierenga 2008; Parry et al. 2010; Swink & Song 2007; Troy, Hirunyawipada & Paswan 2008), whereas little research has been done to investigate the influences of cross-functional integration mechanisms on NPD performance (e.g., Leenders & Wierenga 2002; Moenaert et al. 1994).

There are also some shortcomings in these studies. For example, Kahn & McDonough (1997a) tested the effects of only one mechanism, namely co-location, and therefore could not enrich and expand our understanding of the integration mechanisms. Given that NPD performance is a 'multi-dimensional concept', and 'multiple performance measures are better than a single measure' (Cooper & Kleinschmidt 1995a, p. 389), the studies of Moenaert et al. (1994) and Leenders & Wierenga (2002), which examined the impact of various integrating mechanisms on only one NPD outcome, provided an incomplete view of NPD performance. We should also be cautious about the results of He, Sun & Chen (2016) because the authors did not seem to measure some of their variables in an appropriate manner. For example, they used co-location and liaison roles to measure job rotation, but co-location and liaison roles are two cross-functional integration mechanisms that are very different from job rotation in both theory and practice.

Therefore, to address the lack of research on the impact of cross-functional integration mechanisms on NPD performance and the above-mentioned issues, the first objective of our study is to answer the following question:

Research question 1: Which cross-functional integration mechanisms affect the outcomes of NPD projects?

With respect to research on customer integration into NPD, numerous studies emphasize the relationship between achieved customer integration and new product performance (e.g., Bonner 2010; Campbell & Cooper 1999; Chang & Taylor 2016; Cui & Wu 2017; Fang 2008; Maidique & Zirger 1984; Menguc, Auh & Yannopoulos 2014). Even though 'the prospect of success and, eventually, the reduction of market risks depend on the identification of the right customer' (Enkel, Perez-Freije & Gassmann 2005, p. 433), empirical studies focusing on which kinds of customers are suitable for integration purpose are relatively rare (Hoffman, Kopalle & Novak 2010; Laage-Hellman, Linda & Perna 2014). To date, we are aware of only two published studies of Gruner & Homburg (2000) and Carbonell, Rodriguez-Escudero & Pujari (2012), which examined the effects of customer characteristics on NPD outcomes.

There are also some drawbacks in these two studies. For instance, Carbonell, Rodriguez-Escudero & Pujari (2012) proposed only two types of customers, namely "lead users" and "close customers" in their research. This limited our understanding of customer characteristics in the NPD process. Also, Gruner & Homburg (2000) treated new product performance as a uni-dimensional construct, and therefore could not provide a comprehensive view of NPD performance.

Accordingly, to address the shortage of research on the effects of customer characteristics on NPD projects and the aforementioned problems, we aim to answer the second research question:

Research question 2: Which customer characteristics affect the outcomes of NPD projects?

1.3 Research contributions

The present study makes several contributions to NPD literature and business practice, which are presented as follows.

1.3.1 Theoretical contributions

First, two theoretical frameworks, namely the information processing perspective (e.g., Galbraith 1973, 1977; Tushman & Nadler 1978) and resource dependence theory (e.g., Pfeffer 1982; Pfeffer & Salancik 1978), are used to underpin our study. Our findings demonstrate the salience and complementarity of these two theories. This also reflects the notion that research on a complex social system, such as the NPD process, should be guided by multiple theoretical lenses (e.g., Coviello & Joseph 2012; Kyriazis et al. 2017).

Second, derived from two theories mentioned above, this study proposes numerous relationships between cross-functional integration mechanisms, customer characteristics, and NPD outcomes, and then empirically tests these relationships. Therefore, our study adds to the limited research on the effects of cross-functional integration mechanisms and customer characteristics on NPD performance.

Third, by examining the influence of eight cross-functional integration mechanisms and five customer characteristics on three different outcomes of NPD projects, our research provides a more comprehensive picture of the factors driving NPD performance than existing studies in the research stream.

Fourth, by simultaneously testing the effects of various integration mechanisms on NPD outcomes, this current research advances our knowledge of the relative effectiveness of commonly used cross-functional integration mechanisms.

Finally, by investigating the impact of different kinds of customer characteristics on NPD performance, our study responds to the call for research on which kinds of customers provide the most useful information for innovation process (Griffin et al. 2013), and therefore addresses this gap in the literature.

1.3.2 Managerial contributions

The research aims to understand whether both cross-functional integration mechanisms and customer characteristics have significant and positive effects on NPD performance. If they do, this is managerially important because managers can put time and effort into both of these areas to maximize the likelihood that new products will be successful.

Understanding the relative effectiveness of integration mechanisms enables firms to choose the most effective ones rather than trying to implement as many mechanisms as they can. This not only reduces the cost of applying these mechanisms but also decreases conflict in the workplace, enhances the cooperation as well as knowledge sharing across functional areas, thereby improving the performance of NPD projects.

Understanding the effects of different types of customers on NPD performance allows firms to select the right customers to involve in NPD projects. Involving the right

customers is managerially important because it can help firms save their resources to get valuable information from customers. This can increase NPD speed and reduce the costs of NPD. The new products also meet the real needs of customers. As a consequence, firms can achieve a higher success rate of their new products.

1.4 Methodology

The methodology adopted in this research is based on a deductive approach. Based on the information processing perspective, resource dependence theory, and the literature related to NPD and innovation, we propose a conceptual model that depicts a relational picture of cross-functional integration mechanisms, customer characteristics, and NPD outcomes. Based upon this model and theoretical arguments, the hypotheses of the relationships among these constructs are developed. Data are collected from marketing and/or sales managers, product managers, brand managers, and the like who are working in Australian firms and have been involved in NPD projects. The hypotheses are empirically tested by employing variance-based structural equation modeling (PLS-SEM) and using SmartPLS 3 software (Ringle, Wende & Becker 2015).

1.5 Definitions of key terms

For clarification, the key term definitions adopted in this study are presented as follows.

New products refer to 'all new offerings that a firm develops, whether they are new products, new technologies the firm can license out, or new services' (Yli-Renko & Janakiraman 2008, p. 132).

New product development (NPD) refers to 'the overall process of strategy, organization, concept generation, product and marketing plan creation and evaluation, and commercialization of a new product' (Kahn et al. 2013, p. 458).

New product development process (NPD process) refers to 'a disciplined and defined set of tasks and steps that describe the normal means by which a company repetitively converts embryonic ideas into salable products or services' (Kahn et al. 2013, p. 458).

Integration refers to the degree to which 'separate parties work together in a cooperative manner to arrive at mutually acceptable outcomes' (O'Leary-Kelly & Flores 2002, p. 226).

Cross-functional integration refers to 'the magnitude of interaction and communication, the level of information sharing, the degree of coordination, and the extent of joint involvement across functions', i.e. departments involved in NPD (Song & Montoya-Weiss 2001, p. 65).

Cross-functional integration mechanisms refer to the methods or practices that firms employ to achieve the expected levels of cross-functional integration between departments involved in NPD projects.

Customers refer to 'the next channel members in the value chain - that is, the parties to which the firm sells to generate revenues. Customers may or may not be the end users of the product' (Yli-Renko & Janakiraman 2008, p. 132).

Customer integration refers to the extent to which customers are involved in the NPD process of firms. It should be noted that the concept of customer integration is used synonymously to that of ***customer involvement*** in a considerable number of studies (Zogaj & Bretschneider 2012). Therefore, these two terms are used interchangeably in our research.

1.6 Research scope

1.6.1 Industries to be researched

In a few studies on the effects of cross-functional integration mechanisms and customer characteristics on NPD performance, the authors collected data from only one industry to improve the internal validity of their research (e.g., Gruner & Homburg 2000; Leenders & Wierenga 2002). The generalizability of their results, however, suffers for it. Therefore, to generalize the findings, we collected data from firms in various industries in Australia, e.g., Machinery and Equipment Manufacturing, Food Product Manufacturing, Chemical Manufacturing, Telecommunications Services, Medical and Health Care Services, etc.

1.6.2 Unit of analysis

The unit of analysis of our research is the NPD project. The first rationale behind this choice is that a considerable number of NPD studies are conducted at the project level (Chen, Damanpour & Reilly 2010; Ernst 2002). This implies the research at the project level may have more benefits than those at the program or organization level. Second, one of the NPD outcomes in our research is NPD speed to which 'the project level of analysis is most directly relevant' (Kessler & Chakrabarti 1996, p. 1149). Finally, the project level of analysis 'enables the study to capture unique situational attributes which influence the processes and outcomes of actual projects' (Kessler, Bierly & Gopalakrishnan 2000, p. 217).

1.7 Outline of the thesis

This thesis consists of six chapters. ***Chapter 1***, introduces background to the research, and provides an overview of the research problems and objectives. It then briefly

describes the contributions, methodology, and scope of the study. The key terms used throughout this study are also defined in this chapter.

Chapter 2 reviews the NPD literature to identify research gaps in the field. Firstly, it reviews the factors driving NPD success. Second, it explains why we investigate the effects of cross-functional integration mechanisms and customer characteristics on NPD performance. Next, it focuses on research on cross-functional mechanisms, and characteristics of customers who are engaged in the NPD process to highlight the relevance of these factors to our study. Finally, it provides an overview of the multi-dimensional typology of NPD performance.

Chapter 3 provides the theoretical background for our research including the information processing perspective and resource dependence theory. Based upon this theoretical background, we propose a conceptual framework and develop hypotheses for the relationships between different cross-functional integration mechanisms, customer characteristics, and the outcomes of NPD process.

Chapter 4 describes the research philosophy, research approach, research strategy, and the design of our research. It also presents the data collection and data analysis procedure of the study.

Chapter 5 presents the data analysis results. Firstly, it displays the results of data examination. Next, the descriptive findings are presented. After that, it reveals the results of the measurement model and structural model assessment. Finally, the outcomes of importance-performance matrix analysis and common method bias tests are showed.

Chapter 6 concludes the thesis by discussing research results, suggesting the theoretical and practical implications of the research findings, acknowledging the limitations, and proposing directions for future research.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

As discussed in Chapter 1, our research aims at identifying the determinants of successful NPD. Accordingly, we firstly review the factors driving NPD success, and then explain why we investigate the effects of cross-functional integration mechanisms and customer characteristics on NPD projects in our study. Next, we focus on research on cross-functional integration mechanisms, and characteristics of customers who are engaged in the NPD process to highlight the pertinence of these factors to our study. Finally, an overview of the multi-dimensional nature of NPD performance is presented.

2.2 Success factors of NPD projects

As discussed in the previous chapter, NPD is vital for the survival and the growth of firms (Brown & Eisenhardt 1995). Therefore, academics and practitioners are interested in looking for factors that positively affect the success of NPD projects (Ernst 2002), and numerous success factors have been well documented in the literature. Based on the works of Montoya-Weiss & Calantone (1994), Henard & Szymanski (2001), Pattikawa, Verwaal & Commandeur (2006), and Evanschitzky et al. (2012), we synthesize the determinants of NPD success in the following table (see Table 2.1 below).

Table 2.1 Typical success factors of NPD projects

Marketplace characteristics	Organizational characteristics	Product characteristics	Strategy characteristics	Process characteristics
Market potential	Organizational culture/climate	Product advantage	Marketing synergy	Predevelopment task proficiency
Market competitiveness	Senior management support	Product meeting customer needs	Technological synergy	Marketing task proficiency
Environmental uncertainty	External relations	Product price	Company resources	Technological proficiency
	Project/organization size	Product technological sophistication	Strategic orientation	Launch proficiency
	Degree of centralization	Product innovativeness		Financial/business analysis
	Degree of formalization			NPD speed
				Customer input
				Cross-functional integration
				Cross-functional communication

(Sources: Montoya-Weiss & Calantone (1994), Henard & Szymanski (2001), Pattikawa, Verwaal & Commandeur (2006), and Evanschitzky et al. (2012))

From Table 2.1, we can see that success factors of new products are categorized under five headings, namely marketplace characteristics, organizational characteristics, product characteristics, strategy characteristics, and process characteristics. Each group of these determinants is briefly discussed as follows.

2.2.1 Marketplace characteristics

Marketplace characteristics mention elements that describe the target market (Henard & Szymanski 2001), and include market potential, market competitiveness, and environmental uncertainty. Market potential refers to 'market (and demand) size and growth, as well as an indication of customer need level for the product type' (Montoya-Weiss & Calantone 1994, p. 415). Market competitiveness reflects 'the intensity of competition in the marketplace in general and/or with respect to price, quality, service, or the sales force/distribution system' (Montoya-Weiss & Calantone 1994, p. 415).

Environmental uncertainty refers to the 'degree of uncertainty due to the general operating environment faced by the firm (e.g., regulatory environment, technology uncertainty)' (Evanschitzky et al. 2012, p. 37). Pattikawa, Verwaal & Commandeur (2006) found that market potential, market competitiveness, and environmental uncertainty were not important drivers of NPD success. Nevertheless, Evanschitzky et al. (2012) reported that these three marketplace characteristics had significant relationships with the success of new products. The evidence suggests that the predictor role of marketplace characteristics is still ambiguous and needs to be further examined.

2.2.2 Organizational characteristics

This category of success factors of NPD projects comprises organizational culture/climate, senior management support, external relations, organization size, centralization, and formalization. Organizational culture/climate is an organizational characteristic that refers to 'the extent to which the day-to-day decisions are governed with organization/group's shared values and norms' (Evanschitzky et al. 2012, p. 37). An organizational climate/culture supporting innovation is 'one of the strongest discriminators between best and worst performers' (Cooper 2013, p. 27). This argument is supported by the meta-analyses of Pattikawa, Verwaal & Commandeur (2006) and Evanschitzky et al. (2012) that organizational culture/climate had a strong and significant relationship with NPD performance.

In addition to organizational culture that supports product innovation, the support from top management, which is defined as 'top management's commitment to the project, as well as their day-to-day involvement, guidance/direction, and control over the project development' (Montoya-Weiss & Calantone 1994, p. 415), is critical for new product success (Barczak & Kahn 2012; Brown & Eisenhardt 1995; Cooper 2013; Ernst 2002;

Evanschitzky et al. 2012; Henard & Szymanski 2001; Pattikawa, Verwaal & Commandeur 2006). The underlying reasoning is that senior management's support makes available the essential resources for the NPD process (Brown & Eisenhardt 1995; Cooper 2013).

The coordination and cooperation between firms and other firms (i.e., external relations) is also a success factor in NPD, whereas two other organizational factors, namely organization size and centralization, have no impact on the performance of NPD projects (Evanschitzky et al. 2012; Pattikawa, Verwaal & Commandeur 2006). Organization size mentioned here refers to the number of employees of the firm (Pattikawa, Verwaal & Commandeur 2006), and centralization is defined as the degree of 'centralization or bureaucratization in the organization/project' (Evanschitzky et al. 2012, p. 37). Concerning formalization that refers to the degree to which 'explicit rules and procedures govern decision making in the organization/project' (Pattikawa, Verwaal & Commandeur 2006, p. 1183), Evanschitzky et al. (2012) detected a significant relationship between formalization and the success of new products, whereas Pattikawa, Verwaal & Commandeur (2006) did not. The inconsistency in the findings between these two meta-analytical studies suggests that the effects of formalization on NPD success should be investigated further.

2.2.3 Product characteristics

Product characteristics refer to elements associated with products or services, for example, price, and how well new products or services meet the needs of customers (Henard & Szymanski 2001). The characteristic that a new product can offer superior value and unique benefits to customers (i.e., new product advantage) is one of the most crucial determinants of new product success and profitability (Brown & Eisenhardt

1995; Cooper 2005a). Such products have 'five times the success rate, over four times the market share, and four times the profitability' of those with little advantage (Cooper 2013, pp. 5-6). Products satisfying the desires or needs of customers have also been found to be successful (Evanschitzky et al. 2012; Henard & Szymanski 2001). A new product with appropriate price (i.e., its price is congruent with its performance) also tends to be associated with increased success (Evanschitzky et al. 2012; Henard & Szymanski 2001).

In terms of product technological sophistication, high-tech products are more likely to be successful in comparison with low-tech products (Henard & Szymanski 2001). However, an updated meta-analysis of Evanschitzky et al. (2012) discloses that there is an insignificant relationship between product technological sophistication and new product success.

Regarding product innovativeness (i.e., the newness or radicalness of products), the meta-analyses of Henard & Szymanski (2001) and Pattikawa, Verwaal & Commandeur (2006) demonstrated that there was not the direct impact of product innovativeness on NPD performance. Nonetheless, Evanschitzky et al. (2012) challenged this finding by indicating that product innovativeness had a significant relationship with new product success.

In summary, among five product characteristics including product advantage, product meeting customer needs, product price, product technological sophistication, and product innovativeness, product advantage is the key success factor of new products. But the predictor role of product technological sophistication and product innovativeness in the success of NPD projects is still in question.

2.2.4 Strategy characteristics

Strategy characteristics refer to ‘a firm's planned actions that have the potential for providing it a competitive advantage in the marketplace separate from any factors associated with the new product development process’ (Henard & Szymanski 2001, p. 364). These strategic elements consist of marketing synergy, technological synergy, company resources, and strategic orientation. Marketing synergy means ‘the fit between the needs of the project and the firm’s resources and skills with respect to the sales force, distribution, advertising, promotion, market research, and customer service’ (Montoya-Weiss & Calantone 1994, p. 415). Technological synergy refers to ‘the fit between the needs of the project and the firm’s resources and skills with respect to R&D or product development, engineering, and production’ (Montoya-Weiss & Calantone 1994, p. 415). There is a consensus that NPD projects aligned with a firm’s marketing and technological resources and skills have a high tendency to succeed (Ledwith 2009). The meta-analyses of Pattikawa, Verwaal & Commandeur (2006) and Evanschitzky et al. (2012) supported this notion by indicating that marketing synergy and technological synergy had significant relationships with new product success.

In connection with the effects of company resources on NPD success, many projects that suffer from the lack of necessary resources fail (Cooper 2013). The resources that are found to be vital for NPD success include human resources, R&D resources, financial resources, and other company resources such as knowledge and patents (Cooper 2013; Evanschitzky et al. 2012; Henard & Szymanski 2001; Pattikawa, Verwaal & Commandeur 2006).

Concerning the impact of strategic orientation that refers to ‘strategic impetus, orientation, and focus of corporate strategy’ (Evanschitzky et al. 2012, p. 37) on the

performance of NPD projects, it has also been found to be a crucial component of NPD success (Evanschitzky et al. 2012). Pattikawa, Verwaal & Commandeur (2006) investigated the influence of strategic orientation at a more specific level by classifying it into four categories: market orientation, customer orientation, competitor orientation, and technology orientation. The authors defined these strategic orientations in the following way:

> ***Market orientation*** refers to the organization's wide generation of market intelligence pertaining to current and future customer needs, dissemination of the intelligence across departments, and organization-wide responsiveness to it. ***Customer orientation*** is the firm's understanding of its target buyers in order to be able to create superior value. A customer-oriented firm can be defined as a firm with the ability and the will to identify, analyse, understand, and answer user needs. ***Competitor orientation*** refers to the ability and the will to identify, analyse, and respond to competitors' actions. This includes the identification and construction of competitive advantages in terms of quality or specific functionalities and enables the firm to position the new product. ***Technology orientation*** refers to the capability and will to acquire a substantial technological background and use it in the development of new products. Technology orientation also means that the company can use its technical knowledge to build new technical solutions to answer and meet new needs of the users (p. 1181).

Pattikawa, Verwaal & Commandeur (2006) found that market orientation, competitor orientation, and technology orientation had positive and significant relationships with NPD performance, whereas customer orientation did not. This finding is surprising because as we mentioned earlier, new products that offer superior value to customers or even just satisfy their needs will be successful, and accordingly, the customer-oriented strategy can lead to the positive performance of NPD projects. This unexpected result suggests that the link between customer orientation and NPD performance needs to be further examined.

2.2.5 Process characteristics

Process characteristics captures elements related to the NPD process and its execution (Henard & Szymanski 2001). They encompass predevelopment task proficiency, marketing task proficiency, technological proficiency, launch proficiency, and financial/business analysis. They also consist of NPD speed, customer input, cross-functional integration, and cross-functional communication.

Predevelopment task proficiency means proficiency in 'initial screening, preliminary market and technical assessment, detailed market study and market research, and preliminary business/financial analysis' (Montoya-Weiss & Calantone 1994, p. 415). Predevelopment work or the "homework" is vital for new product success, and successful firms usually spend more time and money on these front-end activities than unsuccessful ones (Cooper 2013). Marketing proficiency refers to proficiency in 'marketing research, customer tests of prototypes or samples, test markets/trial selling, service, advertising, distribution, and market launch' (Montoya-Weiss & Calantone 1994, p. 415). Technological proficiency specifies proficiency in 'product development, in-house testing of the product or prototype, trial/pilot production, production start-up, and obtaining necessary technology' (Montoya-Weiss & Calantone 1994, p. 415). Launch proficiency means proficiency 'with which a firm launches the product/service' (Henard & Szymanski 2001, p. 364). Financial/business analysis refers to the proficiency of 'ongoing financial and business analysis during development, prior to commercialization and full-scale launch' (Montoya-Weiss & Calantone 1994, p. 416). The proficiency of firms in predevelopment work, marketing activities, technological tasks, launch activities, and financial and business analysis has been found to positively

affect NPD performance (Evanschitzky et al. 2012; Henard & Szymanski 2001; Pattikawa, Verwaal & Commandeur 2006).

Regarding the impact of NPD speed that indicates the speed of the NPD process (Montoya-Weiss & Calantone 1994; Pattikawa, Verwaal & Commandeur 2006) on new product success, the results are mixed. Whilst Henard & Szymanski (2001) and Evanschitzky et al. (2012) found that the shorter time to market of new products led to their success, Pattikawa, Verwaal & Commandeur (2006) did not. In a similar vein, there are mixed findings of the effects of customer input, cross-functional integration, and cross-functional communication on NPD performance. Customer input reflects the 'incorporation of customer specifications into new product initiative' (Henard & Szymanski 2001, p. 364). Cross-functional integration indicates the 'degree of multiple-department participation in a new product initiative', and cross-functional communication specifies the 'level of communication among departments in a new product initiative' (Henard & Szymanski 2001, p. 364). While Pattikawa, Verwaal & Commandeur (2006) and Evanschitzky et al. (2012) detected the positive and significant relationships between these three factors and new product success, Henard & Szymanski (2001) did not. Hence, the predictor role of NPD speed, customer input, cross-functional integration, and cross-functional communication in the success of new products needs to be further investigated.

2.3 Justification for examining the effects of cross-functional integration mechanisms and customer characteristics on NPD performance

As we have mentioned above, there are five typical groups of success factors of NPD projects, and in each group, the predictor role of some factors in new product success is still not clear. An analysis of all of such factors, however, is beyond the scope of this

current study. Instead, we primarily focus on cross-functional integration and customer integration for reasons we discussed in Chapter 1. A further explanation for focusing on customer integration is that many success factors reviewed above are related to customers. For example, market potential (belongs to the group of marketplace characteristics), product advantage, product meeting customer needs (belong to the group of product characteristics), market orientation, customer orientation (belong to the group of strategy characteristics), and customer input (belongs to the group of process characteristics). This suggests that customers play a vital role in NPD projects and involving them in such projects may help improve NPD performance. At a more specific level, our study concentrates on the effects of cross-functional integration mechanisms and customer characteristics on NPD outcomes for three main reasons.

First, cross-functional integration mechanisms and customer characteristics are relevant to the performance of NPD projects, even though they are not included in any group of success factors discussed previously. Some mechanisms used in NPD projects can enhance new product success, for example, evaluation and reward procedures (Song, Montoya-Weiss & Schmidt 1997), the use of information and communication technology (Leenders & Wierenga 2002), and job rotation (He, Sun & Chen 2016). About 60% of US firms were found to employ cross-functional integration mechanisms on their NPD projects (Griffin 1997). Some customer characteristics have also been found to be significantly related to NPD performance, for instance, customers with lead user characteristics (Carbonell, Rodriguez-Escudero & Pujari 2012; Gruner & Homburg 2000), customers who have a strong and close relationship with firms (Carbonell, Rodriguez-Escudero & Pujari 2012; Gruner & Homburg 2000), and financially attractive customers (Gruner & Homburg 2000).

Second, there is scant research on the influences of cross-functional integration mechanisms and customer characteristics on NPD performance. Research on cross-functional integration mainly focuses on the relationship between achieved cross-functional integration and new product success (see Table 2.2). In a meta-analysis of Troy, Hirunyawipada & Paswan (2008) that examined the influence of 12 potential moderators on the relationship between cross-functional integration and NPD success, the construct of cross-functional integration also referred to the achieved cross-functional integration. Cross-functional integration in the meta-analyses of Henard & Szymanski (2001), Pattikawa, Verwaal & Commandeur (2006), and Evanschitzky et al. (2012) again specified the achieved integration. On the contrary, there are a few studies that examined the impact of cross-functional integration mechanisms and new product performance (see Table 2.2). Similarly, the majority of studies on customer integration emphasized the effects of achieved customer integration on NPD performance (see Table 2.3). Nonetheless, the empirical studies that concentrated on the relationship between customer characteristics and NPD outcomes are relatively sparse (Hoffman, Kopalle & Novak 2010; Laage-Hellman, Linda & Perna 2014) (see Table 2.3).

Table 2.2 Empirical research on the relationship between cross-functional integration and NPD performance

Factor	Contributors	Comment
Achieved cross-functional integration	Gupta, Raj & Wilemon (1986); Ayers, Dahlstrom & Skinner (1997); Souder, Sherman & Davies-Cooper (1998); Li (1999); Ayers, Gordon & Schoenbachler (2001); Leenders & Wierenga (2002); García, Sanzo & Trespalacios (2008); Leenders & Wierenga (2008); Lamore, Berkowitz & Farrington (2013)	Integration between marketing and R&D has a positive and significant influence on NPD performance
	Swink & Song (2007); Song & Swink (2009); Kong et al. (2015)	Integration between marketing and manufacturing has a positive and significant influence on NPD performance
	Kahn (1996); Sherman, Souder & Jenssen (2000); Song & Xie (2000); Kahn (2001); Olson et al. (2001); Song & Montoya-Weiss (2001); Nakata et al. (2006); Chen (2007); Im & Nakata (2008); Ernst, Hoyer & Rübsaamen (2010); Nakata & Im (2010); Parry et al. (2010); Brettel et al. (2011); Engelen, Brettel & Wiest (2012); Hempelmann & Engelen (2015)	Integration among various functional areas (especially marketing, R&D, and manufacturing) has a positive and significant influence on NPD performance
Cross-functional integration mechanisms	Moenaert et al. (1994)	Project formalization and inter-functional climate significantly relate to product innovation success, whereas project centralization and role flexibility do not.
	Kahn & McDonough (1997a)	Co-location has no effect on product development (pre-launch activities) performance and product management (launch and post-launch activities) performance.
	Leenders & Wierenga (2002)	Five mechanisms, namely relocation and physical facilities design, personnel movement, informal social systems, cross-functional team use, incentives and rewards have no effect on NPD performance. The use of information and communication technology has a positive impact on new product performance, whereas cross-functional phase review board has negative effect on it.
	He, Sun & Chen (2016)	Technical support has a positive impact on the speed in the later stages of NPD projects. Process standardisation positively affects new product quality. Job rotation has positive influences on both the speed in the later stages of NPD projects and the quality of new product.

Table 2.3 Empirical research on the relationship between customer integration and NPD performance

Factor	Contributors	Comment
Achieved customer integration	Maidique & Zirger (1984); Cooper & Kleinschmidt (1994); Cooper & Kleinschmidt (1995a); Salomo, Steinhoff & Trommsdorff (2003); Carbonell, Rodríguez-Escudero & Pujari (2009); Bonner (2010); Lin & Huang (2013); Menguc, Auh & Yannopoulos (2014); Cui & Wu (2016); Cui & Wu (2017)	Customer integration improves the performance of NPD projects.
	Campbell & Cooper (1999); Fang (2008)	Customer involvement does not enhance NPD performance.
	Gruner & Homburg (2000); Chang & Taylor (2016)	Customer integration during the initial phases (i.e., idea generation, product concept development) and later phases (i.e., prototype testing, market launch) improves new product success, while the involvement of customers during the middle stages (i.e., engineering, development) does not.
Customer characteristics	Gruner & Homburg (2000)	Lead users, close customers, and financially attractive customers positively affect NPD success, whereas technically attractive customers do not.
	Carbonell, Rodriguez-Escudero & Pujari (2012)	Lead users positively affect service newness and service advantage, while they have no impact on speed to market. Close customers positively influence new service advantage and speed to market, but they have no effect on service newness.

Finally, there are some drawbacks in the limited research on the impact of cross-functional integration mechanisms and customer characteristics on NPD performance. Regarding four studies on the influence of cross-functional integration mechanisms on NPD projects (see Table 2.2), Kahn & McDonough (1997a) examined only one mechanism, namely co-location, and therefore could not enrich and expand our understanding of the integration mechanisms. Leenders & Wierenga (2002) provided a comprehensive review of integrating mechanisms. However, when they examined the relationship between integrating mechanisms and new product performance, they

treated new product performance as a uni-dimensional construct and measured overall performance. Consequently, their results offered an incomplete view of NPD performance because new product performance is a multi-dimensional concept (Astebro & Michela 2005; Awwad & Akroush 2016; Cooper & Kleinschmidt 1987, 1995a, 1995b; Griffin & Page 1993; Storey et al. 2016). In addition to this, they focused only on the pharmaceutical industry, so generalizing their findings was problematic. Research by Moenaert et al. (1994) had the same issue as that of Leenders & Wierenga (2002). Moenaert et al. (1994) tested the influence of four marketing-R&D integration mechanisms on the commercial success of product innovation projects. Looking at only one dimension of NPD performance may lead to myopic view (Cooper & Kleinschmidt 1987). The findings of He, Sun & Chen (2016) should be viewed with caution because some of their constructs seem not to be measured in an appropriate manner. For instance, technical support consists of different items such as quality function deployment, web-based tools (e.g., web-meeting, teleconferencing), and rapid prototyping. Our humble opinion is that the authors should treat the measure of this construct as a formative measure instead of the reflective one because it taps into various technology tools. Another example is the measurement of job rotation that includes three items associated with job rotation, co-location, and liaison roles. Co-location and liaison roles are two cross-functional integration mechanisms that are very different from the use of job rotation in both theory and practice. Hence, using the items related to co-location and liaison roles so as to measure job rotation is problematic.

Concerning two studies on the effects of customer characteristics on NPD projects (see Table 2.3), Gruner & Homburg (2000) distinguished and measured four dimensions of new product success, namely the quality of the new product, financial new product success, the quality of the NPD process, and the inexpensiveness of new product

ownership. However, the authors treated new product success as a uni-dimensional construct when they examined the impact of four types of customer characteristics on new product success. Similar to the work of Leenders & Wierenga (2002) that we have mentioned above, this research could not provide a complete view of NPD performance. Carbonell, Rodriguez-Escudero & Pujari (2012) addressed this weakness of Gruner & Homburg (2000) by investigating the effects of customer characteristics on four different dimensions of new service performance. Nevertheless, they examined only two kinds of customers in their research, namely lead users and close customers. This limits our understanding of customer characteristics in the NPD process. Accordingly, to deal with these substantive issues of research on the impact of cross-functional integration mechanisms and customer characteristics on NPD performance, we collect data from a variety of industries to examine the influences of eight integration mechanisms and five customer characteristics on three different NPD outcomes.

In summary, cross-functional integration mechanisms and customer characteristics can help firms improve new product success. However, research on the relationship between these factors and NPD performance is still rare. There are also some shortcomings in the existing studies. This motivates us to examine the impact of these factors on three NPD outcomes, namely NPD speed, new product advantage, and new product success in terms of financial performance. The justification for using these three NPD outcomes will be presented in Chapter 3. In the next sections, we review research on cross-functional integration mechanisms and customer characteristics to highlight the relevance of these factors to our study. We also provide an overview of the multi-dimensional typology of NPD performance.

2.4 Review of cross-functional integration mechanisms

As defined in Chapter 1, cross-functional integration mechanisms refer to the methods or practices that firms employ to achieve the expected levels of cross-functional integration. Nevertheless, it should be noticed that integration mechanisms not only foster integration among different functional areas (e.g., Im & Nakata 2008; Pinto, Pinto & Prescott 1993; Rouziès et al. 2005) but also enhance other factors such as knowledge sharing (e.g., Lee & Ahn 2007; Lee & Markham 2013), consensus between marketing and manufacturing (e.g., St.John & Rue 1991), the effectiveness of cross-functional team process (e.g., Hauptman & Hirji 1999). They can also help reduce inter-functional conflict or rivalry (e.g., Maltz & Kohli 2000; Maltz, Souder & Kumar 2001), or lessen the degree of goal incongruity (e.g., Xie, Song & Stringfellow 2003). We can see that using integration mechanisms has different impacts on various factors. This section reviews eight cross-functional integration mechanisms that potentially affect NPD performance. They are job rotation, the use of cross-functional teams, cross-functional training, superordinate goals, co-location, the use of information and communication technology, informal coordination, and joint reward systems.

2.4.1 Job rotation

Job rotation or personnel movement is a technique that employees are rotated among different departments or functional areas (Griffin & Hauser 1996; Xie, Song & Stringfellow 2003). Role flexibility is also a term used to describe this practice (e.g., Garrett, Buisson & Yap 2006; Moenaert et al. 1994; Souder & Moenaert 1992). Based on the information processing perspective (e.g., Galbraith 1973, 1977), Souder & Moenaert (1992) expected that role flexibility could help improve the sharing of information between marketing and R&D personnel so as to reduce uncertainties about

customer needs, technology, competitors, and resources. The findings of Moenaert et al. (1994) partly support this expectation because R&D's role flexibility increased information flows from R&D to marketing, but marketing's role flexibility had no relationship with information flows from marketing to R&D. Song, Neeley & Zhao (1996), however, supported the proposition of Souder & Moenaert (1992) by demonstrating that personnel movement positively affected information exchange between marketing and R&D during the planning stage and development stage of NPD projects. Not limited to departments of marketing and R&D, job rotation also enhanced two-way information flows between R&D/engineering and manufacturing units (Hauptman & Hirji 1999).

Apart from the positive relationship with information sharing, job rotation has also been found to lessen goal incongruity among marketing, R&D, and manufacturing in NPD projects (Xie, Song & Stringfellow 2003), increase acquisition, assimilation, and transformation of new external knowledge (Jansen, Van-Den-Bosch & Volberda 2005), and encourage knowledge generation in the NPD process (Song, Bij & Weggeman 2006). Using a different approach, Song, Xie & Dyer (2000) hypothesized that rotating personnel across marketing, R&D, and manufacturing functions could decrease the probability that marketing managers used avoiding behavior and increase the probability that marketing managers used collaborating behavior. Avoiding behavior refers to 'the extent to which the marketing manager avoids the conflict or ignores disagreements among different functions' (Song, Xie & Dyer 2000, p. 52). Collaborating behavior represents 'the extent to which the marketing manager seeks the common interests of all functions to achieve an integrative solution' (Song, Xie & Dyer 2000, p. 52). Nevertheless, their results did not support these hypotheses by indicating that job rotation had no relationship with both avoiding behavior and collaborating

behavior of marketing managers. By reviewing the literature, Griffin & Hauser (1996) proposed that moving employees across departments could increase integration between marketing and R&D. Nonetheless, the empirical study of Leenders & Wierenga (2002) revealed no significant relationship between personnel movement and marketing-R&D integration.

Regarding the effect of job rotation on NPD performance, Griffin & Hauser (1996) suggested that personnel movement improved marketplace success and reduced the time to market of new products. Leenders & Wierenga (2002) again found no relationship between personnel movement and new product performance, whereas He, Sun & Chen (2016) have recently found that job rotation positively affects the speed in the later stages of NPD projects and new product quality. The evidence suggests that job rotation is pertinent to NPD performance and therefore is examined in our study.

2.4.2 The use of cross-functional teams

The use of cross-functional teams refers to the extent to which NPD teams consist of members from various relevant functional areas within the firm (Rauniar & Rawski 2012). Several other terms are also used to refer the use of cross-functional teams, for instance, “task forces” (Olson, Walker & Ruekert 1995), and “functional diversity” (Carbonell & Rodriguez 2006a; Dayan, Elbanna & Di-Benedetto 2012; Sarin & McDermott 2003; Sethi, Smith & Park 2001). Reviewing the literature, Griffin & Hauser (1996) proposed that the cross-functional team use could help improve integration between marketing and R&D. This proposition was supported by Leenders & Wierenga (2002) who found that using cross-functional teams positively impacted on marketing-R&D integration. This mechanism was also found to enhance the integration between R&D and production functions in the case study of Nihtilä (1999). In addition,

the cross-functional team use reduced the manifest inter-functional conflict between marketing and other departments, namely R&D, manufacturing, and finance (Maltz & Kohli 2000) and the rivalry between marketing and R&D (Maltz, Souder & Kumar 2001). However, the greater level of functional diversity was found to lead to the greater level of political behavior in NPD teams (Dayan, Elbanna & Di-Benedetto 2012). Political behavior is defined as 'intentional acts of influence to enhance or protect the self-interest of individuals or groups' (Dayan, Elbanna & Di-Benedetto 2012, p. 472).

Concerning the effects of cross-functional team use on NPD performance, the information processing perspective (e.g., Galbraith 1973, 1977) proposes that when employees with different backgrounds share their knowledge during the NPD process, the viewpoints can be more diverse and comprehensive than a single view, and this can increase the quality of NPD decisions (Ozer 2003). Resource dependence theory (e.g., Pfeffer & Salancik 1978) also suggests that the involvement of various functional areas in NPD projects can improve decision quality (Ozer 2003). Accordingly, it is expected that the use of cross-functional teams can help firms make better NPD decisions, and thus enhance NPD performance. McDonough (2000) and Lee & Chen (2007) found that using cross-functional teams positively affected NPD performance, but Leenders & Wierenga (2002) did not find any relationship between them. More specifically, Griffin & Hauser (1996) suggested that this practice could help enhance marketplace success and the speed to market of new products. However, the relationship between cross-functional team use and NPD speed was found to be far more complex than the propositions of these authors. Eisenhardt & Tabrizi (1995) and Zirger & Hartley (1996) demonstrated that employing cross-functional teams led to the shorter development time of new products, whereas Sarin & McDermott (2003) found no relationship between them. Furthermore, Carbonell & Rodriguez (2006a) discovered an inverted U-shaped

curvilinear relationship between functional diversity and NPD speed, that is, an increase in functional diversity level would foster NPD speed, however, when it went beyond a moderate level, it reduced the speed of NPD projects. Functional diversity was also predicted to have an inverted U-shaped curvilinear relationship with new product quality (Sethi 2000a) and new product innovativeness (Sethi, Smith & Park 2001). Nonetheless, their results indicated that it had no relationship with either of these two constructs. It is clear that using cross-functional teams is related to and potentially affects NPD performance. Hence, we examine this mechanism in our study.

2.4.3 Cross-functional training

Cross-functional training is an integration technique that aims to help employees in a functional area understand about other functional disciplines and effectively work with people from other departments (Maltz & Kohli 2000). This practice allows personnel in different functions to "speak the same language" by clarifying the terminologies, acronyms, and processes of each function (Arndt, Karande & Landry 2011), thereby overcoming language and jargon barriers and reducing the misunderstanding among various departments (Griffin & Hauser 1996; Maltz & Kohli 2000). It also helps enhance employees' understanding of 'the goals, perspectives, and priorities' of other departments (Maltz & Kohli 2000, p. 481) and 'build trust and sensitivity toward one another' (Cadogan et al. 2005, p. 522), thereby increasing the cooperation among different functional areas. Accordingly, cross-functional training is employed with the expectation that it decreases conflict and increases integration among various functions. In several studies, it was found to have the positive impact on integration between design and manufacturing (e.g., Liker, Collins & Hull 1999), or between marketing and logistics (e.g., Mollenkopf, Gibson & Ozanne 2000), or between exporting and non-

exporting employees (e.g., Cadogan et al. 2005). With respect to reducing conflict, multifunctional training was found to decrease inter-functional conflict between exporting and non-exporting departments (Cadogan et al. 2005), but it had no relationship with inter-functional conflict between marketing and other functions, namely R&D, manufacturing, and finance (Maltz & Kohli 2000). In the context of frontline retail transactions, cross-functional training had a significant and positive effect on communication quality between the frontline departments (i.e., functions dealing directly with customers), which in turn enhanced relationship effectiveness between them (Arndt, Karande & Landry 2011). Communication quality here refers to the degree to which 'two-way communication between individuals is accurate, timely, adequate and complete' (Arndt, Karande & Landry 2011, p. 232).

With regard to the impact of cross-functional training on new product performance, we could not find any study that examined the relationship between them. Lee & Markham (2013), however, proposed an indirect influence of cross-functional training on NPD performance via knowledge sharing activities. By reviewing the literature on marriage and family therapy, the authors were aware that the process of incorporating various perspectives allowed family members to understand each other and constructively deal with their differences, thereby helping families become closer and share more knowledge. They applied these arguments in the context of NPD and suggested that cross-functional training promoted NPD team interactions and knowledge sharing, which in turn helped NPD team members utilize the knowledge and expertise of their partners, and thereby helping increase NPD performance. Moreover, as we have just discussed above, cross-functional training improves cross-functional integration, which in turn has a positive effect on the performance of NPD projects (e.g., Leenders & Wierenga 2002; Nakata & Im 2010; Troy, Hirunyawipada & Paswan 2008). It is clear

that cross-functional training is connected with, and possibly impacts on NPD performance. Our study therefore tests the relationship between them.

2.4.4 Superordinate goals

Superordinate goals are defined as the overall goals of an NPD project to which team members commit during the project (Atuahene-Gima 2003). The term "integrated goal" is also used to refer a superordinate goal (e.g., Fisher, Maltz & Jaworski 1997; Rouziès et al. 2005). Superordinate goals can help reduce tension among various functional areas (Le-Meunier-FitzHugh, Massey & Piercy 2011), and increase interdependence and the need to cooperate among various individuals and functions (Fisher, Maltz & Jaworski 1997). As a result, integrated goals are expected to enhance the integration among different functional areas (e.g., Pinto, Pinto & Prescott 1993; Rouziès et al. 2005). Pinto, Pinto & Prescott (1993) provided support for this proposition by demonstrating that superordinate goals significantly and positively affected cross-functional cooperation.

Not limited to cross-functional integration, superordinate goals also impact on communication behaviors among different departments. Fisher, Maltz & Jaworski (1997) suggested that integrated goals positively influenced three dimensions of communication behaviors between marketing and engineering functions, namely communication frequency, bi-directionality, and coerciveness of influence attempts. Communication frequency refers to 'the number of times information is exchanged over a period of time' (p. 55). Bi-directionality refers to the extent to which 'communication is a two-way process' (p. 55). Coerciveness of influence attempts is the extent to which 'communication references or mediates negative consequences for noncompliance' (p. 55). The authors, however, only found a positive and significant relationship between

integrated goals and communication frequency, whereas the influences of integrated goals on bi-directional communication and coerciveness of influence attempts could not be detected.

Turning now to the relationship between superordinate goals and NPD performance, the input-process-output model of group effectiveness (e.g., McGrath 1984) suggests that organizational inputs affect group effectiveness via group processes (Atuahene-Gima 2003). Based upon this model and the resource-based view of firms (e.g., Barney 1991; Lado & Wilson 1994), Atuahene-Gima (2003) proposed that the effects of superordinate goals on NPD speed and product quality were mediated by three outcomes of problem-solving processes, namely solutions found, problem-solving speed, and solution quality. These outcomes are defined as follows.

> ***Solutions found*** is the ease with which a project team identifies a large number of alternative problem solutions. ***Problem-solving speed*** refers to the degree of speed associated with finding and implementing a solution. ***Solution quality*** refers to the degree to which a solution enhances new product quality and reflects the extent to which the solution generates fresh thinking in the project team, is creative, and is the right solution for the problem encountered by the team (Atuahene-Gima 2003, p. 359).

The author found that solution quality partially mediated the impact of superordinate goals on product quality, whilst there was no relationship between superordinate goals and development speed. Similar to Atuahene-Gima (2003), a conceptual paper by Lee & Markham (2013) proposed that sharing common goals indirectly affects new product performance via knowledge sharing activities. By reviewing marriage and family therapy literature, the authors recognized that sharing common goals among family members helped them 'share more information and achieve deeper understanding' (p. 189). They applied this argument in the context of NPD and suggested that sharing

common goals among NPD team members promoted knowledge sharing, which in turn increased NPD performance. These examples show that superordinate goals are associated with NPD performance and therefore are examined in our study.

2.4.5 Co-location

Co-location refers to the extent to which NPD team members are located within close physical proximity to each other (Swink, Talluri & Pandejpong 2006). Some other terms are also used to mention this practice, for example, "physical proximity" (Dayan & Di-Benedetto 2010; Pinto, Pinto & Prescott 1993; Sethi & Nicholson 2001; Xie, Song & Stringfellow 2003), "physical propinquity" (Dayan & Di Benedetto 2010), and "spatial proximity" (Maltz & Kohli 2000).

Structural contingency theory (e.g., Donaldson 2001; Lawrence & Lorsch 1967) suggests that the greater the extent to which the functional areas are interdependent, the greater the need for appropriate mechanisms to cope with integration challenges. Co-location can be considered as an appropriate mechanism because it enhances communication among various functions and enables efficient joint problem solving among them (Ketokivi & Ali-Yrkkö 2009). Co-location also enables NPD team members to have face-to-face encounters, which provides more opportunities for them to communicate and understand each other (Dayan & Di-Benedetto 2010). Consequently, it is expected that co-location improves integration and reduces conflict among different functional areas (e.g., Maltz & Kohli 2000; Pinto, Pinto & Prescott 1993). Consistent with this expectation, physical proximity was found to enhance cross-functional cooperation (Pinto, Pinto & Prescott 1993) as well as integration between marketing and R&D departments (Leenders & Wierenga 2002). Nonetheless, it could not decrease the manifest conflict between marketing and other functional areas such as

R&D, manufacturing, and finance (Maltz & Kohli 2000), or the rivalry between marketing and R&D units (Maltz, Souder & Kumar 2001).

In addition to its positive effect on cross-functional integration, physical propinquity has been found to facilitate the development of interpersonal trust in NPD teams (Dayan & Di-Benedetto 2010), and diminish goal incongruity among various functions (Xie, Song & Stringfellow 2003). Furthermore, physical proximity was hypothesized to positively affect superordinate identity (Sethi 2000b) and charged behavior (Sethi & Nicholson 2001). Superordinate identity is defined as 'the extent to which members of a team identify with the team (rather than merely with their functional areas) and value their membership in the team' (Sethi 2000b, p. 337). Charged behavior refers to 'the extent to which teams are enthusiastically and jointly driven to develop superior new products' (Sethi & Nicholson 2001, p. 161). The data of these authors, however, failed to support these hypotheses, that is, physical proximity had no relationship with superordinate identity and charged behavior.

Regarding the influence of co-location on NPD performance, co-location was found to have no direct effect on product development (pre-launch activities) performance and product management (launch and post-launch activities) performance (Kahn & McDonough 1997a), and new product performance (Leenders & Wierenga 2002). However, Leenders & Wierenga (2002) noted that it indirectly affected new product performance through marketing-R&D integration. Likewise, Dayan & Di-Benedetto (2010) revealed that the close proximity of NPD team members increased interpersonal trust among them, which in turn led to the commercial success of new products. By applying a marriage and family therapy model to the NPD context, Lee & Markham (2013) proposed that locating team members close together helps promote knowledge

sharing, which in turn enhances new product performance. Not limited to its indirect effects, co-location also has a direct relationship with NPD performance. Whilst co-locating team members could not reduce development time of new products in the research of Zirger & Hartley (1996), it was found to improve NPD speed in studies by Carbonell & Rodriguez (2006a), Lakemond & Berggren (2006), and Zenun, Loureiro & Araujo (2007). Moreover, physical proximity was also found to positively affect the market performance of new products regarding sales and market share (Sethi & Nicholson 2001). We can see that co-location is highly relevant to NPD performance and is therefore included in our study.

2.4.6 Information and communication technology (ICT)

The use of ICT refers to the extent to which employees from one function use information and communication technology, such as telephone, video-conferencing, email, and the internet to work with people from other functions during the NPD process (Koufteros & Marcoulides 2006). ICT tools provide opportunities for contacting people and finding, processing, and exchanging information in an effective way (Carbonara 2005; Leenders & Wierenga 2002). Accordingly, these tools are expected to enhance information sharing among NPD team members. A case study by Hameri & Nihtila (1997) provided support for this argument by indicating that the internet and web-based applications could help promote the sharing of information among NPD team members. Furthermore, by combining the information processing perspective, problem-solving view, and resource dependence theory, Ozer (2003) proposed that using the internet positively impacts on the collaboration among NPD team members. Similarly, the implementation of computer technology and information systems is hypothesized to increase inter-functional integration (Hitt, Hoskisson & Nixon 1993).

Supporting evidence is supplied by Leenders & Wierenga (2002), who demonstrated that the use of ICT had a positive effect on integration between marketing and R&D departments. In the context of global NPD, frequently using ICT tools (e.g., fax, email, telephone, teleconferencing) has been found to improve the performance of global NPD teams (McDonough & Kahn 1996).

Concerning the relationship between ICT use and NPD performance, based upon the resource-based view (e.g., Barney 1991; Wernerfelt 1984), Durmuşoğlu & Barczak (2011) argued that information technology (IT) tools were one of the firms' resources that could improve NPD effectiveness. Leenders & Wierenga (2002) supported this argument by revealing that using ICT increased new product performance. However, more recently, Kawakami, Barczak & Durmuşoğlu (2015) found that there is no relationship between them. At a more specific level, Ozer (2004) proposed that using the internet could enhance NPD speed, new product advantage, and new product success. Barczak, Sultan & Hultink (2007) found that the use of IT tools such as email, web meetings, and scheduling and tracking projects software had a positive impact on the market performance new products, but there was no relationship between IT usage and NPD speed. In addition, several IT tools, namely email, product design software, decision support systems for project evaluation, and file transfer protocols were found to increase new product quality, new product innovativeness, and the market performance of new products (Durmuşoğlu & Barczak 2011). The evidence suggests that using ICT is pertinent to and potentially affects the performance of NPD projects. Hence, our research tests the relationship between them.

2.4.7 Informal coordination

Informal coordination refers to the extent to which the communication among employees from various departments is based on personal contact, which is not controlled by their managers (Willem & Buelens 2009). In some studies, terms such as "informal social systems" (Griffin & Hauser 1996; Leenders & Wierenga 2002), "social orientation" (Maltz & Kohli 2000; Maltz, Souder & Kumar 2001), and "informal integration" (Chimhanzi 2004) are also used to refer to informal coordination mechanisms. The common idea underlying these terms is that they provide opportunities for employees of a firm to communicate with each other in social or non-work related contexts such as recreational activities, picnics, and company parties (Maltz & Kohli 2000; Maltz, Souder & Kumar 2001). Informal communication can help reduce misunderstanding and develop friendships among these employees (Maltz & Kohli 1996, 2000). Accordingly, informal coordination devices are expected to decrease conflict and enhance integration among various functions. However, the empirical evidence suggested that social orientation had no impact on manifest inter-functional conflict (Maltz & Kohli 2000) and inter-functional rivalry (Maltz, Souder & Kumar 2001). Similarly, Chimhanzi (2004) found no effects from informal integration on the conflict between marketing and human resources functions. Regarding its influence on cross-functional integration, Leenders & Wierenga (2002) found no relationship between informal social systems and marketing-R&D integration. Nonetheless, informal integration mechanism had a positive and significant relationship with connectedness (Chimhanzi 2004), which is defined as 'the accessibility of staff, the ease of communication, lack of communication barriers and the propensity to communicate' between marketing and human resources departments (Chimhanzi 2004, p. 725). Furthermore, informal networks build trust and promote the common understanding

among employees, and are therefore expected to encourage knowledge sharing activities among them (Willem, Buelens & Scarbrough 2006). Nevertheless, informal coordination was found to have no relationship with knowledge sharing (Willem & Buelens 2009). In a worst-case scenario, it can actually hamper knowledge sharing (Willem, Buelens & Scarbrough 2006).

Regarding the relationship between informal coordination and NPD performance, organizations are conceptualized as information processing systems (Maltz, Souder & Kumar 2001). Through the lens of information processing theory, informal communication is more likely to satisfy the information needs of receivers as well as senders (Daft & Lengel 1986; Souder & Moenaert 1992). It is therefore expected that informal communication can contribute to the success of innovation projects such as NPD (Rouziès et al. 2005; Souder & Moenaert 1992). Developing informal social networks can also help reduce the time to market of new products and lead to successful NPD projects in terms of profitability and marketplace success (Griffin & Hauser 1996). Even though Leenders & Wierenga (2002) found that informal social systems had no relationship with NPD performance, based upon the basis of information processing theory, we still believe that informal coordination can potentially affect NPD outcomes. Therefore, we examine this mechanism in our study.

2.4.8 Joint reward systems

Joint reward systems are defined as the degree to which employees from one function are rewarded for working effectively with people from other functions and contributing to the overall goals of the organization (Arndt, Karande & Landry 2011). Some other terms are also used to refer to joint reward systems such as “team-based rewards” (Liker, Collins & Hull 1999; Moffat 1998), “team-based incentives” (Menon,

Chowdhury & Lukas 2002; Swink 1998), and "group-based rewards" (Hauptman & Hirji 1999; Ozer 2000). Maltz & Kohli (2000) defined compensation variety as the extent to which managers' compensation is based on factors beyond their personal performance. These factors included their contributions to other functions, the performance of their subordinates, their project group's performance, and the performance of strategic business units. Therefore, the term "compensation variety" used in the research of these authors can also be considered as joint reward systems. Likewise, in the studies of Cadogan et al. (2005), Im & Nakata (2008), and Nakata & Im (2010), the concept of market-oriented reward systems, which reward the achievement of common goals, can be regarded as joint reward systems.

Rewarding employees for achieving common organizational goals rather than individuals' or departments' performance provides incentives to resolve conflicts among them and among different functions, thereby reducing cross-functional conflicts (Griffin & Hauser 1996). Maltz & Kohli (2000), however, could not detect any relationship between compensation variety and inter-functional conflict. Similarly, Le-Meunier-FitzHugh, Massey & Piercy (2011) revealed that joint or aligned rewards had no relationship with the conflict between marketing and sales departments. However, joint rewards were found to decrease conflicts between marketing and human resources units (Chimhanzi 2004), and between exporting and non-exporting functions (Cadogan et al. 2005).

Implementing team-based rewards is also an effective integrating mechanism (Griffin & Hauser 1996) because it develops the cooperation and mutual problem solving across different functional areas (Coombs & Gomez-Mejia 1991). Using group-based rewards is therefore expected to increase the degree of integration between marketing and R&D

functions (Gupta, Raj & Wilemon 1986), and between marketing and sales departments (Rouziès et al. 2005). Supporting evidence is presented by Leenders & Wierenga (2002), who found that joint incentives and rewards enhanced marketing-R&D integration, and by Le-Meunier-FitzHugh, Massey & Piercy (2011), who demonstrated that joint or aligned rewards positively affect marketing-sales collaboration. Nevertheless, joint reward systems do not impact on the integration of some other dyads. For instance, they had no effect on integration between design and manufacturing (Liker, Collins & Hull 1999), between marketing and logistics (Mollenkopf, Gibson & Ozanne 2000), between marketing and human resources (Chimhanzi 2004), and between exporting and non-exporting departments (Cadogan et al. 2005). For cross-functional integration in general (i.e., integration without specifying the focal interface), market-based reward systems were found to increase cross-functional integration in NPD teams (Im & Nakata 2008; Nakata & Im 2010).

In addition to reducing inter-functional conflicts and increasing cross-functional integration, joint reward systems were found to lessen the degree of goal incongruity among marketing, R&D and manufacturing units in NPD projects (Xie, Song & Stringfellow 2003). It is also expected to promote information sharing across various functional areas (Coombs & Gomez-Mejia 1991). Song, Neeley & Zhao (1996) supported this proposition by indicating that rewards for the collaboration and cooperation improved the quantity and quality of information exchanged during the planning and implementation phases of NPD projects. In the context of frontline retail transactions, joint rewards had no relationship with individual performance, but had a significant and positive effect on job satisfaction of employees in frontline departments (i.e., functions dealing directly with customers) (Arndt, Karande & Landry 2011).

Turning now to the relationship between joint reward systems and NPD performance, Bonner, Ruekert & Walker (2002) and Leenders & Wierenga (2002) revealed that joint incentives had no impact on new product performance. Nonetheless, team-based incentives were found to be more effective than individual rewards in enhancing the overall performance of R&D projects (Gomez-Mejia & Balkin 1989). Moreover, as we have just mentioned above, joint reward systems improve cross-functional integration, which in turn has a positive impact on new product performance (e.g., Leenders & Wierenga 2002; Nakata & Im 2010; Troy, Hirunyawipada & Paswan 2008). At a more specific level, Menon, Chowdhury & Lukas (2002) suggested that team-based incentive systems positively influenced NPD speed. Sethi, Smith & Park (2001) demonstrated that team rewards had an insignificant relationship with new product innovativeness. However, market-based reward systems were found to enhance cross-functional integration, which in turn positively impact on new product advantage (Im & Nakata 2008). The evidence suggests that joint reward systems potentially affect NPD performance. Accordingly, our research examines this mechanism.

2.5 Review of customer characteristics

Customer involvement is vital for the success of new product and service development (Alam 2006; Cooper 2001). Many firms, however, cannot acquire customer inputs into their NPD process (Alam & Perry 2002) due to the challenges of customer integration. First, customers are considered not to know what they want and cannot easily articulate their needs (Tuli, Kohli & Bharadwaj 2007; Workman 1995). Second, if firms listen too closely to customers, this may lead to niche products or un-innovative products (Enkel, Kausch & Gassmann 2005). Finally, confidentiality is another issue. Firms worry that customers may know and reveal their business secrets (Alam 2006, 2011). These three

problems will be overcome if firms can involve the right customers in their NPD projects. The right customers mentioned here are customers who clearly know what they want and can express how to satisfy their needs. They are also capable of helping firms produce innovative products, and keeping business secrets of firms confidential. Nonetheless, selecting the right customers is a difficult task because firms may not know who the right ones are (Alam 2006; Enkel, Kausch & Gassmann 2005; Nambisan 2002). Therefore, in the following, we review five types of customers (or customer characteristics) that can be regarded as potentially the right customers. They are customers with lead user characteristics, innovative customers, customers with product expertise, customers with price expertise, and financially attractive customers.

2.5.1 Customers with lead user characteristics

The term "lead user" is coined by von-Hippel (1986), and he defines lead users, including user firms and individual users of a given product or service, as those who (1) 'face needs that will be general in a marketplace - but face them months or years before the bulk of that marketplace encounters them', and (2) 'are positioned to benefit significantly by obtaining a solution to those needs' (p. 796). Substantially benefitting from the solutions motivates them to innovate, that is, they modify or develop existing offerings, or suggest ideas for new products or services, which are not available on the market yet (Eisenberg 2011; Franke, von-Hippel & Schreier 2006). Lead users innovate to solve their own needs rather than to sell the innovations (von-Hippel 2005). However, because they are ahead of the market trends, they can generate commercially attractive ideas (Franke, von-Hippel & Schreier 2006; Schreier & Prügl 2008), which may lead to successful new products. It is therefore recommended by some scholars that firms should involve lead users in the NPD process (e.g., Langerak, Peelen & Nijseen

1999; Schreier & Prügl 2008; Spann et al. 2009) because they provide valuable input and are useful for increasing the success rates of new products (Alam 2011; Spann et al. 2009).

The contributions of lead users to NPD have been well documented in the literature. For example, in the field of computer-aided systems for designing printed circuit boards (PC-CAD), Urban & von-Hippel (1988) demonstrated that the new product concepts generated by lead users were strongly preferred by the majority of PC-CAD users. The new product concepts generated by them were also found to be practical, appealing to the market, and cost-effective (Herstatt & von-Hippel 1992; Olson & Bakke 2001). Moreover, lead users' ideas could help firms develop new-to-the-firm and even new-to-the-world products (Lüthje & Herstatt 2004). In another study, Lilien et al. (2002) conducted an experiment at the 3M company to evaluate the effectiveness of lead user idea-generation technique compared with the traditional idea-generation method for NPD projects. Concerning the traditional method, the authors asked only the need information of users or customers of the intended target market. In contrast, the lead user idea-generation technique took a different approach. This method obtained both need and solution information from lead users. They found that the ideas generated by the lead user technique are more novel than those generated by the conventional method. Further, the annual sales of new products developed from lead users' ideas were more than eight times higher than those of new products developed from the traditional technique. Based upon resource dependence theory (e.g., Pfeffer & Salancik 1978), Gruner & Homburg (2000) argued that information and ideas from lead users could be viewed as resources on which firms depended to develop successful new products. Their data supported this argument by disclosing that involving lead users in NPD projects had a positive impact on new product success. Lead users are also helpful

in circumstances where new products fail and need to be re-launched. Harrison & Waluszewski (2008) reported that Biacore, the producer of biotechnology tools, which was acquired by GE Healthcare, had to re-launch a failed new product or lose a 500-million-euro investment. Interacting with lead users helped Biacore develop a set of new use applications and successfully re-launch the product. In the context of new service development, Carbonell, Rodriguez-Escudero & Pujari (2012) found that whilst lead users had no effect on the speed to market of the new service, they positively affected service newness and new service advantage. The evidence suggests that lead users play a vital role in NPD projects, and thus, our study investigates the influence of customers with lead user characteristics on NPD outcomes.

2.5.2 Innovative customers

Before reviewing innovative customers, we need to discuss one of the findings of Gruner & Homburg (2000). The authors found that technically attractive customers had no impact on new product success, possibly because these customers might have different needs compared with other customers of the target market, and therefore mislead the firms conducting NPD projects. On the other hand, when we considered the construct "technical attractiveness" of customers, it was measured by two items: (1) customers' innovativeness and (2) customers' know-how. Based on the contents of the items, it seems that these two items assessed two different characteristics of customers. We suspect the lack of face validity of this construct may be an additional explanation as to why this kind of customer had no influence on new product success. Accordingly, our research decomposes the construct technically attractive customers of Gruner & Homburg (2000) into two distinct variables, namely innovative customers and

customers with product expertise. In this subsection, we discuss innovative customers. Customers with product expertise are discussed in the next subsection.

There is no general consensus on the definition of innovative customers. They are defined as customers who are receptive to new experiences (Leavitt & Walton 1975), willing to change (Hurt, Joseph & Cook 1977), or who desire to seek the new and different (Goldsmith 1984; Manning, Bearden & Madden 1995). They are also viewed as the ones who adopt or purchase new products or services earlier than other customers (Midgley & Dowling 1978; Rogers 2003). Based on the ideas of Goldsmith (1984) and Manning, Bearden & Madden (1995) that innovative customers incline towards novelty-seeking behavior, and consistent with Bin (2013), we define innovative customers as customers who are willing to try new products, services, and technologies earlier than other customers.

Innovative customers tend to deal with uncertain usage circumstances at the cutting edge of the market, and therefore not only soon recognize the disadvantages of existing products but also propose promising improvements (Schreier & Prügl 2008). To put it simply, they can uncover both problems and solutions associated with existing products. Through the lens of resource dependence theory (e.g., Pfeffer & Salancik 1978), the information they provide on product issues and solutions can be considered as a resource upon which companies depend to enhance NPD success (Gruner & Homburg 2000). We can see that innovative customers may have significant contributions to NPD projects. By reviewing the literature, we find that there are numerous studies that empirically test the relationship between customer innovativeness and new product adoption behavior (e.g., Foxall 1995; Goldsmith, Freiden & Eastman 1995; Im, Bayus & Mason 2003; Lassar, Manolis & Lassar 2005; Lu, Yao & Yu 2005). More recently,

Truong et al. (2014) revealed that an innovative product form increased the perceived value, product liking, and purchase intention of innovative consumers. The authors define product form as 'the visual elements of a product such as color, shape, size, and proportion that creates a product's appearance' (p. 868). On the contrary, there is hardly any research that investigates the impact of innovative customers on NPD outcomes. In the study by Gruner & Homburg (2000), the construct of technically attractive customers taps both customers' innovativeness and customers' know-how. This cannot help us understand the impact of innovative customers on NPD performance. Coviello & Joseph (2012) documented that firms with successful NPD interacted with and benefited from the so-called "technically eager" customers. The authors, however, did not examine the relationship between these customers and NPD outcomes. Technically eager customers are reported not to be technical experts, but to be creative and inventive. Accordingly, even though these customers can be regarded as innovative customers, this study again cannot help us understand the influence of innovative customers on NPD projects. This motivates us to test this relationship in our research.

2.5.3 Customers with product expertise

As have just been discussed above, we decompose the construct "technically attractive customers" of Gruner & Homburg (2000) into two distinct variables, namely "innovative customers" and "customers with product expertise". Based on the work of Mitchell & Dacin (1996), we define customers with product expertise as customers who have good knowledge of a certain product. Product related knowledge enables these customers to translate their needs and demands from the language of customers into the language of engineers (Lüthje 2004). From the information processing perspective (e.g., Daft & Lengel 1986; Galbraith 1973, 1977), this can help firms reduce uncertainty

about customers' needs, thereby increasing the likelihood that firms develop new products that satisfy the real needs of customers. Under resource dependence theory (e.g., Pfeffer & Salancik 1978), the need information from these customers can be considered as a resource on which firms rely to develop new products successfully (Gruner & Homburg 2000). This is the reason why Alam (2005) suggested that manufacturers should involve customers who are knowledgeable and can clearly articulate their needs in the NPD process. Alam (2011) also found that Australian financial services companies engaged customers with product expertise in their new service development (NSD) process. Furthermore, these customers are better than novice customers at evaluating the ability of products to perform desired functions (Thompson, Hamilton & Rust 2005). This implies that they can help firms develop the new use applications of products. Recall that in the study of Harrison & Waluszewski (2008), lead users helped Biacore, a producer of biotechnology tools, develop a set of new use applications and successfully re-launch its failed new product. Thus, we believe that customers with product expertise will be helpful in the situation that firms need to re-launch their failed new products.

We can see that this kind of customer is relevant and can potentially affect the outcomes of NPD projects. Nonetheless, we are unaware of any research that investigates the relationship between customers with product expertise and NPD outcomes. Gruner & Homburg (2000) could not explain the effects of these customers on NPD performance because the construct "technically attractive customers" in their study taps both customers' innovativeness and customers' know-how. The research of Alam (2011) discussed above also did not test the impact of this kind of customers on NSD performance. Hence, our study examines the relationship between customers with product expertise and NPD outcomes.

2.5.4 Customers with price expertise

New product diffusion models suggest that product price can affect the adoption of a new product (e.g., Kalish 1985; Mahajan, Muller & Bass 1990). Economic theory also proposes that if all things are equal, 'the higher the average price of the new product relative to alternatives in the product category, the lower the inclination of consumers to buy the product' (Steenkamp & Gielens 2003, p. 371). Hence, to be successful with new products, firms should understand the price sensitivity of buyers and avoid 'introducing a high-priced product with no economic advantage' (Cooper 1979, p. 99). The empirical study of Langerak, Rijsdijk & Dittrich (2009) indicated that price had no impact on the sales of new products with a short development time but had a negative effect on that of new products with a long development time. Product price was also found to be a predictor of new product success (Evanschitzky et al. 2012; Henard & Szymanski 2001).

We can see that product price is crucial for the success of new products. Veryzer (2005) revealed that determining the right price of new products was an important task of firms during various stages of NPD projects, and this task became extremely significant in the commercialization stage. In addition to this, the price of new products was also the most important issue among others in this stage. The vital role of the product price in NPD success motivates researchers to identify which pricing strategies or which pricing practices can enhance the probability that new products are successful (e.g., Hultink & Robben 1999; Ingenbleek et al. 2003; Ingenbleek, Frambach & Verhallen 2013). It should be noted, however, that pricing strategies and pricing practices are two different concepts. Pricing strategies refer to 'how the firm tries to achieve its pricing objectives in the marketplace', whereas pricing practices refer to 'the use of information in a

pricing process that leads to price decisions' (Ingenbleek et al. 2003, p. 302). Hultink & Robben (1999) found that a penetration pricing strategy enhanced the market acceptance of new products. Regarding pricing practices, price decisions based upon information on costs associated with the development, production, and marketing of new products, and those based on information on the competitors' pricing policy did not affect NPD performance (Ingenbleek et al. 2003; Ingenbleek, Frambach & Verhallen 2013). In contrast, the price decisions based upon the customers' perception of new product value were found to improve the market performance of new products (Ingenbleek et al. 2003; Ingenbleek, Frambach & Verhallen 2013). From this finding, we propose that involving customers who are knowledgeable about product prices in the market may help firms make better pricing decisions, thereby increasing new product success. Such customers are termed customers with price expertise in our study. To the best of our knowledge, there is little published research that examines the impact of customers with price expertise on the performance of NPD projects, and our study therefore will do so.

2.5.5 Financially attractive customers

Gruner & Homburg (2000) defined financially attractive customers as customers who were representatives of the target market and had established a reputation within that market. Nonetheless, Coviello & Joseph (2012) argued that customers' willingness to financially support premature forms of new products instead of their reputation and market representativeness should be an indicator of the financial attractiveness. Consistent with this notion, and based upon the work of Rocca, Caruana & Snehota (2012), in this study we define financially attractive customers as those who buy products in large volumes. Because they have the capability to make bulk purchases, we

suspect that they tend to be organizations or firms rather than individual customers, and therefore possess resources such as human, finance, knowledge, production facilities, and so on. As proposed by resource dependence theory (e.g., Pfeffer & Salancik 1978), to reduce dependence on essential resources, firms should cooperate with resource owners (Gruner & Homburg 2000). Accordingly, the resources of financially attractive customers are helpful for manufacturing firms to develop new products (Laage-Hellman, Linda & Perna 2014). Cooperating with financially attractive customers was also found to positively impact new product success (Gruner & Homburg 2000). On the basis of the theory and empirical evidence available, we posit that involving these customers in NPD projects may help firms improve new product performance, and therefore test the relationship between financially attractive customers and NPD outcomes.

2.6 The multi-dimensional nature of NPD performance

As mentioned earlier, NPD performance is a multi-dimensional concept. Cooper & Kleinschmidt (1987) identified three underlying dimensions of new product performance, namely financial performance, market impact, and opportunity window. Financial performance reflects the overall financial success of new products, which includes 'relative profits and sales, meeting profit and sales objectives, profitability level, and payback period' (p. 216). Market impact describes the impact of new products in both domestic and foreign markets. Opportunity window refers to the extent to which new products 'open up new opportunities to the firm in terms of a new category of products and a new market area for the firm' (p.216).

Taking a different angle, Hart (1993) categorized NPD performance into two main groups: financial performance and non-financial performance. Financial performance is

evaluated by sales growth, average profits, and percentage of turnover accounted for by new products. This variable is also gauged by comparing the sales growth of the focal firm with that of five largest competitors, and that of the industry benchmark. Non-financial performance is assessed by technological competitiveness, cost and price competitiveness, and time-to-market of new products. This variable is also evaluated by the number of R&D projects conducted, the number of new product launches, and the percentage of successful product launches.

Griffin & Page (1993) found that there were five dimensions of new product performance, namely financial performance, customer acceptance measures, product-level measures, program-level measures, and firm-level measures. The authors, however, also stated that financial performance, customer, and product categories were 'all aspects of project-level measures' (p. 295). From this point, we argue that NPD performance can be measured at three main levels, which are firm, program and project levels.

At the firm level, new product success is measured by the Return on Investment (ROI) of the development program, whether the new products fit the current business strategy, their success/failure rate, the percentage of profits from new products, the percentage of sales from new products, whether the program hits five-year objectives, whether the new products lead to future opportunities, the overall program success, the percentage of sales under patent protection, and the percentage of profits under patent protection (Griffin & Page 1996).

At the program level, it is important to note that the term program is used by some managements to refer to 'a specific new product project or cluster of related projects' (Cooper & Kleinschmidt 1995a, p. 378). Nevertheless, Cooper & Kleinschmidt (1995a,

p. 378) define new product program as ‘the totality of new product efforts of the company or division’. At this level, the authors identified two underlying dimensions of NPD performance, that is, program impact and program profitability. Program impact is measured by the percentage of firm sales by new products, new product success rate, the technical success rating of the new product program, the impact of the new product program on sales, and the impact of the new product program on profits. Program profitability is gauged by new product success in meeting sales objectives, new product success in meeting profit objectives, the profitability of the new product program relative to spending, the profitability of the new product program relative to competitors, and the overall success rating of the new product program relative to competitors.

At the project level, Cooper & Kleinschmidt (1995b) identified two performance dimensions of NPD projects, namely financial performance and time performance. Financial performance includes success rates, profitability ratings, technological success ratings, current domestic market share, and the impact on the company sales and profits. Time performance comprises time efficiency rating and on-schedule rating. Griffin & Page (1996) proposed three dimensions of NPD success at this level, which are customer-based success, financial success, and technical performance success. Customer-based success is assessed by customer satisfaction, customer acceptance, market share goals, revenue goals, revenue growth goals, unit volume goals, and the number of customers. Financial success is evaluated by meeting profit goals, meeting margin goals, break-even time, and Internal Rate of Return (IRR) or Return on Investment (ROI). Technical performance success is gauged by competitive advantage, innovativeness, meeting performance specs, meeting quality specs, speed to market, launch on time, and development cost.

Taking a different approach in classifying performance dimensions of NPD projects, Tatikonda & Montoya-Weiss (2001) suggested that new product performance could be evaluated by operational outcomes (i.e., product quality, unit cost, and time-to-market) and market outcomes (i.e., customer satisfaction and relative sales). Following Tatikonda & Montoya-Weiss (2001), in the context of new service development, Carbonell, Rodríguez-Escudero & Pujari (2009) considered innovation speed and technical quality as operational outcomes, and competitive superiority and sales performance as market outcomes. In a similar vein, the operational outcomes of NPD projects in the study of Cankurtaran, Langerak & Griffin (2013) include development costs, market entry timing, technical product quality, and product competitive advantage; whereas customer-based outcomes and financial outcomes are regarded as market outcomes. Customer-based measures comprise customer satisfaction and acceptance, revenue, sales volume, and market share. Financial measures consist of break-even time, return on assets and investment, margin, and profitability. The multi-dimensional typology of NPD performance implies a hierarchical structure: operational outcomes can be seen as primary indicators of new product success, and financial performance is the ultimate goal (Cankurtaran, Langerak & Griffin 2013; Huang, Soutar & Brown 2004). Recall that section 2.2 of this chapter mentions that NPD speed and new product advantage (i.e., operational outcomes) are predictors of NPD success.

In short, NPD performance is indeed a multi-dimensional concept. The level of analysis in our research is the project level. Consequently, the current study includes three dimensions of NPD performance at this level, namely NPD speed, new product advantage, and new product success in terms of financial performance. The next chapter will provide further explanations as to why we use these three outcomes of NPD projects.

2.7 Conclusion

By reviewing the literature, we found that eight mechanisms and five customer characteristics discussed above are highly relevant to and potentially affect the performance of NPD projects. To bridge the gaps and deal with some problems of previous research that we have discussed above, we collect data from various industries to test the direct effects of eight integration mechanisms and five customer characteristics on three different NPD outcomes.

We also found that various theories are used to explain the impact of cross-functional integration mechanisms and customer characteristics, for example, the information processing perspective (e.g., Galbraith 1973, 1977), resource dependence theory (e.g., Pfeffer & Salancik 1978, 2003), contingency theory of organization (e.g., Lawrence & Lorsch 1967; Thompson 1967), the resource-based view of firms (e.g., Barney 1991; Lado & Wilson 1994; Wernerfelt 1984), the knowledge-based theory (e.g., Grant 1996; Spender 1996), the input-process-output model of group effectiveness (e.g., McGrath 1984). Among them, the information processing perspective and resource dependence theory are used to underpin our research. The next chapter justifies why we employ these two theories and develops hypotheses about the relationships among cross-functional integration mechanisms, customer characteristics, and NPD outcomes.

CHAPTER 3 CONCEPTUAL FRAMEWORK & HYPOTHESES

3.1 Introduction

The purpose of this chapter is to propose a conceptual framework and then develop hypotheses to address two research questions presented in Chapter 1. Firstly, the use of the information processing perspective and resource dependence theory as theoretical backgrounds is justified. Next, we propose a conceptual framework including four blocks of variables. The first block consists of eight cross-functional integration mechanisms. The second one relates to five customers characteristics. The third block contains three different NPD outcomes, and the final one comprises four control variables. Finally, we develop hypotheses about the relationships among these constructs.

3.2 Theoretical background

Given that the NPD process is a complicated social system (Coviello & Joseph 2012), a single theoretical framework seems not to be appropriate to explain the relationships between cross-functional integration mechanisms, customer characteristics, and NPD outcomes. Accordingly, we use the information processing perspective (e.g., Galbraith 1973, 1977; Tushman & Nadler 1978) and resource dependence theory (e.g., Pfeffer 1982; Pfeffer & Salancik 1978) to specify our research model and develop hypotheses for the relationships among the aforementioned constructs. These two theories are employed in our research because they have been used to complement each other in many existing studies towards the management of NPD projects (e.g., Atuahene-Gima & Evangelista 2000; Kyriazis et al. 2017; Massey & Kyriazis 2014; Ozer 2003; Song &

Xie 2000). The following subsections provide further explanations as to why we use these two perspectives to underpin our research.

3.2.1 Information processing perspective

At the organization level, information processing theory views organizations as information processing systems (Tushman & Nadler 1978), whose function is to reduce uncertainty and equivocality (Daft & Lengel 1986; Galbraith 1973, 1977, 1984). Uncertainty refers to 'the difference between the amount of information required to perform the task and the amount of information already possessed by the organization' (Galbraith 1977, pp. 36-37). There are four main categories of uncertainty identified by Moenaert & Souder (1990): consumer uncertainty (uncertainty about the needs of consumers), technological uncertainty (uncertainty about the best technology to use), competitive uncertainty (uncertainty about the competitors in the marketplace), and resource uncertainty (uncertainty about the resources needed to innovate). Equivocality is 'ambiguity, the existence of multiple and conflicting interpretations about an organizational situation' (Daft & Lengel 1986, p. 556). The fundamental proposition of information processing theory is that the greater the uncertainty and equivocality, the greater the amount of information that needs to be processed to attain an acceptable level of performance (Daft & Lengel 1986; Galbraith 1973, 1977, 1984).

At the level of the NPD project, according to the information processing perspective, NPD is frequently viewed as a process that consists of substantial information processing activities (Swink & Calantone 2004; Tatikonda & Montoya-Weiss 2001; Tatikonda & Rosenthal 2000), and NPD teams can be seen as information processing subsystems of the organization, whose function is to reduce uncertainties associated with customer, market, and technology in NPD process (Atuahene-Gima & Evangelista

2000; Kyriazis et al. 2017; Massey & Kyriazis 2014). Therefore, it is reasonable to employ the information processing view in our study, which examines the relationships between cross-functional integration mechanisms and NPD outcomes.

As suggested by this theory, when uncertainty and equivocality increase, this can require a large amount of information to be processed, and thus place demands on organizations to increase their capacity to process more information (Daft & Macintosh 1981; Tushman & Nadler 1978). Galbraith (1977) proposed several methods such as utilizing direct contact, establishing liaison roles, and employing temporary groups or permanent teams to create lateral relations, thereby enhancing the capacity for handling information. The information processing model of Daft & Lengel (1986) provided some potential structural mechanisms such as group meetings, integrator, formal information systems, and so forth, which can help reduce uncertainty and equivocality. New products and the NPD process are more likely to change often (Shafritz, Ott & Jang 2011). This implies that NPD is inherently uncertain and equivocal, and thus requires strategies to promote information processing capabilities and to decrease uncertainty and equivocality in the NPD process. The use of information processing theory, therefore, justifies the inclusion of cross-functional integration mechanisms in our conceptual framework.

As we mention above, one of four major sources of uncertainty comes from customers (Moenaert & Souder 1990). Firms are uncertain about the real needs or hard-to-articulate requirements of their customers (Bonner 2010; Souder & Moenaert 1992). Hence, involving customers in NPD projects can help firms deal with this kind of uncertainty. Based upon the information processing perspective, Bonner (2010) argued that interacting with customers in the NPD process could enhance NPD performance,

and his data supported this argument. We can see that this theoretical perspective is pertinent to the relationship between customer involvement in NPD projects and new product success. Accordingly, the use of information processing theory explains why we include customer characteristics in our conceptual model.

3.2.2 Resource dependence theory

In addition to the information processing standpoint, resource dependence theory (e.g., Pfeffer & Salancik 1978, 2003) also offers an appropriate theoretical background for scrutinizing the influence of cross-functional integration on NPD outcomes (Brettel et al. 2011; Ernst, Hoyer & Rübsaamen 2010).

Resource dependence theory has become one of the leading theories in organization theory and management research (Drees & Heugens 2013; Hillman, Withers & Collins 2009). The basic tenet of this theory is that organizations are not self-sufficient in generating all required resources that help them survive and develop (Aldrich & Pfeffer 1976; Pfeffer 1982), and therefore become interdependent with other organizations for the provision of essential resources (Drees & Heugens 2013; Hillman, Withers & Collins 2009). The resources include funds, customers, personnel, information, products, and services (Aiken & Hage 1968; Aldrich 1976).

This theory can be applied to the context of NPD projects since a certain NPD project can be considered as a temporary organization (Swink & Calantone 2004). At this level, resource dependence theory suggests that the interdependence and interaction among different functional specialists in a company are influenced by the achievement of collective tasks (Song & Swink 2002; Swink 1999; Swink & Song 2007). The development of new products is a complex process and involves a wide variety of tasks

(Song, Thieme & Xie 1998). Each functional area of an organization possesses specific resources needed for the NPD process (Ernst, Hoyer & Rübsaamen 2010). This means that every department is interdependent with other departments for accessing required resources. Hence, to attain individual and joint objectives as well as to improve NPD performance, functions that engage in a NPD project need to cooperate with each other to exchange vital resources (Ernst, Hoyer & Rübsaamen 2010; Song, Thieme & Xie 1998). However, securing essential resources may be problematic (Massey & Kyriazis 2014). To cope with this problem, at the firm level, resource dependence theory suggests firms should participate in various types of inter-organizational arrangements such as alliances, joint ventures, mergers and acquisitions, and so forth (Pfeffer & Salancik 1978, 2003). At the NPD project level, also derived from resource dependence theory, Olson, Walker & Ruekert (1995) proposed several lateral linkage devices (or coordination mechanisms) such as individual liaisons, temporary task forces, design teams, design centers, and so on in order to help different functional units secure the resources that they needed to achieve their ends. Thus, the use of resource dependence theory provides the explanation as to why we employ cross-functional integration mechanisms in our research.

As noted above, resource dependence theory postulates that firms depend upon other players in the marketplace for essential inputs. Customers have long been acknowledged as one of the most important elements of organizations (Salomo, Steinhoff & Trommsdorff 2003). There is, however, a general information asymmetry between customers and organizations (Salomo, Steinhoff & Trommsdorff 2003). Customers know what they need, and their long experience in using products or services may help them have ‘a better understanding of relevant product or service requirements’ than organizations (Salomo, Steinhoff & Trommsdorff 2003, p. 444). Therefore, in the

NPD process, information from customers can be seen as a vital resource that helps firms successfully develop new products (Gruner & Homburg 2000; Stock 2014). In addition to being considered as an information source, customers can also be regarded as a financial source by funding for research and development activities of NPD projects (Coviello & Joseph 2012). Accordingly, as predicted by resource dependence theory, customers are a crucial resource on which firms should rely to reduce the dependence on their environment and enhance organizational performance including NPD performance (Salomo, Steinhoff & Trommsdorff 2003). Using arguments based on resource dependence theory, Gruner & Homburg (2000) proposed and found that interacting with customers in the NPD process improved new product success. Also based on this theoretical perspective, the authors suggested and demonstrated that several customer characteristics, such as financial attractiveness and lead user characteristics, had positive and significant effects on NPD success. The evidence suggests that resource dependence theory is relevant to the relationship between customer participation in NPD projects and NPD performance. Hence, the use of this theory warrants the inclusion of customer characteristics in our theoretical framework.

Thus far, according to the information processing perspective, interdependence among different functional areas increases uncertainty for the reason that 'action by one department can unexpectedly force adaptation by other departments' (Daft & Lengel 1986, p. 565), and therefore requires a large amount of information to be processed (Scott 1981; Tushman & Nadler 1978). According to resource dependence theory, information can be considered as a crucial resource, and various functional units depend on each other for this resource to perform their tasks (Emerson 1962). This can be implied that the more the information is needed, the more the interdependence among different departments. From these points of view, we can see that the information

processing perspective is complementary to resource dependence theory and vice versa. The use of these two theories to underpin our study is therefore justified.

3.3 Conceptual framework

Based upon the above-mentioned theoretical frameworks, we propose two groups of variables that can explain the outcomes of NPD projects, namely cross-functional integration mechanisms and customer characteristics. Figure 3.1 below illustrates eight integration mechanisms and five customer characteristics that potentially affect three different NPD outcomes.

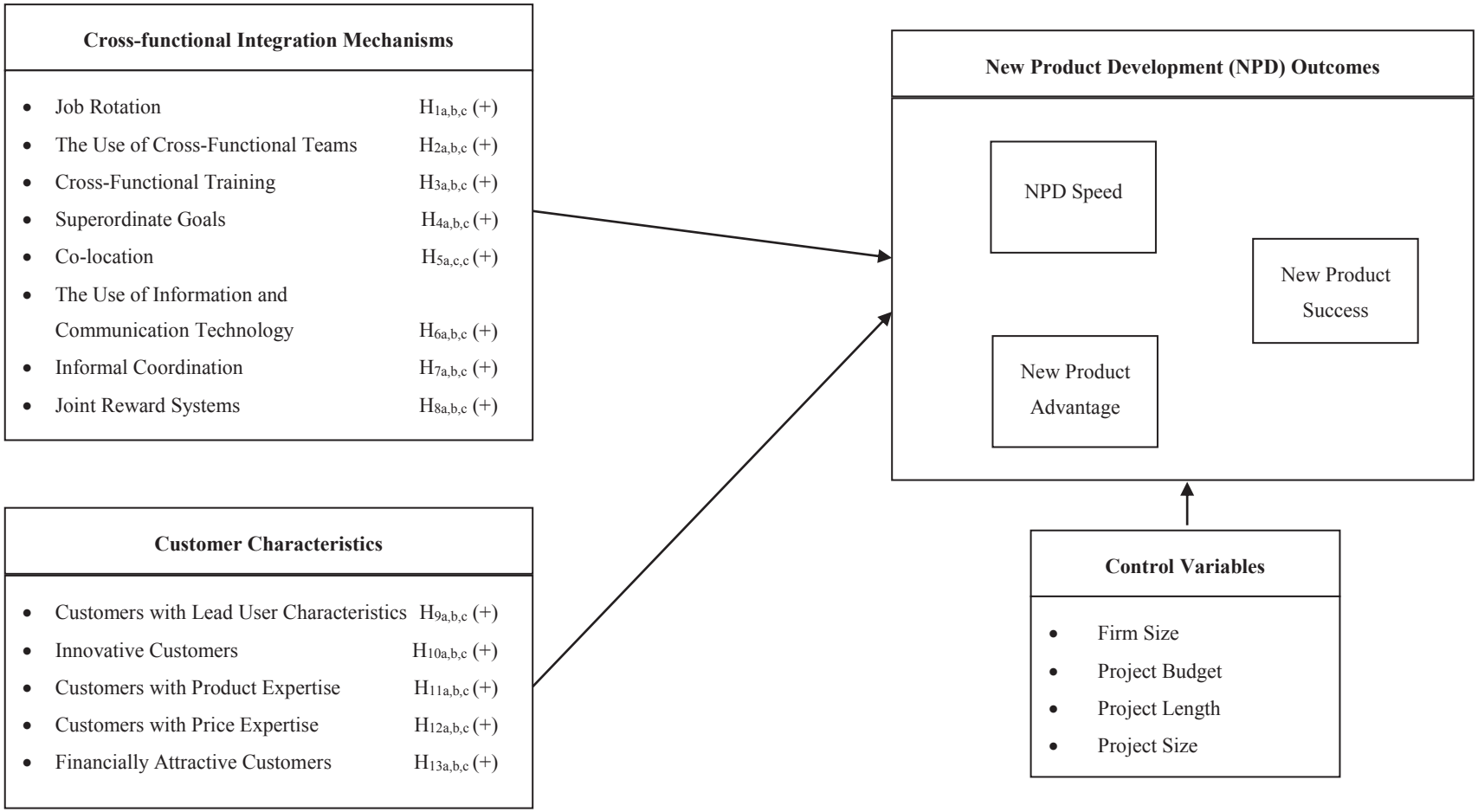

Figure 3.1 Conceptual model

3.3.1 Dependent variables

As discussed in Chapter 2, new product performance is a multi-dimensional concept. Paying attention to only one dimension of NPD outcomes may lead to a myopic view (Cooper & Kleinschmidt 1987), and 'multiple performance measures are better than a single measure' (Cooper & Kleinschmidt 1995a, p. 389). It has also been suggested that a sounder model should include a wide range of performance criteria (Menor, Tatikonda & Sampson 2002). Hence, in line with the multi-dimensional typology of NPD performance discussed by Tatikonda & Montoya-Weiss (2001), Carbonell, Rodríguez-Escudero & Pujari (2009), and Cankurtaran, Langerak & Griffin (2013) (see section 2.6 of Chapter 2), our research examines two operational outcomes of NPD projects, namely NPD speed and new product advantage, and one market outcome that is new product success in terms of financial performance.

We include the construct of new product success in terms of financial performance because the financial success of new products is not only the most important objective (Awwad & Akroush 2016) but also the ultimate goal of NPD projects (Cankurtaran, Langerak & Griffin 2013; Huang, Soutar & Brown 2004). The fact that financial performance is discussed in almost all of the studies that we present in section 2.6 of the previous chapter again accentuates that financial success of NPD projects is a crucial objective of firms.

Regarding NPD speed, nowadays, firms are confronted with continuously reduced product life cycle time and increased competition from globalization and advancements in technology (Carbonell & Rodriguez 2006b; Chen, Damanpour & Reilly 2010; Ozer 2000). This leads to the need for faster NPD because as first movers, firms can (1) 'establish technology and industry standard', (2) 'preempt scarce resources and

suppliers', (3) 'gain a competitive edge over later entrants', and (4) 'secure favorable market positions' (Cankurtaran, Langerak & Griffin 2013, p. 468). Accordingly, NPD speed is selected as the second NPD outcome that is examined in our study.

Finally, we include new product advantage in this research because it is an important NPD outcome and is found to be a dominant driver of NPD success regarding financial performance (see section 2.2 of Chapter 2). The definitions of three endogenous variables are presented below.

NPD speed refers to 'the pace of progress that a firm displays in innovating and commercializing new products' (Carbonell & Rodriguez 2006b, p. 2).

New product advantage is defined as the degree to which a new product outperforms competing products in terms of benefiting customers (Rijsdijk, Langerak & Hultink 2011).

New product success refers to the success of new products in terms of financial performance (McNally, Cavusgil & Calantone 2010).

3.3.2 Antecedent variables

3.3.2.1 Cross-functional integration mechanisms

According to Olson et al. (2001, p. 258), NPD is 'fundamentally a multidisciplinary process'. Hence, to succeed in developing new products, firms should employ appropriate mechanisms to integrate different people in different specialist functional areas, e.g., Marketing, Sales, and R&D. Griffin & Hauser (1996) reviewed the literature and suggested six methods used for integrating marketing and R&D, namely relocation and physical facilities, personnel movement, informal social systems and culture,

organizational structure, incentive and rewards, and formative integrative management processes. Leenders & Wierenga (2002) added the use of information and communication technology (ICT) to six integration methods of Griffin & Hauser (1996), and examined the effects of these seven mechanisms on marketing-R&D integration and NPD performance. Furthermore, there are also other integrating methods such as cross-functional training (e.g., Chimhanzi 2004; Lee & Markham 2013; Liker, Collins & Hull 1999; Shaw, Shaw & Enke 2003), inter-functional meetings (e.g., Lee & Markham 2013; Rho, Hahm & Yu 1994; St.John & Rue 1991), superordinate goals (e.g., Atuahene-Gima 2003; Pinto, Pinto & Prescott 1993), joint project management (e.g., Armstrong & Lengnick-Hall 2013; Jansen, Van-Den-Bosch & Volberda 2005), use of facilitators (e.g., Garrett, Buisson & Yap 2006; Olson, Walker & Ruekert 1995; Swink 1998), and so forth. An analysis of all mechanisms is beyond the scope of our study. We focus on the eight mechanisms that we have reviewed in Chapter 2 because the literature suggests that they are highly pertinent to and potentially affect the performance of NPD projects.

Following Arndt, Karande & Landry (2011), we classify integration mechanisms into three groups, that is (1) process-based mechanisms, (2) culture-based mechanisms, and (3) outcome-based mechanisms. Our study examines the impact on NPD performance of six process-based mechanisms, namely job rotation, cross-functional team use, cross-functional training, superordinate goals, co-location, and the use of information and communication technology (ICT); one culture-based mechanism named informal coordination; and one outcome-based mechanism which is joint reward systems. Each method is defined as follows.

Job rotation refers to 'the extent to which employees are assigned to areas outside their functional specialties' (Xie, Song & Stringfellow 2003, p. 237).

The use of cross-functional teams refers to the extent to which NPD teams consist of members from various relevant functional areas within the firm (Rauniar & Rawski 2012).

Cross-functional training refers to the extent to which employees in different functional areas are trained to work together effectively (Maltz & Kohli 2000).

Superordinate goals refer to the extent to which NPD team members accept the overall goals during the NPD project (Atuahene-Gima 2003).

Co-location refers to the extent to which NPD team members are located within close physical proximity to each other (Swink, Talluri & Pandejpong 2006).

The use of ICT refers to the extent to which employees from one function use information and communication technology such as telephone, video-conferencing, email, and internet to work with people from other functions during the NPD project (Koufteros & Marcoulides 2006).

Informal coordination refers to the extent to which the communication among employees from different functional areas is based on personal contact, which is not controlled by their managers (Willem & Buelens 2009).

Joint reward systems refer to the degree to which employees from one function are rewarded for working effectively with people from other functions and contributing to the overall goals of the organization (Arndt, Karande & Landry 2011).

3.3.2.2 Customer characteristics

The literature suggests that customers with lead user characteristics and close customers are the most useful customers to involve in the NPD process (e.g., Alam 2005; Bonner & Walker 2004; Carbonell, Rodriguez-Escudero & Pujari 2012; Coviello & Joseph 2012; Laage-Hellman, Linda & Perna 2014; Mahr, Lievens & Blazevic 2014; Noordhoff et al. 2011). Moreover, customers who possess technological knowledge or are representative of the target market are also appropriate for integration purposes (e.g., Coviello & Joseph 2012; Enkel, Perez-Freije & Gassmann 2005; Griffin 2013; Gruner & Homburg 2000). Our study investigates five types of customers, namely customers with lead user characteristics, innovative customers, customers with product expertise, customers with price expertise, and financially attractive customers. The rationale for this is that these customers are relevant to and potentially affect NPD performance, but little is known about the impact of these kinds of customers on NPD projects (see section 2.5 of Chapter 2).The definitions of these customers are presented below.

Customers with lead user characteristics refer to customers who identify needs, new solutions and applications for a product earlier than the rest of the market (Morrison, Roberts & Midgley 2004).

Innovative customers refer to customers who are willing to try new products, services, and technologies earlier than other customers (Bin 2013).

Customers with product expertise refer to customers who have good knowledge of a certain product (Mitchell & Dacin 1996).

Customers with price expertise refer to customers who can be viewed as a good source of information about product prices in the market (Kopalle & Lindsey-Mullikin 2003).

Financially attractive customers refer to customers who buy products in large volumes (Rocca, Caruana & Snehota 2012).

3.3.3 Control variables

As suggested by Sarin & McDermott (2003) and Neuman (2003), to make the test of our hypotheses more stringent and accurate, we also include four control variables in our research model. They are firm size, project size, project budget, and project length. Firm size is included because it is believed to positively affect NPD activities and outcomes (Chandy & Tellis 2000), and is used as a control variable in numerous NPD studies (e.g., Im & Nakata 2008; Nakata & Im 2010; Stock 2014). We employ project size and project budget since they are also well established as control variables in NPD research at the project level (e.g., Ernst, Hoyer & Rübsaamen 2010; Swink & Song 2007). An additional explanation for using project size is that the size of the project team can potentially impact work group effectiveness and project success (Campion, Medsker & Higgs 1993; Sarin & McDermott 2003). A further justification for choosing project budget is that a project with higher budget implies senior management have prioritized and will pay more attention to that project, and the support of senior managers has been found to positively influence NPD performance (Ernst 2002; Evanschitzky et al. 2012; Henard & Szymanski 2001). Finally, project length is adopted as a control variable for the reason that it may have negative effect on the outcomes of NPD projects, that is, a longer project is likely to be costly and less profitable (Swink & Song 2007). The control variables in our study are defined as follows.

Firm size refers to the number of full-time (and full-time equivalent) employees in a firm during the NPD project.

Project size refers to the number of full-time (and full-time equivalent) team members for the NPD project.

Project budget refers to the amount of money that is invested for the NPD project.

Project length refers to the length of the NPD project.

3.4 Hypothesis development

3.4.1 The effects of job rotation

Job rotation or personnel movement is a technique that employees are rotated among different functional areas (Griffin & Hauser 1996; Xie, Song & Stringfellow 2003). Moving people across functional areas offers personnel opportunities to communicate with their colleagues who have different backgrounds, expertise and professional orientations, which can help them understand the jargon and "thought-worlds" of employees in other departments. Thought-worlds refer to the world views in terms of the knowledge, attitudes, belief systems, and assumptions of different groups or departments (Dougherty 1992; Homburg & Jensen 2007). Job rotation also allows NPD team members to experience a variety of different roles in the NPD process and understand the difficulties and challenges that their counterparts have to confront. These things can help overcome the barriers of languages, thought-worlds, and personality differences (Griffin & Hauser 1996), minimize miscommunication (Seamon 2004), foster interaction and cooperation among people from different functional areas (Hauptman & Hirji 1999; Leenders & Wierenga 2002; Soderquist & Kostopoulos 2012), and lessen the cross-functional goal incongruity (Xie, Song & Stringfellow 2003); thereby smoothing the way for employees to carry out NPD activities. He, Sun &

Chen (2016) recently found that rotating employees between design and manufacturing functions positively affects the speed in the later stages of NPD projects.

Also, job rotation can help broaden the experience and knowledge of NPD team members (Campion, Cheraskin & Stevens 1994; Seamon 2004; Soderquist & Kostopoulos 2012; Song, Bij & Weggeman 2006; Swink 1998; Xie, Song & Stringfellow 2003), thereby enhancing their problem-solving skills that can help them easily and quickly deal with problems arising in the NPD process. As such, job rotation implies that it offers advantages in the form of reducing the overall time to develop new products. Park, Lim & Birnbaum-More (2009) provided empirical evidence that multi-knowledge team members had a positive impact on NPD time efficiency.

Additionally, information processing theory suggests that lateral relations can enhance the capacity for handling information (Galbraith 1977). Job rotation also promotes personal and professional relationships across departmental boundaries (Griffin & Hauser 1996). In the case that employees themselves cannot cope with their issues, they can ask for help from their networks, and these problems can be quickly overcome. Based upon these arguments, we believe that job rotation will improve the speed of NPD projects. Hence, we suggest that:

H1a: Job rotation positively affects NPD speed.

Souder & Moenaert (1992) argued that job rotation encouraged the transfer of innovative information among people from different departments. Jansen, Van-Den-Bosch & Volberda (2005) revealed that job rotation improved the capacity of team members to acquire, assimilate, and transform new external knowledge (e.g., from customers); thereby increasing the ability of firms to utilize and exploit market

information (Griffin & Hauser 1996; Maltz, Souder & Kumar 2001). By combining the innovative ideas from internal functions and important information from the marketplace, firms can introduce new products providing superior value for customers. This argument is supported by the finding of He, Sun & Chen (2016), which shows that job rotation enhances new product quality, whose main indicator is product innovativeness. Also, as mentioned previously, job rotation can lead to the high level of information sharing, which is positively associated with the financial success of new products (Fredericks 2005; Moorman & Miner 1997). It is therefore hypothesized that:

H1b: Job rotation positively affects new product advantage.

H1c: Job rotation positively affects new product success.

3.4.2 The effects of cross-functional team use

NPD is a complex and uncertain process (Lee & Chen 2007; Minguela-Rata & Arias-Aranda 2009). Therefore, according to resource dependence theory, the participation of employees from different departments in NPD teams is crucial because team members can bring a wide variety of ideas, perspectives and functional specialties needed to make complicated, non-routine decisions (Armstrong & Lengnick-Hall 2013; Fredericks 2005). Members of a diverse team can learn the languages of different professionals and then act as "translators" for colleagues in their home departments (Maltz & Kohli 2000; Maltz, Souder & Kumar 2001). This can decrease the barriers of functionally specialized languages and thought-worlds between different departments, thereby reducing perceived conflicts, enhancing the ability to solve problems and make decisions, and ultimately leading to the shorter time of developing new products (Griffin & Hauser 1996). Furthermore, early involvement of various departments in the

NPD process can lessen the waiting time between steps (Eisenhardt & Tabrizi 1995). From these points, we argue that using cross-functional teams can increase the pace of NPD activities even though Sarin & McDermott (2003) found no relationship between functional diversity and speed to market of new products. Eisenhardt & Tabrizi (1995) reported that using multifunctional team can help accelerate the NPD process. The finding of Zirger & Hartley (1996) revealed that cross-functional team use reduced the development time of new products by facilitating communication and cooperation, and decreasing goal incongruity among various functional areas. Carbonell & Rodriguez (2006a) also found that at an appropriate level of functional diversity in an NPD team, it had a positive effect on innovation speed. Therefore, we hypothesize that:

H2a: The use of cross-functional teams positively affects NPD speed.

The diversity of different functions in NPD teams also provides opportunities for team members to broaden and deepen their knowledge by combining new knowledge from other professions with their current knowledge base (Jansen, Van-Den-Bosch & Volberda 2005; Maltz, Souder & Kumar 2001). Also, Jansen, Van-Den-Bosch & Volberda (2005) revealed that cross-functional team use enhanced the capacity of team members to acquire, assimilate, and transform new external knowledge (e.g., from customers); thereby increasing their ability to utilize and exploit market information (Maltz, Souder & Kumar 2001). In addition to this, increasing the diversity of an NPD team can help to increase the probability that the team will discover novel ideas (Sethi, Smith & Park 2001). By using valuable selected information from the marketplace and innovative ideas of internal functions, firms can produce products that not only meet customer needs but also offer superior value to customers (i.e., product advantage).

Accordingly, we predict that the greater use of cross-functional teams can help firms produce new products that provide advantages in comparison with their competitors.

H2b: The use of cross-functional teams positively affects new product advantage.

Though the lens of information processing theory, cross-functional team use can promote information sharing among NPD team members (Daft & Lengel 1986; Egelhoff 1991), which is positively associated with the financial performance of NPD projects (Fredericks 2005; Moorman & Miner 1997). Additionally, the rational plan model of product development suggests that using cross-functional teams is strongly related to the financial success of new products (Brown & Eisenhardt 1995). Griffin (1997) found that companies with higher levels of financial success used cross-functional teams in NPD projects more extensively than firms with lower levels of financial success. We therefore hypothesize that:

H2c: The use of cross-functional teams positively affects new product success.

3.4.3 The effects of cross-functional training

Cross-functional training is an integration technique that aims to help employees in one functional area understand about other functional areas, and work effectively with people from those other departments. Employees can attend various forms of training. For example, employees can directly learn the subject matter of other departments, or they can take part in training sessions with people from other functions, or they can work in more than one department (i.e., job rotation) (Maltz & Kohli 2000). Such training enables employees in different functions to "speak the same language" by clarifying the terminology, acronyms, and processes of each function (Arndt, Karande & Landry 2011), thereby overcoming language and jargon barriers and reducing the

likelihood that misunderstanding occurs among various departments (Griffin & Hauser 1996; Maltz & Kohli 2000). The training also helps employees to improve their understanding of 'the goals, perspectives, and priorities' of other departments (Maltz & Kohli 2000, p. 481) and to 'build trust and sensitivity toward one another' (Cadogan et al. 2005, p. 522), thereby increasing the cooperation among different functional areas.

In terms of empirical evidence, training systems were found to lessen the inter-functional conflict and foster inter-functional connectedness (Cadogan et al. 2005). Cross-education and training were also found to enhance the coordination of activities between marketing and logistics departments (Mollenkopf, Gibson & Ozanne 2000). In short, these examples show that cross-functional training can help reduce inter-functional conflict and increase cross-functional integration, thereby smoothing the way for employees to perform their NPD activities. Accordingly, we believe cross-functional training can help decrease the development time of new products. As such, we hypothesize that:

H3a: Cross-functional training positively affects NPD speed.

Furthermore, cross-functional training adjusts the cognitive models of NPD team members and expands their tacit knowledge bases, thereby improving their ability to fully understand significant information across departmental boundaries (Hitt, Hoskisson & Nixon 1993), and facilitating their acceptance of doing things in novel ways (Cadogan et al. 2005). Also, cross-functional training can help increase knowledge sharing and information sharing activities of employees in different departments (Lee & Markham 2013; Mollenkopf, Gibson & Ozanne 2000). Mollenkopf, Gibson & Ozanne (2000) revealed that cross-education and training enhanced the dissemination of information between marketing and logistics departments. The more

information and knowledge that can be exchanged between departments, the more innovative ideas can be generated (Leenders, Kratzer & van-Engelen 2004). Thus, cross-functional training can improve employees' ability to work in an innovative manner and encourage knowledge sharing and information sharing. Park, Lim & Birnbaum-More (2009) found that the greater information sharing led to the higher levels of innovativeness of new products. Further, increased levels of knowledge sharing and information sharing can lead to increased levels of new product success in terms of profitability (Lee & Markham 2013; Moorman & Miner 1997). We therefore expect cross-functional training to help firms produce new products that offer greater value to customers, and these products are then financially successful.

H3b: Cross-functional training positively affects new product advantage.

H3c: Cross-functional training positively affects new product success.

3.4.4 The effect of superordinate goals

Superordinate goals refer to the overall goals of the NPD project to which team members commit during the project (Atuahene-Gima 2003). In theory, different departments in a particular firm should have complementary goals derived from a set of overall goals of that organization. Nevertheless, in practice, general goals are usually 'broken down into specific functional objectives that conflict with each other' (Pinto, Pinto & Prescott 1993, p. 1284). As a consequence, the difference in goals among various functional areas can reduce motivation for solving cross-functional conflicts in an active and cooperative manner (Song, Xie & Dyer 2000). Thus, committing to the overall goals can help promote a cooperative working environment for three reasons. First, it increases the interdependence among different functions, and accordingly the

need to cooperate (Fisher, Maltz & Jaworski 1997). Second, to achieve their collective goals, NPD team members should have mutual understanding, work together informally, and share their ideas and resources (Kahn & McDonough 1997b; Kahn & Mentzer 1998). Third, superordinate goals can help reduce tension among various functional areas (Le-Meunier-FitzHugh, Massey & Piercy 2011). Sherif (1962, cited in Pinto, Pinto & Prescott 1993, p. 1284) provided evidence that overall goals reduced intergroup conflict and enhanced intergroup cooperation. Pinto, Pinto & Prescott (1993) also found that superordinate goals had a positive impact on cross-functional cooperation. By increasing the level of cooperation in the working environment, NPD team members can work together more effectively. This can help reduce the time to complete their own tasks as well as the tasks of others. Therefore, the time to develop new products is diminished. We also posit that workplace cooperation can enhance information sharing and knowledge sharing among the members of NPD team, which are strongly associated with the financial success of new products (Lee & Markham 2013; Moorman & Miner 1997).

Moreover, resource dependence theory suggests that a fundamental strategy to reduce resource dependence is cooperation with resource owners (Gruner & Homburg 2000). By sharing common goals, team members can employ their collective authority to acquire and utilize internal expertise from other departments to solve their problems. They are more likely to find novel solutions because different departments possess quality ideas, knowledge and information (Atuahene-Gima 2003). This can help them prevent wasteful efforts and solve their own problems in a timely and innovative manner. Solving problems in a timely and innovative manner can offer advantages in terms of increasing the likelihood that the development process will meet scheduled milestones, and that products developed may have superior features in comparison with

competing products. The qualitative evidence of Soderquist & Kostopoulos (2012) suggests that shared goals allow NPD team members to align their activities towards the success of NPD projects. Kay et al. (2005) demonstrated that using shared goals and objectives is one of the common practices of the PDMA's Outstanding Corporate Innovator Award winners. Cooper (2013, p. 25) also found that NPD team members in firms that achieved the best NPD performances usually 'worked together to a common goal'. Thus, we suggest that:

H4a: Superordinate goals positively affect NPD speed.

H4b: Superordinate goals positively affect new product advantage.

H4c: Superordinate goals positively affect new product success.

3.4.5 The effects of co-location

Co-location refers to the extent to which NPD team members are located within close physical proximity to each other (Swink, Talluri & Pandejpong 2006). Allen & Fustfeld (1975) found that the probability of communication significantly decreased when the geographic distance increased. Therefore, locating team members close together can facilitate interaction and face-to-face communication among them (Hitt, Hoskisson & Nixon 1993; Kahn & McDonough 1997a; Schilling 2013; Sethi 2000b). From the view of information processing theory, face-to-face communication fosters rapid feedback, decoding, and synthesizing diverse and complicated information (Carbonell & Rodriguez 2006a; Jain, Triandis & Weick 2010; Sicotte & Langley 2000). It also allows transferring information by visual and audible means (Xie, Song & Stringfellow 2003), thereby increasing 'mutual understanding of constraints, limitations and potential problems' among team members (Zirger & Hartley 1996, p. 146). As a consequence,

co-location is expected to encourage greater information exchange and knowledge sharing (Griffin & Hauser 1996; Lee & Markham 2013) as well as decrease conflict among members of the NPD team (Maltz & Kohli 2000). In addition, Xie, Song & Stringfellow (2003) found that physical proximity lessened goal incongruity, which might lead to the conflicts of goal, decision criteria, and time among marketing, R&D, and manufacturing functions.

Co-location also provides more opportunities for team members to communicate and understand each other (Sethi 2000b; Sethi & Nicholson 2001. As a result, it can create a social bonds among them and improve cooperative behaviors (Sethi 2000b; Sethi & Nicholson 2001). Pinto, Pinto & Prescott (1993) found that physical proximity had a significant and positive influence on cooperation between various departments. A collaborative working environment may also facilitate the processes of problem-solving and decision-making among different departments (Ketokivi & Ali-Yrkkö 2009; Zirger & Hartley 1996), thereby smoothing the progress of NPD projects. A case study of Lakemond & Berggren (2006) revealed that co-locating dedicated employees of different departments to work with NPD projects enhanced cross-functional collaboration and speeded up the project progress. Similarly, Carbonell & Rodriguez (2006a) demonstrated that team proximity positively affected the speed of technologically complex projects. Analyzing three pairs of similar NPD projects, Zenun, Loureiro & Araujo (2007) found that the development time of NPD projects with co-located teams is shorter than that of NPD projects with no co-located teams. Thus, it is expected that:

H5a: Co-location positively affects NPD speed.

As discussed above, co-locating NPD team members facilitates face-to-face communication, reduces conflicts, and enhances information sharing and knowledge sharing. Sharing information and knowledge can lead to the higher levels of new product innovativeness (Park, Lim & Birnbaum-More 2009) and the financial success of new products (Lee & Markham 2013; Moorman & Miner 1997). We therefore believe that this practice can help firms produce superior products that are financially successful. Sethi & Nicholson (2001) demonstrated that physical proximity had a positive and significant relationship with new product market performance in terms of sales and market share. Kay et al. (2005) found that co-location is one of the common practices of the PDMA's Outstanding Corporate Innovator Award winners. Dayan & Di-Benedetto (2010) also found that the close proximity of NPD team members increased interpersonal trust among them, which in turn positively affected new product success. Hence, we hypothesize that:

H5b: Co-location positively affects new product advantage.

H5c: Co-location positively affects new product success.

3.4.6 The effects of information and communication technology (ICT)

Information and communication technology (ICT), such as telephone, video-conferencing, email, and the internet, provide opportunities for easily contacting people and finding, processing, and exchanging information in an effective way (Leenders & Wierenga 2002). In the context of NPD, ICT tools such as email and web meetings encourage more frequent communication because of their low cost, thereby enhancing information sharing among team members of NPD projects (Durmuşoğlu & Barczak 2011; McDonough & Kahn 1996). Additionally, the internet can promote the

collaboration of various employees who are involved in NPD projects and coordinate NPD activities more effectively (Crawford & Di-Benedetto 2011, 2015; Marion, Barczak & Hultink 2014; Ozer 2003). Leenders & Wierenga (2002) found that the use of ICT positively affected integration between marketing and R&D personnel. By increasing cross-functional integration and information sharing among NPD team members, ICT use can enhance the pace of NPD activities (Ozer 2004). Ozer (2000) also observed that firms in a wide range of industries used information technology to speed up their NPD process. Consequently, we hypothesize that:

H6a: The use of ICT positively affects NPD speed.

According to Durmuşoğlu & Barczak (2011), ICT tools such as email and web meetings can help firms increase the competitive advantage of new products in two ways. First, by facilitating communication among NPD team members, email and web meetings can help develop new products that can meet customer needs and perform their expected functions. Second, by enhancing collaboration, NPD team members can mesh various perspectives on the market opportunities and the new product concepts under development, thereby increasing the likelihood of producing highly innovative products. Another ICT tool, namely the internet, can help firms gather, classify and utilize relevant information for developing new products, thereby reducing the fuzziness of the NPD process and permitting them to understand the marketplace better (Ozer 2003). By better understanding their market, firms can develop new products that offer superior value to their customers (Ozer 2004). Thus, we believe that using ICT tools can help increase the advantages of new products. We, therefore, hypothesize that:

H6b: The use of ICT positively affects new product advantage.

ICT can be seen as a powerful tool to rapidly communicate NPD project information and new products to wide audiences in the market (Swink 1998). By quickly doing so, firms can receive a lot of helpful feedback from customers, which helps firms produce new products that meet customers' needs. In addition to this, customers can also quickly be made aware of new products. These factors can lead to the high probability of new product success. As noted above, the frequent use of ICT also enhances knowledge and information sharing among NPD team members (Carbonara 2005; Durmuşoğlu & Barczak 2011; Pavlou & El-Sawy 2006), which is positively associated with the commercial success of new products (Lee & Markham 2013; Moorman & Miner 1997). The empirical study of Barczak, Sultan & Hultink (2007) supported the positive effect of information technology usage on the market performance of NPD projects. Hence, we expect that:

H6c: The use of ICT positively affects new product success.

3.4.7 The effects of informal coordination

As defined earlier, informal coordination refers to the way employees from different functional areas work and communicate together is based on personal contact, which is not controlled by their managers (Willem & Buelens 2009). Informal contact is part of the informal social system that can be a substitute for formal NPD processes (Griffin & Hauser 1996). Informal social systems provide opportunities for employees to directly communicate with each other in social settings or non-work related environments such as recreational activities, picnics, and company parties (Maltz & Kohli 2000; Maltz, Souder & Kumar 2001). These informal conversations are vital to help them reduce misunderstandings among each other and functions, develop friendship, and decrease both perceived and manifest inter-functional conflict (Maltz & Kohli 1996, 2000). In

addition to this, Griffin & Hauser (1996) argued that informal social systems can enhance open communication and provide contacts both inside and outside the NPD team. Accordingly, NPD team members can request help from or jointly work with other people who possess the essential expertise to solve particular problems (Chimhanzi 2004; Griffin & Hauser 1996). This can help them perform their tasks easier and faster. This also implies that under these conditions, NPD projects can be completed on or ahead of their schedule.

From the information processing perspective, direct contact, a form of informal coordination, can relieve information overloads (Galbraith 1973) and decrease uncertainty and equivocality in the NPD process (Daft & Lengel 1986; Souder & Moenaert 1992). This helps NPD team members save time in processing information, thereby decreasing the development time for new products.

Also, it is expected that informal communication, which allows information to flow freely and ideas to be exchanged easily, helps firms produce new products that are highly innovative (Olson, Walker & Ruekert 1995; Rouziès et al. 2005). A product with the high levels of innovativeness can offer advantages over competing products.

Furthermore, informal coordination based upon trust and voluntary collaboration can create a higher willingness to cooperate as well as share knowledge and information among employees in various departments (Egelhoff 1991; Willem & Buelens 2009). Sharing knowledge and information can enhance the commercial success of new products (Lee & Markham 2013; Moorman & Miner 1997). According to Pinto & Pinto (1990), informal communication is vital for the success of R&D projects. Griffin & Hauser (1996) also postulated that developing informal cross-functional networks can

lead to successful NPD projects in terms of profitability and marketplace success. Thus, we propose that:

H7a: Informal coordination positively affects NPD speed.

H7b: Informal coordination positively affects new product advantage.

H7c: Informal coordination positively affects new product success.

3.4.8 The effects of joint reward systems

Joint reward systems refer to the degree to which employees from one function are rewarded for working effectively with people from other functions and contributing to the overall goals of the organization (Arndt, Karande & Landry 2011). Rewarding employees for achieving the common organizational goals rather than individuals' or departments' performance promotes cross-functional interaction (Cadogan et al. 2005). The reason is that different functions are interdependent in goal achievement (Fisher, Maltz & Jaworski 1997), and NPD team members understand that these common ends cannot be attained by working individually (Hauser, Simester & Wernerfelt 1994). By providing employees with incentives to interact with colleagues in other departments, joint reward systems can reduce language barriers that are a prime source of cross-functional conflict (Maltz & Kohli 2000). It also aligns the objectives and responsibilities of employees in different functions, thereby reducing the conflicts among them (Griffin & Hauser 1996; Maltz & Kohli 2000; Xie, Song & Stringfellow 2003). Cadogan et al. (2005) found that market-oriented reward systems recognizing the achievement of common goals partially eliminated the sources of conflict between exporting and non-exporting functions.

From the view of information processing theory, a system rewarding cooperative behaviors is essential (Galbraith 1973) because it increases cooperation and integration between various functional areas (Cadogan et al. 2005; Coombs & Gomez-Mejia 1991; Gupta, Raj & Wilemon 1986; Mollenkopf, Gibson & Ozanne 2000; Rouziès et al. 2005; Wageman & Baker 1997). Joint rewards and incentives were found to enhance the integration between marketing and R&D departments (Leenders & Wierenga 2002). Market-oriented reward systems encouraging the accomplishment of shared goals were also found to positively affect cross-functional integration (Im & Nakata 2008; Nakata & Im 2010).

Furthermore, joint reward systems are likely to enhance the flow of information (Cadogan et al. 2005) and promote information sharing among employees of various functional areas (Coombs & Gomez-Mejia 1991). Song, Neeley & Zhao (1996) found that rewards for collaboration and cooperation improved the quantity and quality of information exchanged during the planning and implementation stages of NPD projects.

By decreasing conflict, enhancing cooperation and integration, and fostering information sharing among employees, joint reward systems can help smooth the way for them to perform NPD activities. As Ozer (2000) suggested, group-based rewards could advance group performance. Hauptman & Hirji (1999) found that group rewards increased the extent of overlap in problem-solving between R&D/Engineering and Manufacturing personnel. Accordingly, we believe that joint reward systems help reduce the development time of new products.

H8a: Joint reward systems positively affect NPD speed.

As discussed earlier, joint reward systems can promote information sharing among NPD team members, which help firms produce highly innovative products (Park, Lim & Birnbaum-More 2009). In addition, rewarding all employees who contribute to the overall goals of NPD projects can 'lead to increased profits' (Griffin & Hauser 1996, p. 209) and assure the financial success of new products (Nakata & Im 2010). Gomez-Mejia & Balkin (1989) found that team-base rewards had a significant and positive influence on the performance of R&D projects. Market-oriented reward systems were also found to enhance cross-functional integration (Im & Nakata 2008; Nakata & Im 2010), which in turn had a positive impact on new product advantage (Im & Nakata 2008) and new product success (Nakata & Im 2010). Based upon the evidence available to us, we believe that joint reward systems can help firms increase the advantages and the success of new products. Therefore, we suggest that:

H8b: Joint reward systems positively affect new product advantage.

H8c: Joint reward systems positively affect new product success.

3.4.9 The effects of customers with lead user characteristics

As noted earlier, lead users are users who (1) face the new needs of products earlier than other users and (2) significantly benefit by achieving solutions to those needs (von-Hippel 1986, 1988). It is argued that involving customers with lead user characteristics can help firms increase NPD speed (Carbonell, Rodriguez-Escudero & Pujari 2012; Schirr 2013) for several reasons. First, according to information processing theory, firms are uncertain about the needs of customers (Souder & Moenaert 1992). Lead users can provide firms with both need and solution information (Langerak, Peelen & Nijseen 1999; Morrison, Roberts & von-Hippel 2000; Urban & von-Hippel 1988; von-Hippel,

Thomke & Sonnack 1999). By providing need information, customers with lead user characteristics can help firms prevent postponements because of a mismatch between the ideas generated within firms and the needs of customers (Langerak, Peelen & Nijseen 1999). The empirical study of Herstatt & von-Hippel (1992) reported that working with lead users helped firms faster identify the promising concepts of new products. By suggesting solution information, they can help firms faster cope with the problems related to NPD activities. Second, they are highly motivated to participate in the innovation and interaction process (Alam 2005, 2011; Franke, von-Hippel & Schreier 2006). Accordingly, it may be valuable for firms to invite lead users to take part in NPD projects, and to acquire their helpful knowledge. Lead users are also willing to freely share their innovations (Alam 2011; Schirr 2013) and help NPD team members understand the nature of innovations (von-Hippel, Thomke & Sonnack 1999). This can help project team members perform their NPD activities faster. Finally, lead users can help improve the cooperation between technical and marketing groups within a firm because they can articulate their needs by the language that is meaningful to both groups (Herstatt & von-Hippel 1992). Prior research documents a significant and positive relationship between cross-functional cooperation and speed to market (Cankurtaran, Langerak & Griffin 2013; Chen, Damanpour & Reilly 2010). Therefore, it is reasonable to expect that working with customers with lead user characteristics can help firms enhance their NPD speed. More formally, we hypothesize that:

H9a: Customers with lead user characteristics positively affect NPD speed.

According to Noordhoff et al. (2011), in the innovation process, firms benefit from customers who can generate innovative ideas because innovation is an uncertain process that requires dependable information about the latent needs of customers. Lead users

can be seen as a source of 'novel product concepts' (von-Hippel 1986, p. 791) or 'innovative new product opportunities' (Alam 2005, p. 259), and they can offer insightful and reliable understanding of customers' needs to firms (Carbonell, Rodriguez-Escudero & Pujari 2012). Also, their novel knowledge is understandable for NPD teams and can be easily incorporated into new products (Mahr, Lievens & Blazevic 2014). As discussed earlier, Lilien et al. (2002) compared the novelty of ideas generated by lead user technique and those generated by the conventional method. Regarding lead user idea-generation technique, the authors obtained both need and solution information from lead users. Concerning the traditional method, the authors asked only the need information of users or customers of the intended target market. Their findings suggested that the ideas generated by lead user technique were more novel than those generated by the conventional method. Carbonell, Rodriguez-Escudero & Pujari (2012) also found that lead users had a positive impact on new service advantage. We therefore expect that customers with lead user characteristics can help firms develop new products or services with superior value to customers.

H9b: Customers with lead user characteristics positively affect new product advantage.

Through the lens of resource dependence theory, information on customer needs provided by lead users can be seen as a resource on which firms should depend to develop new products successfully (Gruner & Homburg 2000). Alam (2011) suggested that in new product or service development, properly using data from lead users enables firms to discover profitable new opportunities. Similarly, Coviello & Joseph (2012) proposed that when technology firms conduct NPD with customers who are lead users, those new products tend to be successful. In keeping with these notions, by helping

firms enhance NPD speed and the advantages of new products, we also believe that customers with lead user characteristics can help firms achieve new product success in terms of financial performance. In the field of computer-aided systems for designing printed circuit boards (PC-CAD), Urban & von-Hippel (1988) demonstrated that new product concepts generated by lead users were strongly preferred by the majority of PC-CAD users. Also, Gruner & Homburg (2000) found that customers with lead user characteristics had a positive influence on the success of new products. Lilien et al. (2002) reported that the annual sales of new products developed from lead users' ideas were more than eight times higher than those of new products developed from the traditional technique. Hence, we hypothesize that:

H9c: Customers with lead user characteristics positively affect new product success.

3.4.10 The effects of innovative customers

Innovative customers are those customers who have a willingness to try new products, services, and technologies (Bin 2013). They tend to deal with uncertain usage circumstances at the cutting edge of the market, and therefore quickly discern the drawbacks of existing products, however they are also the ones who can suggest promising improvements (Schreier & Prügl 2008). Simply put, they can uncover not only problems but also solutions associated with existing products. Consequently, involving innovative customers help firms save time in generating ideas and developing new product concepts that meet the needs of target customers. Furthermore, due to their innate willingness to try new products, services, and technologies, they tend to quickly accept the invitation of firms to test trial versions of new products. This can help firms reduce time in testing new products. Moreover, with the ability to discover both

problems and solutions, innovative customers can help firms quickly identify the shortcomings of trial versions of new products as well as soon find solutions to overcome these defects, thereby reducing the time which firms should spend at the product testing stage. Taken together, we believe that involving innovative customers can enhance the speed of NPD projects.

H10a: Innovative customers positively affect NPD speed.

Customers with the high level of innovativeness can easily recognize the prospective applications from others' suggestions but apply them in novel ways rather than in a machinelike manner (Bin 2013). They are willing to learn during the NPD process, and therefore overcome the lack of foresight (Coviello & Joseph 2012). They are also active information-seekers and have the ability to obtain information and knowledge from a wide range of external sources (Rogers 2003). As a result, we believe that innovative customers can provide novel solutions, and involving them in NPD activities can help firms introduce new products with superior value to customers. Hence, we hypothesize that:

H10b: Innovative customers positively affect new product advantage.

Under the view of resource dependence theory, information on problems and solutions related to existing products or trial versions of new products provided by innovative customers can be considered as resources upon which firms should rely to successfully develop new products (Gruner & Homburg 2000). Innovation diffusion theory suggests that innovative customers are more likely to appreciate innovation and adopt new products (Rogers 2003). The reason is that they not only tend to seek new ideas and experiences but also are inherently venturesome, and therefore respond favorably to

new products (Truong et al. 2014). This theory also suggests that innovative customers are commonly inclined to be opinion leaders from whom potential customers look for advice and information about new products (Rogers 2003). In a case study conducted by Enkel, Perez-Freije & Gassmann (2005), data collected in a Swiss engineering firm illustrated that this company concentrated more on integrating reference customers into their NPD process. Consequently, working with innovative customers can increase the probability that they accept the new products of firms. They also make valuable comments about the new products. This can help these products to be widely accepted by a larger number of prospective customers. Thus, we suggest that:

H10c: Innovative customers positively affect new product success.

3.4.11 The effects of customers with product expertise

Customers with product expertise are those customers who have good knowledge and experience with a certain product (Mitchell & Dacin 1996). By frequently using a product, customers can acquire very clear, relevant and highly trustworthy knowledge including know-how about the structure, the materials used and technologies of the product (Lüthje 2004). Generally, customers cannot provide information about the things with which they are unfamiliar (Griffin 2013). Therefore, customers with product expertise can provide reliable information about the product issues that firms are trying to understand when they conduct NPD (Griffin 2013). Through the lens of information processing theory, trustworthy information helps reduce uncertainty in NPD projects and therefore speed up the NPD process.

Moreover, those with high levels of product expertise can help firms early recognize the prospective problems and shortcomings in the product design stage (Bin 2013), thereby saving the time for redesigning new products.

Furthermore, in the product testing stage, customers are considered to possess an inherent ability to uncover the weaknesses of product that the testing groups of firms could never have envisaged (Cooper 2001). Those with good product knowledge tend to give more careful consideration and express more precise reactions than normal customers (Crawford & Di-Benedetto 2011). Accordingly, inviting knowledgeable customers to be members of product use testing groups can help reduce the time for testing new products. Based on these arguments, we propose that:

H11a: Customers with product expertise positively affect NPD speed.

Customers with product expertise are highly demanding and expect new products will be more superior or advanced than existing products, so they frequently complain about the disadvantages of the current products (Alam 2005). However, they are knowledgeable, so they can clearly articulate their needs and may propose possible solutions to the problems associated with the existing products. Based upon the constructive complaints and helpful suggestions of these customers, firms can come up with novel ideas to introduce highly innovative products into the market. For example, Alam (2005) reported that a well-known company had produced a novel hands-free battery-operated lawnmower from the complaints and suggestions of customers. Accordingly, we argue that involving customers with product expertise help firms increase the advantages of new products. Lüthje, Herstatt & von-Hippel (2005) revealed that mountain bikers who experienced directly and repeatedly troubles linked to mountain biking often had outstanding ideas. Thus, manufacturers could produce new

mountain bikes with superior value if they involved these experienced mountain bikers in their NPD process. Hence, it is expected that:

H11b: Customers with product expertise positively affect new product advantage.

Before we can make any propositions about the relationship between customers with product expertise and the commercial success of new products, we should review the concept "market mavens" suggested by Feick & Price (1987). Market mavens refer to customers 'who have information about many kinds of products, places to shop, and other facets of markets, and initiate discussions with consumers and respond to requests for market information' (Feick & Price 1987, p. 85). Therefore, customers with product expertise in our study can be regarded as a specific type of market maven.

Market mavens or customers with product expertise are more likely to buy new products (Steenkamp & Gielens 2003) because they wish to attain and transfer new product information, as well as usage experience, to other customers (Feick & Price 1987). Inviting them to participate in NPD projects can help increase their awareness about a firm's new products, thereby increasing the probability that they will make a purchase.

Additionally, customers with product expertise can be seen as opinion leaders (Feick & Price 1987; Steenkamp & Gielens 2003) from whom ordinary customers will seek advice and information about new products (Rogers 2003). By working with them in NPD projects, they can help diffuse good information about the new products of firms, thereby enhancing the adoption of new products by a larger amount of potential customers.

Furthermore, as discussed above, customers with product expertise can express their needs and propose solutions to the problems related to existing products. As suggested by resource dependence theory, need and solution information provided by these customers can be viewed as resources that help firms to develop successful new products (Gruner & Homburg 2000). Thus, it is hypothesized that:

H11c: Customers with product expertise positively affect new product success.

3.4.12 The effects of customers with price expertise

Customers with price expertise refer to customers who can be viewed as a good source of information about product prices in the market (Kopalle & Lindsey-Mullikin 2003). Interacting with these customers may help firms reduce the time for developing new products in two ways. First, to conduct NPD projects, firms need components, raw materials, and services from outside suppliers. Hence, choosing the right suppliers is paramount (Koufteros, Cheng & Lai 2007). However, the problem is how can firms know which suppliers are the most suitable partners (Petersen, Handfield & Ragatz 2005)? This means firms need to establish criteria and spend time evaluating every supplier based on these conditions. Price or cost of the inputs from suppliers is one of the most important criteria for firms to select their partners (Ho, Xu & Dey 2010; Melander 2011; Petersen, Handfield & Ragatz 2005). Customers with price expertise, who know 'where to get a good price on products' (Feick & Price 1987, p. 84), can help firms quickly identify the suppliers that offer the best price for them, thereby decreasing the time for selecting suitable partners. Second, customers who are knowledgeable about product prices in the market can also help firms rapidly determine the appropriate prices for new products before introducing them to the marketplace. Accordingly, we

posit that consulting customers with price expertise enables firms to reduce their development time of new products and hypothesize that:

H12a: Customers with price expertise positively affect NPD speed.

Handfield et al. (1999) estimated that the required inputs (e.g., components, raw materials, and services) from outside suppliers could account for over 50% of the cost of a new product. Thus, firms consistently look for ways to significantly lessen product cost (Ragatz, Handfield & Petersen 2002). As discussed above, customers with price expertise can suggest the best suppliers in terms of price or cost. This can help firms reduce the costs of developing new products, and then introduce the products with the most appropriate prices. As such, cost savings can be passed onto consumers in the form of lower prices, which is an important ingredient of a superior product (Cooper 2001; Crawford & Di-Benedetto 2011). We, therefore, postulate that working with customers who have good knowledge about product prices in the market can enhance the advantage of new products.

H12b: Customers with price expertise positively affect new product advantage.

As discussed in section 2.5.4 of Chapter 2, product price is important for firms to succeed with new products. Accordingly, under the view of resource dependence theory, information on product prices provided by customers with price expertise can be regarded as resources on which firms should rely to develop new products successfully. Further, customers are the ones who decide whether the price of a product is right or not (Kumar & Phrommathed 2005). Consequently, the pricing decisions of firms should start with customer value (Kotler et al. 2009). Involving customers with price expertise in NPD projects can help firms set appropriate prices for new products, A suitable price

diminishes the risks of underpricing relative to customers' perception of value, and overpricing that leads to lower expected sales (Ingenbleek, Frambach & Verhallen 2013; Kotler et al. 2009). The pricing decisions based upon the customers' perception of new product value were found to improve the market performance of new products (Ingenbleek et al. 2003; Ingenbleek, Frambach & Verhallen 2013). Therefore, we believe customers with price expertise help firms enhance the financial success of new products and suggest that:

H12c: Customers with price expertise positively affect new product success.

3.4.13 The effects of financially attractive customers

As discussed in section 2.5.5 of Chapter 2, financially attractive customers are defined as those who buy products in large volumes. Because they have the capability to make bulk purchases, we suspect that they are more likely to be organizations or firms rather than individual customers. As organizations, they have resources such as human, finance, knowledge, production facilities, and so forth, which are helpful for manufacturing firms to develop new products (Laage-Hellman, Linda & Perna 2014). Through the lens of resource dependence theory (e.g., Pfeffer & Salancik 1978, 2003), the resources of these customers, which complement that of producers, can help the producers overcome the problem of resource shortage, thereby reducing the waiting time for required resources. Therefore, we believe that cooperating with financially attractive customers in developing new products accelerate the NPD process.

H13a: Financially attractive customers positively affect NPD speed.

As has just been mentioned above, customers who make large volume purchases may possess strong financial resources. This allows these customers to provide financial

support for manufacturers when they develop new products. It has been documented that numerous NPD projects lack resources (Cooper 1998), and only 10.7% of firms have adequate resources for their NPD projects (Cooper 2005b, 2013). One executive stated that '*my business has a limited R&D budget … If I had a larger R&D budget, then I might tackle some more venturesome projects*' (Cooper 2005, p. 97). We argue that based upon the financial support from financially attractive customers, firms can heavily invest in research and development activities. This enables them to produce innovative products that offer many advantages to customers. Thus, we hypothesize that:

H13b: Financially attractive customers positively affect new product advantage.

Financial support from financially attractive customers can alleviate the financial risk of NPD projects (Coviello & Joseph 2012). Moreover, big customers are ready buyers for subsequent products (Enkel, Kausch & Gassmann 2005). Therefore, working with them in the NPD process can increase the likelihood that they accept the new product and buy it in large volumes. Gruner & Homburg (2000) found that cooperating with financially attractive customers positively affected new product success. Consequently, although there is a difference between us and Gruner & Homburg (2000) in defining the concept of financially attractive customers, we still expect that involving these customers in NPD projects helps firms enhance the commercial success of NPD projects. Hence, we propose that:

H13c: Financially attractive customers positively affect new product success.

3.5 Conclusion

The information processing perspective and resource dependence theory provide the theoretical background for our research. Based on these two theories and derived from the literature, we propose eight cross-functional integration mechanisms and five customer characteristics that are likely to affect three different outcomes of NPD projects. In total, 39 hypotheses are developed. Job rotation, cross-functional team use, cross-functional training, superordinate goals, co-location, the use of ICT, informal coordination, and joint reward systems are hypothesized that they positively impact on NPD speed, new product advantage, and new product success. In a similar vein, we propose that involving customers with lead user characteristics, innovative customers, customers with product expertise, customers with price expertise, and financially attractive customers in NPD projects has significant and positive influence on all of three NPD outcomes. The next chapter presents a set of methods to test the hypotheses.

CHAPTER 4 METHODOLOGY

4.1 Introduction

This chapter presents the methodology used in our study. First, we explain why we embrace positivism as our research philosophy. Next, the use of a deductive approach is justified. We then provide some explanations as to why we choose a quantitative strategy and employ cross-sectional design for our study. The constructs' measures are also presented. After that, we present how the sampling frame is constructed and how we collect the data. We then discuss the methods of data analysis and give some reasons why we select PLS-SEM approach. Finally, human research ethics are considered.

4.2 Research philosophy

Research philosophy is defined as 'a system of beliefs and assumptions about the development of knowledge' (Saunders, Lewis & Thornhill 2016, p. 124). Understanding research philosophy is useful because of four reasons explained by Easterby-Smith, Thorpe & Jackson (2015, p. 46). First, it helps researchers better understand their role in research methods. Second, the knowledge of philosophy helps clarify the designs of research. Third, it helps researchers know which designs should be used and which ones should not. Finally, it helps researchers recognize and modify research designs according to 'the constraints of different subjects or knowledge structures'.

In terms of marketing research, all marketing studies have their own philosophical underpinnings (Hunt 2014). Marketing researchers can choose positivism, or realism, or interpretivism, or pragmatism, and so forth as a philosophical foundation for their research. There have been long-standing debates among scholars on which "ism" is

more appropriate for marketing and consumer research. For example, there has been a debate between Shelby Hunt, who advocates scientific realism, and Paul Anderson, who is in favour of critical relativism (Kavanagh 1994; Tadajewski 2014). It seems that the marketing's philosophy debates will never come to an end because researchers have different assumptions as to the most suited paradigm for conducting their own studies (Hunt 2014; Wilson 2014). With respect to our research, we employed a positivist perspective for several reasons, which we now outline.

First, positivists argue that a certain study should be carried out in a value-free manner (Carson et al. 2001; Saunders, Lewis & Thornhill 2016), and it is not based on 'personal, political, or religious values' (Neuman 2003, p. 74). This is also our point of view when we conduct the research.

Second, positivism seeks for objective research by suggesting that observer should be independent from what is observed (Carson et al. 2001; Easterby-Smith, Thorpe & Jackson 2015; Neuman 2003). In line with this school of thought, we wish to ensure the objectivity of our study by keeping our distance from research participants.

Third, positivist researchers wish to conduct their studies in a scientific manner (Easterby-Smith, Thorpe & Jackson 2015; Wilson 2014) and want their results obtained from a sample 'to have applicability to the whole of a population' (Wilson 2014, p. 9). We also wish to generalize our research findings and therefore adopt positivist philosophy.

Finally, positivism is widely acknowledged and applied in social science, management, and business research (Easterby-Smith, Thorpe & Jackson 2015; Neuman 2003, 2014; O'Gorman & MacIntosh 2015), particularly in marketing research (Anderson 1983;

Deshpande 1983; Hunt 1994, 2014; Peter & Olson 1983). Numerous applied researchers including marketing researchers employ a positivist paradigm in their studies (Neuman 2003, 2014), and approximately 80 per cent of articles published in the top tier US-based journals are positivist (Easterby-Smith, Thorpe & Jackson 2015). The prevalence and relevance of positivism in marketing research motivated us to choose it for our study.

4.3 Research approach

Two main approaches that researchers usually adopt when they conduct their research are deduction and induction (Hyde 2000; Wilson 2014). A deductive approach is defined as a theory testing process, which involves applying existing theory to develop a hypothesis (or hypotheses) and testing the hypothesis (Hyde 2000; Saunders, Lewis & Thornhill 2016; Wilson 2014). In contrast, an inductive approach is defined as a theory building process, which concerns collecting data and developing theory from the result of data analysis (Hyde 2000; Saunders, Lewis & Thornhill 2016; Wilson 2014).

As discussed earlier, positivism suggests that research should be conducted using scientific methods, and is often based on the deduction process, moving from theory to findings (Wilson 2014). As mentioned previously, we consider ourselves positivists, and therefore follow a deductive approach for our study. Another justification for choosing this approach is because the role of deduction has been historically emphasized in marketing research (Bonoma 1985).

The process of deduction is presented in figure 4.1. Following this process, in Chapter 3, we employed the information processing perspective and resource dependence theory to develop hypotheses about the relationships among cross-functional integration

mechanisms, customer characteristics, and the outcomes of NPD projects. This chapter presents the strategy to collect data. The findings are illustrated and discussed in Chapter 5 and Chapter 6.

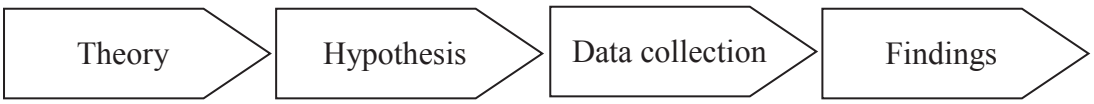

Figure 4.1 The process of deduction

Sources: Adapted from Bryman (2012); Bryman & Bell (2015); and Wilson (2014)

4.4 Research strategy

Quantitative research and qualitative research are two key research strategies in business research (Wilson 2014). Quantitative strategy puts emphasis on 'quantification in the collection and analysis of data' (Bryman & Bell 2015, p. 37). On the contrary, qualitative studies stress the importance of 'words' (Bryman & Bell 2015, p. 38). In addition to these two main strategies, researchers have increasingly used mixed methods research strategies that combine both quantitative and qualitative approaches to carry out business research (Bryman & Bell 2015; Wilson 2014). Regarding our study, we chose a quantitative strategy for several reasons.

First, quantitative studies are generally underpinned by positivism (Creswell 2014; Deshpande 1983; Hyde 2000; Neuman 2003, 2014; Saunders, Lewis & Thornhill 2016). Our research is guided by a positivist school of thought. Therefore, choosing the quantitative strategy is plausible.

Second, quantitative research usually follows a deductive process (Hyde 2000; Neuman 2003, 2014; Saunders, Lewis & Thornhill 2016; Wilson 2014). As we adopt a deductive approach for our study, applying quantitative method is credible.

Third, Creswell (2014) suggested if the research objective is to identify factors which affect an outcome, a quantitative strategy is the best option. This suggestion is directly relevant to our study that also investigates which factors have a direct impact on the outcomes of NPD projects. Thus, employing quantitative approach is appropriate.

Fourth, Creswell (2014) also proposed that personal training and experiences can influence the choice of strategy of researchers. A scholar who is technically trained or trained in statistics, computer statistical programs may gravitate to the quantitative approach (Creswell 2014). I have a technical background and experience in technical work. Hence, quantitative method is most suitable for me to conduct this study.

Lastly, a quantitative approach has long been considered as a dominant strategy for carrying out business research (Bryman & Bell 2015). This can be implied that the quantitative strategy is the most appropriate for our study.

4.5 Research design

In the field of marketing research, a research design is 'a framework or blueprint for conducting the marketing research project that specifies the procedures necessary to obtain the information needed to structure and/or solve the marketing research problem' (Malhotra & Peterson 2006, p. 71). There are various types of research design, namely experimental design, longitudinal design, cross-sectional or survey design, archival research, case study, ethnography, action research, grounded theory, and narrative inquiry (Saunders, Lewis & Thornhill 2016; Wilson 2014). Among those, our study employs a cross-sectional design, which is defined by Bryman & Bell (2015, p. 62) as follows:

> A cross-sectional design entails the collection of data on more than one case (usually quite a lot more than one) and at a single point in time in order to collect a body of quantitative or quantifiable data in connection with two or more variables (usually many more than two), which are then examined to detect patterns of association.

The first rationale for selecting this design is that our study is guided by positivism and this philosophical stance is the dominant epistemology that underlies survey research design (Easterby-Smith, Thorpe & Jackson 2015).

As mentioned earlier, our study adopts a deductive approach. The survey research design is generally considered to be linked to and to follow a deductive process (Neuman 2003, 2014; Saunders, Lewis & Thornhill 2016). This is the second explanation as to why this design is selected for our research.

Third, survey designs such as the one employed here are exclusively associated with quantitative methods, which is our research strategy (Saunders, Lewis & Thornhill 2016; Zikmund et al. 2010). This justifies the use of cross-sectional design in the present study.

Fourth, as suggested by Saunders, Lewis & Thornhill (2016), the choice of research design can be guided by the research question(s). A survey design is appropriate for questions about opinions, beliefs, attitudes, behaviors, characteristics, intentions, expectations, and so forth (Malhotra & Peterson 2006; Neuman 2003, 2014). We request potential respondents to give their opinions about using cross-functional integration mechanisms in their firms, their customers' characteristics, and their NPD project outcomes. Therefore, using a survey research design for our study is appropriate.

The final justification for choosing this design is that it is frequently used in marketing research (Malhotra & Peterson 2006) and has some advantages. For instance, a survey

design can accommodate large sample sizes at fairly low costs (Hair et al. 2008; Zikmund et al. 2010), questionnaires are quite straightforward to administer (Hair et al. 2008; Malhotra & Peterson 2006), and the survey design is simple to code, analyze, and interpret data (Hair et al. 2008; Malhotra & Peterson 2006).

4.6 Measures of the constructs

When researchers measure a concept or a construct of interest, they often follow two steps: conceptualization and operationalization (Venkatraman 1989). Conceptualization refers to 'the process of taking a construct and refining it by giving it a conceptual or theoretical definition' (Neuman 2003, p. 172). Operationalization is a process that 'links a conceptual definition to a specific set of measurement techniques or procedures'(Neuman 2003, p. 174). In other words, researchers develop a set of measures so as to empirically observe the constructs of interest. Consistent with this two-step process, we first define the constructs used in our study and then review the measures of these constructs, which have been validated in prior research. Based on the literature, we selected the best measurement scale for each construct regarding face or content validity, reliability, convergent validity, and discriminant validity. We then considered whether we needed to modify the existing scales in order to make them more appropriate in the context of our research. The measures for the constructs are presented in the following. All items, except for three indicators of the use of ICT, are measured via a seven-point Likert scale with scale anchors ranging from 1 - strongly disagree to 7 - strongly agree. Three items of the use of ICT are scored on a seven-point scale anchored by 1 - never to 7 - very frequently.

4.6.1 Job rotation

Job rotation is defined as 'the extent to which employees are assigned to areas outside their functional specialties' (Xie, Song & Stringfellow 2003, p. 237). Simply put, employees from one department are assigned to work temporarily in other departments. To measure the practice of job rotation in a firm, we used a three-item reflective scale derived from the two-item scale employed by Xie, Song & Stringfellow (2003). Based upon extensive consultations with the expert panel, including three academics and two practitioners, we reworded two items and added a third item to improve the face validity of the construct. One more item was added to the construct's measure because two-indicator constructs can lead to technical problems or improper solutions when SEM technique is employed, and this method prefers measures with a minimum of 3 items (Ding, Velicer & Harlow 1995; Kline 2016). The indicators of job rotation with their wording and respective codes are presented in Table 4.1.

Table 4.1 Indicators of job rotation (Code: Rotation)

Code of item	Item wording	Adapted from
Rotation_1	In my firm, employees from one department are often temporarily placed to work in other departments	Xie, Song & Stringfellow (2003)
Rotation_2	My firm uses job rotation of staff to connect different departments	
Rotation_3	Job rotation of staff across different departments is normal practice within my firm	Added item

4.6.2 Cross-functional team use

Cross-functional team use refers to the extent to which NPD teams consist of members from various relevant functional areas within the firm (Rauniar & Rawski 2012). Cross-functional team use is measured by using a four-indicator scale derived from the five-item scale of Rauniar & Rawski (2012). We removed one item whose factor loading

was lower than 0.7 and modified the four remaining items so as to improve content validity. Four items of cross-functional team use with their wording and respective codes are presented in Table 4.2.

Table 4.2 Indicators of cross-functional team use (Code: CFTeam)

Code of item	Item wording	Adapted from
CFTeam_1	Members of the NPD team came from a variety of departments within my firm.	Rauniar & Rawski (2012)
CFTeam_2	The NPD team consisted of members from different departments	
CFTeam_3	During the project, various departments jointly carried out product development activities	
CFTeam_4	There were many different departments involved in the NPD project	

4.6.3 Cross-functional training

As defined in Chapter 3, cross-functional training refers to the extent to which employees in different functional areas are trained to work together effectively. Based on the five-item scale developed by Maltz & Kohli (2000) and consultations with the expert panel, we decided to omit two indicators and reworded three remaining items to increase the likelihood that these items could precisely tap into the construct of cross-functional training. The following table shows the item wording and their codes.

Table 4.3 Indicators of cross-functional training (Code: Training)

Code of item	Item wording	Adapted from
Training_1	Within my firm, employees from one department participate in training programs that acquaint them with the work of people in other departments	Maltz & Kohli (2000)
Training_2	Employees in different departments receive on-going training on how to improve their relationship with people in other departments within my firm	
Training_3	The company I work for requires employees from one department participate in training sessions with people from other departments	

4.6.4 Superordinate goals

Superordinate goals refer to the extent to which NPD team members accept the overall goals during the NPD project (Atuahene-Gima 2003). From the five-item scale that was used by Atuahene-Gima (2003), we dropped one item due to its lack of face validity and employed the four remaining items (see Table 4.4) to assess the construct of superordinate goals.

Table 4.4 Indicators of superordinate goals (Code: Goal)

Code of item	Item wording	Adapted from
Goal_1	During our NPD project, team members were all committed to the same project goals	Atuahene-Gima (2003)
Goal_2	During the project, NPD team members focused on the overall goals of the project	
Goal_3	Every NPD team member behaved in ways that supported the overall goals of the project	
Goal_4	The NPD project had specific objectives and each team member treated those goals as if they were their own personal goals	

4.6.5 Co-location

Co-location refers to the extent to which NPD team members are located within close physical proximity to each other (Swink, Talluri & Pandejpong 2006). Based upon the two-item scale of Swink, Talluri & Pandejpong (2006) and consultations with the expert panel, we reworded two items and added a third item to improve the content validity of the construct. The reason we added one more item to the construct's measure is that two-indicator constructs can lead to technical problems or improper solutions when SEM technique is employed, and this method prefers measures with a minimum of three items (Ding, Velicer & Harlow 1995; Kline 2016). The indicators of co-location with their wording and respective codes are showed in Table 4.5.

Table 4.5 Indicators of co-location (Code: Colocation)

Code of item	Item wording	Adapted from
Colocation_1	NPD team members shared office space with each other when working on this project	Swink, Talluri & Pandejpong (2006)
Colocation_2	The work sites of NPD team members were located within close physical proximity of each other	
Colocation_3	Overall, NPD team members were located closely to each other during the project	Added item

4.6.6 The use of information and communication technology (ICT)

As discussed in Chapter 3, ICT use refers to the extent to which employees from one function use information and communication technology such as telephone, video-conferencing, email, and internet to work with people of other functions during the NPD process**.** Koufteros & Marcoulides (2006**)** employed the six-indicator scale to gauge the use of information technology (IT) in firms. In their study, IT use concentrated only on the use of computers. This is insufficient for the construct of ICT use of our research. Therefore, after consulting with the expert panel, we adapted the scale of Koufteros & Marcoulides (2006) in the following way. We did not use the first five items because of their lack of face validity in the context of our study. As mentioned previously, constructs with a minimum of three indicators are preferred by SEM technique (Ding, Velicer & Harlow 1995; Kline 2016). We, therefore, reworded the last item and added two similar items to improve the content validity of the construct. Accordingly, a three-item scale (see Table 4.6) is used to measure the use of ICT in firms.

Table 4.6 Indicators of the use of ICT (Code: ICT)

Code of item	Item wording	Adapted from
ICT_1	Employees from one department frequently used ICT to coordinate their product development activities with those of other departments	Koufteros & Marcoulides (2006)
ICT_2	On the NPD project, employees from one department regularly used ICT to interact with people in other departments	Added items
ICT_3	During the project, employees from one department used ICT frequently to exchange work-related information with people in other departments	

4.6.7 Informal coordination

Informal coordination refers to the extent to which the communication among employees from different functional areas is based on personal contact, which is not controlled by their managers (Willem & Buelens 2009). The four-indicator reflective scale of Willem & Buelens (2009) was adapted to measure the construct of informal coordination. The following table shows the item wording and respective codes.

Table 4.7 Indicators of informal coordination (Code: Informal)

Code of item	Item wording	Adapted from
Informal_1	During the NPD project, employees from one department coordinated their activities with the other departments informally, via personal contacts	Willem & Buelens (2009)
Informal_2	Employees from one department worked directly with their personal contacts without consulting their supervisors during the NPD project	
Informal_3	On the project, employees from one department directly contacted colleagues whom they know well in other departments when they needed information	
Informal_4	Cooperation among employees from different departments during the NPD project was based on personal contacts	

4.6.8 Joint reward systems

Joint reward systems refer to the degree to which employees from one function are rewarded for working effectively with people from other functions and contributing to the overall goals of the organization (Arndt, Karande & Landry 2011). Based on the five-item scale developed by Arndt, Karande & Landry (2011) and consultations with the expert panel, we decided to remove two indicators that were ambiguous and lacked content validity. We also reworded three remaining items to increase the likelihood that these items accurately measure the construct of joint reward systems. The indicators of joint reward systems with their wording and codes are showed as follows.

Table 4.8 Indicators of joint reward systems (Code: Reward)

Code of item	Item wording	Adapted from
Reward_1	On the NPD project, employees from one department were rewarded for how effectively they worked together with other departments	Arndt, Karande & Landry (2011)
Reward_2	Employees in a department earned rewards when they worked well with other departments during the NPD project	
Reward_3	When employees from a department worked with other departments and contributed to the overall goals of the project, they received valuable rewards	

4.6.9 Customers with lead user characteristics

Lead users are those who (1) face the new needs of products earlier than other users, and (2) significantly benefit by achieving solutions to those needs (von-Hippel 1986, 1988). We examine only the first dimension of lead users' characteristics because we believe it is not difficult for potential respondents (e.g., marketing managers) to answer whether their customers identify needs, new solutions and applications for their products earlier than other customers. Regarding the second dimension, customers may

suggest their new needs to a firm. This firm then provide customers the solutions, or customers may find the solutions by themselves. However, these customers do not communicate the effectiveness of the solutions to firms. Accordingly, it is difficult for a respondent who has been working for this firm to answer if the customers benefit from the solutions or not. Accordingly, in our study, we define customers with lead user characteristics as customers who identify needs, new solutions and applications for a product earlier than the rest of the market (Morrison, Roberts & Midgley 2004).

Morrison, Roberts & Midgley (2004) developed a seven-item scale to measure leading edge status of lead users. Despite the fact that this measurement possessed high reliability (Cronbach's alpha is 0.81, and composite reliability is 0.76), its seven indicators captured different facets of the construct such as benefits recognized early, high level of benefits expected, perceived leading edge status, and application generation. If we borrowed all of these items for our study, this would have confused the informants, and we may not have received the accurate answers. Hence, after discussing with the expert panel, we decided to drop four items which were not appropriate for the construct of customers with lead user characteristics for our research. Three remaining indicators were reworded to enhance their face validity (see Table 4.9).

Table 4.9 Indicators of customers with lead user characteristics (Code: Lead)

Code of item	Item wording	Adapted from
Lead_1	Our customers are usually ahead of the rest of the market in recognizing new needs, solutions and applications for our products	Morrison, Roberts & Midgley (2004)
Lead_2	The people who buy our products are always suggesting new solutions and applications for our products	
Lead_3	The customers of our firm are regarded as pioneers in proposing solutions and applications for our products	

4.6.10 Innovative customers

Innovative customers are customers who are willing to try new products, services, and technologies (Bin 2013). From the five-item scale used by Bin (2013), we omitted two items due to their lack of content validity. We modified the three remaining items (see Table 4.10) to assess the construct of innovative customers.

Table 4.10 Indicators of innovative customers (Code: Inno)

Code of item	Item wording	Adapted from
Inno_1	If our customers hear about a new product, service or technology, they always like to try it earlier than other users	Bin (2013)
Inno_2	Among their peers, our customers are usually the first to explore new products, services, or technologies	
Inno_3	If a new product, service or technology is introduced in the market, our customers are often ahead of other users in trying it	

4.6.11 Customers with product expertise

Customers with product expertise are those customers who have good knowledge and experience with a certain product (Mitchell & Dacin 1996). Derived from the four-indicator scale developed by Mitchell & Dacin (1996) and based upon consultations with the expert panel, we deleted one item which was not pertinent to the construct of customers with product expertise. We then reworded three remaining items so as to make them more suitable for our study. The following table shows the item wording and their respective codes.

Table 4.11 Indicators of customers with product expertise (Code: ProdKnow)

Code of item	Item wording	Adapted from
ProdKnow_1	Our customers have a very good knowledge of our products	Mitchell & Dacin (1996)
ProdKnow_2	The people who buy our products tend to know a great deal about them	
ProdKnow_3	Overall, our customers are very knowledgeable about our products	

4.6.12 Customers with price expertise

Customers with price expertise are the ones who can be viewed as a good source of information about product prices in the market (Kopalle & Lindsey-Mullikin 2003). The three-item reflective scale of Kopalle & Lindsey-Mullikin (2003) was adapted to measure the construct of customers with price expertise. The indicators of this construct with their wording and codes are presented as follows.

Table 4.12 Indicators of customers with price expertise (Code: PriceKnow)

Code of item	Item wording	Adapted from
PriceKnow_1	Our customers have a very clear idea of the prices charged by us and our competitors for our products	Kopalle & Lindsey-Mullikin (2003)
PriceKnow_2	The customers of my firm are considered experts when it comes to knowing the prices of products in the market	
PriceKnow_3	We believe that our customers are very knowledgeable about the prices of products in the market	

4.6.13 Financially attractive customers

As defined in Chapter 2, financially attractive customers refer to customers who buy products in large volumes. Based on the customer attractiveness scale developed by Rocca, Caruana & Snehota (2012) and considerable discussion with the expert panel, we selected one item which is related to the construct of financially attractive customers of our study and added two similar items to increase the probability that these items

could precisely measure this construct. We put two additional items because two-indicator constructs can lead to technical problems or improper solutions when SEM technique is employed, and this method prefers measures with a minimum of 3 items (Ding, Velicer & Harlow 1995; Kline 2016). The following table describes the item wording and their codes.

Table 4.13 Indicators of financially attractive customers (Code: Bulk)

Code of item	Item wording	Adapted from
Bulk_1	The people who buy our products tend to make bulk purchases.	Rocca, Caruana & Snehota (2012)
Bulk-2	Our customers usually buy our products in large volumes	Added items
Bulk_3	Overall, the customers of my firm are bulk buying customers	

4.6.14 NPD speed

NPD speed refers to 'the pace of progress that a firm displays in innovating and commercializing new products' (Carbonell & Rodriguez 2006b, p. 2). The three-item reflective scale of Carbonell & Rodriguez (2006b) was adapted to measure the construct NPD speed. The items of this construct with their wording and respective codes are presented in the following table.

Table 4.14 Indicators of NPD speed (Code: Speed)

Code of item	Item wording	Adapted from
Speed_1	We launched this new product on or ahead of our schedule	Carbonell & Rodriguez (2006b)
Speed_2	We completed the NPD project faster than we expected	
Speed_3	The development time of this product was faster than our typical product development time	

4.6.15 New product advantage

New product advantage is defined as the degree to which a new product outperforms competing products in terms of benefiting customers (Rijsdijk, Langerak & Hultink 2011). To measure the construct new product advantage, we adapted the three-indicator scale employed by McNally, Cavusgil & Calantone (2010). The items of this construct with their wording and respective codes are described in Table 4.15.

Table 4.15 Indicators of new product advantage (Code: Advantage)

Code of item	Item wording	Adapted from
Advantage_1	Compared to competitive products, our new product provided many more benefits to the customers	McNally, Cavusgil & Calantone (2010)
Advantage_2	Our new product offered much more value to the customers than competing products did	
Advantage_3	Overall, our new product offered many advantages in comparison with competing products	

4.6.16 New product success

New product success refers to the success of new products in terms of financial performance (McNally, Cavusgil & Calantone 2010). Derived from the two-indicator scale developed by McNally, Cavusgil & Calantone (2010) and based upon consultations with the expert panel, we reworded two items of their scale and added two similar items so as to increase the likelihood that these items accurately measure the construct of new product success. Again, two more items were added to the measure because using constructs having at least three to five indicators can help solve the technical problems of using two-item variables in the analysis (Kline 2016). The following table shows the item wording and their respective codes.

Table 4.16 Indicators of new product success (Code: Success)

Code of item	Item wording	Adapted from
Success_1	Our new product succeeded in achieving our budget objectives	Added item
Success_2	Profits from our new product exceeded the minimum acceptable return for projects like this in our company	McNally, Cavusgil & Calantone (2010)
Success_3	The sales and profits of our new product had a profound impact on our company	
Success_4	Our new product was successful with respect to financial performance	Added item

4.7 Sampling procedure and expected sample size

This section defines the target population of our study, presents who informants are, and then focuses on how we constructed our sampling frame. Finally, the minimum sample size that we expect to achieve is calculated.

4.7.1 Target population

Prior to developing sampling frame, we define the target population of this research. As discussed in Chapter 1, the unit of analysis of our study is the NPD project. It should be noted that a new product refers to either a good or a service (Kahn et al. 2013). Therefore, the target population consists of all completed NPD projects from a wide range of industries in Australia, in which customers are involved. In addition to this, the projects needed to have participation of both marketing (or sales) department and R&D (or manufacturing or engineering) department.

4.7.2 Key informants of the research

Given that our research is largely based on perceptions, people who provide information about NPD projects are departmental managers working in Australian firms such as marketing and/or sales managers, product managers, brand managers, and the like. The

informants with such titles are appropriate because they are more likely to be involved in NPD projects and have good knowledge about the practices of their firms (i.e., cross-functional integration mechanisms) as well as the outcomes of their NPD projects (Leenders & Wierenga 2002). In addition to this, our study also examines the characteristics of customers involved in NPD projects. Compared with technically trained managers such as R&D managers, engineering managers, and manufacturing managers, our target respondents have more chances to communicate with customers, and therefore have a better understanding of their customers' characteristics.

4.7.3 Process of constructing sampling frame

To seek the list of potential informants, we contacted more than ten list brokers in Australia, including IncNet, The Prospect Shop, Remington Direct, Action Mailing Lists, Media M Group, Impact Lists Pty Ltd, and so on. In the beginning, we requested them to provide the list of marketing and/or sales managers, product managers, brand managers, or the like who have been involved in NPD projects which met two criteria. First, the projects must have had customer involvement to ensure that potential participants can answer the questions related to their customers. Second, the projects had the participation of both marketing (or sales) department and R&D (or manufacturing or engineering) department for two reasons. The first reason is that these departments are considered as crucial functions in NPD projects (Song & Xie 2000; Song, Montoya-Weiss & Schmidt 1997). The second rationale is that personnel of marketing (or sales) department and R&D (or manufacturing or engineering) department usually 'differ in training and background' (Griffin & Hauser 1996, p. 196). The effective integration of these two types of functional areas can significantly contribute to NPD success (Griffin & Hauser 1996). However, none of these list brokers

were able to deliver such list because they could not know whether these managers have been involved in NPD projects or not.

Later on, we asked them for the list of the kinds of managers who have been working for the companies which have conducted NPD. We did so because we supposed that the managers working for such firms were more likely to be involved in the process of developing new products. Unfortunately, they again replied that they could not discern if the firms have conducted NPD projects or not.

Finally, we proposed that they simply provide the list of above-mentioned managers working for companies that tend to develop new products such as manufacturing firms. These firms should (1) have at least 50 employees, and (2) have both marketing (or sales) department and R&D (or manufacturing or engineering) department. Firms with at least 50 employees were chosen because the larger the firms are, the more likelihood that they perform NPD activities (Alam 2002; Carbonell, Rodriguez-Escudero & Pujari 2012). We also wished to select the companies with both a marketing (or sales) department and an R&D (or manufacturing or engineering) department because there is a high probability that NPD projects of these firms had the participation of these two types of departments. We also notified the list brokers that we needed only one manager for each firm. We did so to avoid the possibility that they provide contact details of more than two managers from the same company. The reason is that if we sent the questionnaire to more than two managers of one company, we may receive replies regarding the same project.

After about four months of working with the list brokers (from 05/2015 to 08/2015), we finally selected IncNet as our mailing list provider because they could provide a list of potential respondents at a lower cost in comparison with other list brokers. IncNet could

deliver the list of 1,000 required managers of 1,000 firms that had at least 50 employees and had both a marketing (or sales) department and an R&D (or manufacturing or engineering) department.

After receiving human ethics approval from the UTS Human Research Ethics Committee (see section 4.10 of this chapter), we signed a contract with IncNet, to secure the required mailing list. Next, from the initial list of 1,000 managers of 1,000 firms, we searched on the internet to find out which firms were unlikely to conduct NPD and removed them from the list.

We then telephoned 773 remaining managers to determine: (1) whether they had been involved in NPD projects, (2) if one of the projects in which they took part had customers' engagement, (3) whether the customer-involved project had the participation of both marketing (or sales) department and R&D (or manufacturing or engineering) department, (4) whether they would like to participate in the research. Among them, some we could not contact, some hung up the phone, some had already moved to another workplace, the majority of them were not qualified, and 13 eligible managers were not interested in participating in the research. Finally, the sampling frame for our study comprised 297 qualified managers who agreed to participate in the research. It took us about two months (from 09/2015 to 10/2015) to screen the initial list and to telephone all of the remaining managers.

4.7.4 Expected sample size

As suggested by many leading researchers (e.g., Hair et al. 2014; Hair et al. 2012; Henseler, Ringle & Sinkovics 2009), we use the ten times rule of thumb proposed by Barclay, Higgins & Thompson (1995) as a rough guideline to estimate the minimum

sample size requirements. According to this rule, the minimum sample size should be equal to the greater of (1) ten times 'the indicators on the most complex formative construct', or (2) ten times 'the largest number of antecedent constructs leading to an endogenous construct' (Barclay, Higgins & Thompson 1995, p. 292).

We examine the effects of eight cross-functional integration mechanisms and five customer characteristics on three different outcomes of NPD projects, namely NPD speed, new product advantage, and new product success. Therefore, the largest number of antecedents leading to an endogenous variable is thirteen. There are no formative constructs in our study. Hence, the required sample size of our research should be at least 130 observations.

4.8 Data collection

In this section, we describe the issue of common method bias and how we develop the questionnaire, a tool to collect data, and then present the design of our questionnaire. Next, the strategy for collecting data is reported. Lastly, we assess the achieved sample size in terms of response rate and then compare it with the expected sample size.

4.8.1 The issue of common method bias (CMB)

Common method bias (CMB) or common method variance (CMV) is defined as 'variance that is attributable to the measurement method rather than to the constructs the measures represent' (Podsakoff et al. 2003, p. 879), or 'the amount of spurious covariance shared among variables because of the common method used in collecting data' (Malhotra, Kim & Patil 2006, p. 1865). It can bias the estimates of construct reliability and validity, and this leads to system measurement errors (Chang, Witteloostuijn & Eden 2010; MacKenzie & Podsakoff 2012; Podsakoff, MacKenzie &

Podsakoff 2012). In addition to this, it can also bias estimates of the relationships between various constructs, which leads to the inflation or deflation of the relationships between different variables (Chang, Witteloostuijn & Eden 2010; Conway & Lance 2010; MacKenzie & Podsakoff 2012; Podsakoff, MacKenzie & Podsakoff 2012). With these two detrimental effects, common method variance can be seen as 'the most common and dangerous threat to correct interpretation of research results' (Pace 2010, p. 421). Accordingly, researchers have been recommended that they should address common method bias in their studies (Craighead et al. 2011).

When self-report surveys are employed to collect data from the same respondents at the same time, CMV should be considered (Chang, Witteloostuijn & Eden 2010; Conway & Lance 2010; Craighead et al. 2011; Lindell & Whitney 2001; Malhotra, Kim & Patil 2006; Podsakoff & Organ 1986). Our study used self-report questionnaires to capture responses, and each questionnaire was answered by only one informant. Therefore, it may be susceptible to CMB. There are two main ways to control CMB, namely procedural remedies and statistical remedies (Podsakoff et al. 2003; Podsakoff, MacKenzie & Podsakoff 2012). Our study embraces both of these two kinds of remedies. The statistical methods are presented in section 5.6.2 Testing Common Method Bias of the next chapter. The procedural remedies associated with the development of the questionnaire are reported in the following.

4.8.2 Questionnaire development

As proposed by Podsakoff et al. (2003), assuring informant anonymity and decreasing evaluation anxiety can help reduce method bias. Accordingly, in the invitation letter (Appendix 2), we confirmed that respondents' information has been completely confidential so that they have remained anonymous. Moreover, we also noted that there

were no right or wrong answers and encouraged them to answer as honestly as possible. By doing so, we hoped that respondents would be less likely to edit their answers in order to (1) provide more socially desirable responses, and (2) be consistent with what we would prefer for them to reply. Also, as an incentive for answering and returning the questionnaire, in the invitation letter, we also offered an executive summary of the results to the respondents.

Another procedure that can be used to reduce common method bias is improving scale items and constructing effective questions (Podsakoff et al. 2003; Podsakoff, MacKenzie & Podsakoff 2012). To this end, we followed the principles for writing survey questions, which were suggested by Bryman & Bell (2015), MacKenzie & Podsakoff (2012), Neuman (2003), Peterson (2000), and Tourangeau, Rips & Rasinski (2000). Specifically, every item or question was carefully checked to ensure that it was (1) applicable to the research; (2) brief, simple, and understandable; (3) unambiguous by avoiding technical terms, slang, jargon, and words that may be interpreted several ways; (4) objective by avoiding leading question that tended to offer an answer; (5) not a double-barrelled question by asking about two different things but using a single measure; and (6) a question that did not include negatives.

Apart from constructing effective items and questions, as recommended by Wilson (2014), we also considered the overall design of the questionnaire to increase response rate and the quality of information provided by informants. We carefully examined the whole questionnaire to ensure that (1) the questions were in a logical order, (2) the structure of questionnaire was clear and logical, (3) the length of questionnaire was appropriate (i.e., the questionnaire was long enough to yield an adequate amount of data, but not so long as to lower response rates).

The first draft of the questionnaire was developed and then sent to a panel of three academics and two practitioners for evaluation based upon the above-mentioned criteria. These three academics has experience in quantitative research. One of them has considerable expertise in NPD, and the two remaining academics have extensive knowledge of the innovation literature. The two practitioners were general managers who had been involved in NPD projects. An enormous amount of helpful feedback on the questionnaire was received from the panel. The main comments of the first draft were that: (1) a questionnaire of 11 pages was considered relatively long, which might decrease the willingness to complete it of time-poor managers; (2) numerous items were ambiguous and should be modified to improve content or face validity; (3) the question order should be rearranged in a logical manner.

There was an iterative process of revising the drafts of the questionnaire and consulting with the expert panel. Totally, there were eight draft versions of the questionnaire until the final version which was considered ready for administration, and more than six months were consumed (from 04/2015 to the middle of 10/2015). In comparison with the first draft, the final questionnaire had significant improvements. Firstly, the length of the questionnaire was shortened (8 pages) by (1) removing some items which were still confusing and unnecessary; (2) eliminating one construct which could not be defined in an appropriate way; (3) deleting the optional part which might violate the anonymity of informants. This could help increase the propensity for potential informants to complete and return the questionnaire. Secondly, the items were much clearer and appeared to be suitable for measuring the constructs for which they are intended to measure (i.e., face validity/content validity). This enabled research participants to respond accurately, which led to high quality of information. Thirdly, the questions were in a more logical order, which allowed respondents to follow the

flow of questionnaire easily. Finally, three additional questions were included to confirm the eligibility of informants. This was done to ensure that data was collected from the qualified respondents.

Thus far, we have described the procedure for developing the questionnaire. The next section presents the overall design of our questionnaire.

4.8.3 Questionnaire design

The final questionnaire (Appendix 4) was divided into five parts. Part 1 included six questions, from question 1 to question 6. The first three questions were used to determine whether the respondent was still qualified or not (even though we had identified the eligible ones at the stage of constructing the sampling frame). In addition to this, to prevent them from telling only "success stories", as suggested by Swink & Calantone (2004, p. 474), in question 3, we encouraged them to concentrate on the most recently completed NPD projects even if these projects had failed. The next three questions were used to collect general information about the NPD project in terms of the category and characteristics of the project.

Part 2 consisted of eight questions, from question 7 to question 14. Each question was used to ask participants about the use of a specific cross-functional integration mechanism in their organizations. These mechanisms are job rotation, cross-functional team use, cross-functional training, superordinate goals, co-location, the use of information and communication technology (ICT), informal coordination, and joint reward systems.

Part 3 had five questions, from question 15 to question 19. Each question was used to request respondents describe a particular characteristic of the customers who were most

involved in their NPD projects. There are five customer characteristics examined in the research, namely customers with lead user characteristics, innovative customers, customers with product expertise, customers with price expertise, and financially attractive customers.

Part 4 contained three questions, from question 20 to question 22. These questions were used to measure the different outcomes of NPD projects, namely NPD speed, new product advantage, and new product success in terms of financial performance.

Part 5 included six questions, from question 23 to question 28. These questions were used to gather further information about the characteristics of respondents and firms when the projects were conducted.

4.8.4 Process of data collection

In our study, a mail survey was the main technique used to collect data, supplemented with online survey for several reasons. First, a mixed-mode survey design can help improve the response rates and overcome the problems of each single mode (Dillman, Smyth & Christian 2014). Second, regarding mail surveys or paper based surveys, several studies revealed that 'when carefully planned and implemented, mail surveys can do reasonably well and achieve response rates of 50% or higher' (Dillman, Smyth & Christian 2014, p. 351). Finally, online surveys can incur lower costs. It was, however, more difficult for us to control the appearance of such survey because of the various ways people read their e-mail (e.g., web-based e-mail providers, local software programs, mobile devices and phones, and so on) (Dillman, Smyth & Christian 2014). It is also difficult for respondents to complete the survey on mobile devices (Dillman, Smyth & Christian 2014). This can lead to extremely low response rates that jeopardize

external validity and cannot provide enough data for detailed analysis. We also had conversations with some managers about the online survey. They said that it is convenient but has some drawbacks. For instance, their e-mail accounts may recognize an online survey as junk mail or spam, and they delete it immediately, or their computer system may not support a program that the survey is running on. We implemented mail survey and online survey as follows.

Firstly, survey packages were sent to 297 potential respondents in the middle of November 2015. The package included an invitation letter (Appendix 2), an information sheet (Appendix 3), a questionnaire (Appendix 4), and a prepaid envelope.

Secondly, after three weeks, survey packages were again sent to them. This package differed from the above package in only one thing, i.e. an invitation letter was replaced by a reminder letter.

Lastly, because the managers take holidays at the end of the year 2015, we waited until their return in the middle of January 2016 and emailed them. Our email reminded them to complete and return the questionnaire. It also provided them another option to complete the questionnaire via the link that led to our online survey. We employed the SurveyGizmo software to design the online survey. At the end of February 2016, we stopped receiving responses leaving us 106 responses in total.

4.8.5 Data screening and the achieved sample size

Before entering data, we examined the collected data to see if it had any suspicious response patterns or missing data. In general, there are two kinds of suspicious response patterns, namely straight lining and inconsistency (Hair et al. 2014). Straight lining happens when an informant marks the same answer for a high proportion of a question

(Hair et al. 2014). Inconsistency in answers happens when the questionnaire is completed by a respondent who does not meet the criteria of the research (Hair et al. 2014). This also occurs when respondents do not read the questions carefully and try to complete the survey quickly. As a result, they provide very different answers to similar questions (Hair et al. 2014). Concerning missing data, it happens when an informant does not answer one or more questions. If a questionnaire has the overall missing data that exceeds 15 percent, it is recommended to be eliminated from the data file (Hair et al. 2014).

After carefully screening our data, no responses had straight lining pattern. Also, no responses had inconsistency in answers. In addition to this, no responses were found to have missing data exceeding 15 percent. The data set therefore still consisted of 106 observations or cases. Nevertheless, after carrying out some statistical techniques to detect outliers (see section 5.2.1 Detecting outliers of Chapter 5), we decided to eliminate two observations from the original data because they represented multivariate outliers. The final data set used for further analyses consists of 104 observations.

From 297 eligible potential respondents, we received 104 usable responses. The net response rate of our study is therefore 35%. This response rate can be considered typical because postal questionnaire surveys generally yield response rates that range between 10% and 50% (Saunders, Lewis & Thornhill 2016). We also reviewed the response rates of several similar studies in terms of related research stream and type of respondents to see if our response rate is comparable. Research on the effects of different integrating mechanisms on new product performance of Leenders & Wierenga (2002) reported a response rate of 19%. Brettel et al. (2011) examined the influences of cross-functional integration of marketing, R&D, and manufacturing on NPD

effectiveness and efficiency, and their sample size accounted for 22.1% of the sampling frame. The study of Gruner & Homburg (2000) that tested the relationship between customer characteristics and NPD success had a response rate of 25.4%. The response rate of Bonner (2010) investigating the indirect effect of customer interactivity on new product performance was 46%. Homburg & Kuehnl (2014) researched the impact of cross-functional integration, customer integration, and inter-firm collaboration on new product and new service success, and they achieved a response rate of 21.8%. The informants of these studies had titles of marketing manager, product manager, project manager, R&D manager, and the like. From these response rates, we can again state that our response rate of 35% is reasonable for the research context and type of respondent.

Our achieved sample size (104 observations) is smaller than the expected sample size (130 observations) which is calculated by using the "ten times" rule of thumb. Nevertheless, this rule 'does not take into account effect size, reliability, the number of indicators, and other factors known to affect power'(Hair et al. 2012, p. 420). It may work properly in some circumstances, but fail miserably in other situations, and this may lead to the misleading recommendations on acceptable sample size (Henseler, Ringle & Sinkovics 2009). Consequently, aside from considering sample size, researchers should evaluate the statistical power to ensure the adequate power of their data analyses (Goodhue, Lewis & Thompson 2012; Hair et al. 2014; Hair, Ringle & Sarstedt 2013; Henseler, Hubona & Ray 2016). According to Iacobucci (2010), SEM models can well perform, even with small sample sizes (e.g., 50 to 100). Specifically, Reinartz, Haenlein & Henseler (2009) revealed that PLS-SEM can yield robust parameter estimates and high statistical power in small sample sizes (i.e., 100 observations). Hence, we used PLS-SEM to analyze the collected data and then conducted several post hoc tests to assess the statistical power of our data analyses.

4.9 Methods of data analysis

In this section, we give an overview of structural equation modeling (SEM), a technique employed in our study to test the developed hypotheses. Next, we compare covariance-based SEM (CB-SEM) and variance-based SEM (PLS-SEM), which are two typical types of SEM, and then explain why we use PLS-SEM. Finally, the two-step procedure for evaluating PLS-SEM results is described.

4.9.1 Overview of structural equation modeling (SEM)

Structural equation modeling (SEM) is a multivariate data analysis technique used to demonstrate the complex relationships among multiple variables (Hair et al. 2010). SEM possesses several useful abilities such as modeling latent variables, taking into account diverse forms of measurement error, and testing complete theories (Dijkstra & Henseler 2015a; Henseler, Hubona & Ray 2016). With its helpful abilities, using SEM offers researchers numerous benefits which can be summarized by Bagozzi & Yi (2012, p. 12) as follows.

1. Provides integrative function (a single umbrella of methods under leading programs).
2. Helps researchers to be more precise in their specification of hypotheses and operationalizations of constructs.
3. Takes into account reliability of measures in tests of hypotheses in ways going beyond the averaging of multi-measures of constructs.
4. Guides exploratory and confirmatory research in a manner combining self-insight and modeling skills with theory. Works well under the philosophy of discovery or the philosophy of confirmation.
5. Often suggests novel hypotheses originally not considered and opens up new avenues for research.

6. Is useful in experimental or survey research, cross-sectional or longitudinal studies, measurement or hypothesis testing endeavours, within or across groups and institutional or cultural contexts.

Therefore, SEM has become one of the most powerful tools for analyzing multivariate data. It has been employed in many disciplines such as psychology, health sciences, education, management, and especially marketing research (Babin, Hair & Boles 2008; Baumgartner & Homburg 1996; Hair et al. 2012; Kline 2011; Martínez-López, Gázquez-Abad & Sousa 2013; Reinartz, Haenlein & Henseler 2009). The important role of SEM in empirical research is again stressed by Gefen, Straub & Boudreau (2000, p. 6): 'SEM has become *de rigueur* in validating instruments and testing linkages between constructs'.

4.9.2 Covariance-based SEM (CB-SEM) and variance-based SEM (PLS-SEM)

There are two types of SEM that scholars should consider when applying it: covariance-based method (CB-SEM) and variance-based partial least squares (PLS-SEM). CB-SEM estimates model parameters in order that 'the theoretical covariance matrix implied by the system of structural equations is as close as possible to the empirical covariance matrix observed within the estimation sample' (Reinartz, Haenlein & Henseler 2009, p. 332). Unlike CB-SEM, PLS-SEM concentrates on estimating model parameters so as to 'maximize the variance explained for all endogenous constructs in the model through a series of ordinary least squares (OLS) regressions' (Reinartz, Haenlein & Henseler 2009, p. 332). We can see that there is a difference in statistical viewpoint between CB-SEM and PLS-SEM (Hair et al. 2014). Nonetheless, these two techniques can be used to complement to each other (Chin & Newsted 1999; Hair, Ringle & Sarstedt 2011) because CB-SEM's strengths are the weaknesses of PLS-SEM,

and vice versa (Hair et al. 2014). Accordingly, researchers should understand the different applications of each method and use them in an appropriate manner (Hair et al. 2014). The following table compares CB-SEM and PLS-SEM, which can help researchers employ the right technique in order to best suit their research objectives, research models, and collected data.

Table 4.17 Comparison between CB-SEM and PLS-SEM

Criterion	Covariance-based SEM (CB-SEM)	Variance-based SEM (PLS-SEM)
Objective	Parameter oriented	Prediction oriented
Approach	Covariance based	Variance based
Assumptions	Typically multivariate normal distribution and independent observations (parametric)	Predictor specification (nonparametric)
Parameter estimates	Consistent	Consistent as indicators and sample size increases (i.e., consistency at large)
Latent variable scores	Indeterminate	Explicitly estimated
Epistemic relationship between a latent variable and its measures	Typically only with reflective indicators	Can be modeled in either formative or reflective model
Implications	Optimal for parameter accuracy	Optimal for prediction accuracy
Model complexity	Small to moderate complexity (e.g., less than 100 indicators)	Large complexity (e.g., 100 constructs and 1,000 indicators)
Sample size	Ideally based on power analysis of specific model - minimal recommendations range from 200 to 800.	Power analysis based on the portion of the model with the largest number of predictors. Minimal recommendations range from 30 to 100 cases

(Source: Chin & Newsted 1999, p. 314)

4.9.3 Justifications for using PLS-SEM

Our study embraces PLS-SEM approach to test the research models for several reasons. First, PLS-SEM is used when the research objective is to identify main “driver” constructs (Hair et al. 2014; Hair, Ringle & Sarstedt 2011). The goal of our research is

seeking which cross-functional integration mechanisms and which customer characteristics have a positive impact on the performance of NPD projects. This means that we attempt to look for the key drivers or predictors of NPD outcomes, and the use of PLS-SEM is therefore plausible.

Second, a model in which 'the number of exogenous latent variables is at least twice as high as the number of endogenous latent variables' is defined as focused model (Hair et al. 2012, p. 421). Our study examines the effects of eight cross-functional integration mechanisms and five customer characteristics on three different NPD outcomes. This means that the number of independent variables is four times higher than that of dependent variables, and our research model therefore can be considered a focused model. Hair et al. (2012) assert that the prediction goal of PLS-SEM is suitable for the focused model. This also justifies our use of PLS-SEM for the current study.

Third, our achieved sample size (104 observations) is relatively small. PLS-SEM can be considered as the best solution to cope with small sample research (Chin 1998, 2010; Chin & Newsted 1999; Hair et al. 2014; Hair, Ringle & Sarstedt 2011; Henseler et al. 2014; Henseler, Ringle & Sinkovics 2009). Thus, this justifies the use of PLS-SEM in our study.

Finally, our data slightly violate distributional assumptions. The details of our data distribution are presented in section 5.2.3 of the next chapter and Appendix 6. In the circumstance that data are not normally distributed, PLS-SEM should be selected (Chin 1998, 2010; Chin & Newsted 1999; Hair et al. 2014; Hair, Ringle & Sarstedt 2011; Henseler, Ringle & Sinkovics 2009). Hence, it is appropriate to employ PLS-SEM in our study.

4.9.4 Two-step approach to evaluation of PLS-SEM results

The assessment of PLS-SEM is carried out by a two-step process (Anderson & Gerbing 1988; Chin 2010; Hair, Ringle & Sarstedt 2011). The first step is to evaluate the measurement models (or outer models), and the second one relates to evaluating the structural models (or inner models). The logic behind this process is that if researchers cannot assure themselves that the measures represent the constructs of interest, it seems implausible to use them to test the structural relationships (Chin 2010; Hair, Ringle & Sarstedt 2011). We used SmartPLS 3 software (Ringle, Wende & Becker 2015) for evaluating PLS-SEM results. The assessment of measurement models and structural models is detailed as follows.

4.9.4.1 Evaluation of the measurement models

All measures used in our study are reflective multi-item ones. Therefore, we follow the rules of thumb for evaluating reflective measurement model suggested by Hair et al. (2014). First of all, we assess internal consistency reliability, and then check indicator reliability of the constructs used in our study. Next, we evaluate convergent validity, and finally, we examine discriminant validity of them.

Internal consistency reliability refers to the extent to which 'responses are consistent across the items within a measure' (Kline 2011, p. 69). In other words, it 'requires indicators assigned to the same construct to reveal a strong mutual association'(Götz, Liehr-Gobbers & Krafft 2010, p. 695). To assess internal consistency reliability, we use three criteria, namely Cronbach's alpha (α) (Cronbach 1951), composite reliability (ρ_c) (Werts, Linn & Jöreskog 1974), and rho A (ρ_A) (Dijkstra & Henseler 2015b). Rho A is 'a new and consistent reliability coefficient for PLS', which can help solve the problem

of Cronbach's alpha that underestimates the actual reliability of a certain construct, and the issue of composite reliability that overestimates the reliability (Dijkstra & Henseler 2015b, p. 300). To be considered satisfactory, these three reliability values should be higher than 0.70 (Henseler, Hubona & Ray 2016).

The indicator reliability indicates 'which part of an indicator's variance can be explained by the underlying latent variable' (Götz, Liehr-Gobbers & Krafft 2010, p. 694). The absolute standardized outer loading of each indicator is used to assess indicator reliability, and this value should be larger than 0.70 (Hair, Ringle & Sarstedt 2011).

Convergent validity referred to the degree to which 'blocks of items strongly agree (i.e., converge) in their representation of the underlying construct they were created to measure' (Chin 2010, p. 674). The average variance extracted (AVE) can be used as the common measure of convergent validity at the construct level (Hair et al. 2014). To establish convergent validity, AVE value should be greater than 0.50 (Chin 2010; Hair et al. 2014; Hair, Ringle & Sarstedt 2011; Henseler, Ringle & Sinkovics 2009). This means that, on average, a latent variable can explain more than 50% of its indicators' variance (Hair et al. 2014; Henseler, Ringle & Sinkovics 2009).

Discriminant validity is defined as the extent to which a construct is sufficiently different from other constructs by empirical criteria (Hair et al. 2014; Henseler, Ringle & Sinkovics 2009). To evaluate the discriminant validity, we use three standards, namely the cross loadings of the indicators, Fornell & Larcker criterion, and the heterotrait-monotrait ratio (HTMT) of the correlations. The first criterion suggests that discriminant validity is established if the outer loading of an indicator on the associated construct is larger than all of its loadings on other constructs (i.e., the cross loadings)

(Barclay, Higgins & Thompson 1995; Chin 1998, 2010; Gefen & Straub 2005; Hair et al. 2014; Hair, Ringle & Sarstedt 2011). The second, or Fornell & Larcker criterion, proposes that the discriminant validity is established when the square root of each construct's AVE larger than its correlation with any other constructs (Fornell & Larcker 1981). The third criterion currently developed by Henseler, Ringle & Sarstedt (2015) recommends if the heterotrait-monotrait ratio (HTMT) value of the correlations is higher than the threshold value of 0.85, there is a lack of discriminant validity.

If the reliability and validity of the construct measures can be considered satisfactory (i.e., all criteria above are met), it is then appropriate to examine the structural models. The procedure is shown below.

4.9.4.2 Evaluation of the structural models

Structural model assessment allows us to understand how well the collected data support the theory or concept. We make a minor adjustment of the five-step process of evaluating the structural models, which is recommended by Hair et al. (2014) so that our report can be straightforward to follow. At the first step, we assess the structural models for collinearity. The reason is that if there are high levels of collinearity among independent variables, the path coefficients may be biased (Hair et al. 2014). To gauge collinearity, we calculate the variance inflation factor (VIF). If a VIF value of 5 or higher, the collinearity level is high (Hair et al. 2014).

At the second step, we run the PLS-SEM algorithm to obtain path coefficients which demonstrate the strength of the relationships among variables (Hair, Ringle & Sarstedt 2011). Path coefficient values range from -1 to +1. Path coefficients that are close to +1 signify strong positive relationships, whereas the ones that are close to -1 indicate

strong negative relationships. The estimated coefficients that are close to 0 reveal weak or non-existent relationships. The significance of path coefficients can be evaluated by means of bootstrapping procedure (Hair, Ringle & Sarstedt 2011). It computes the empirical t values and p values which allow researchers to decide whether estimated path coefficients are significant or not (Hair et al. 2014; Henseler, Ringle & Sinkovics 2009). For the details about bootstrapping procedure, please see Hair et al. (2014) and Garson (2016).

At the third step, we evaluate the coefficients of determination (R^2) which are indicators of the predictive accuracy of structural models. In the context of PLS-SEM, R^2 can be interpreted as 'the amount of variance in the construct in question that is explained by the model' (Chin 2010, p. 674). R^2 has the value between 0 and 1. The higher values of R^2 illustrate the higher levels of predictive accuracy. In the context of marketing research, R^2 values of 0.75, 0.50, or 0.25 can be regarded as substantial, moderate, or weak respectively (Hair et al. 2014; Hair, Ringle & Sarstedt 2011).

We then examine Stone-Geisser's Q^2 (Geisser 1974; Stone 1974, cited in Hair et al. 2014, p. 178) that is used to measure the predictive relevance of structural models at the fourth step. Q^2 'represents a measure of how well-observed values are reconstructed by the model and its parameter estimates' (Chin 1998, p. 318). Q^2 value is attained by the use of blindfolding procedure (Hair et al. 2014; Hair, Ringle & Sarstedt 2011). Q^2 values greater than 0 reveal that the structural model has predictive relevance, whilst the Q^2 values of 0 or less than that indicate a lack of predictive relevance (Chin 1998; Hair et al. 2014). For the details about blindfolding procedure, please see Hair et al. (2014) and Garson (2016).

At the final step, we evaluate the f^2 effect sizes and the q^2 effect sizes. The f^2 effect size is used to assess if a certain exogenous construct has a substantial effect on an endogenous construct or not (Chin 1998, 2010). According to Hair et al. (2014, p. 177), the f^2 effect size can be calculated as follows.

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}}$$

Where $R^2_{included}$ and $R^2_{excluded}$ are the R^2 values of the endogenous latent variable when a selected exogenous latent variable is included in or excluded from the model.

The f^2 values of 0.02, 0.15, and 0.35 can be considered as representing small, medium, and large effects of the exogenous variable (Chin 1998, 2010; Henseler, Ringle & Sinkovics 2009).

In terms of the q^2 effect size, it is used to gauge whether a certain exogenous construct has a substantial predictive relevance for an endogenous construct (Hair et al. 2014). According to Hair et al. (2014, p. 183), the q^2 effect size can be calculated as follows.

$$q^2 = \frac{Q^2_{included} - Q^2_{excluded}}{1 - Q^2_{included}}$$

Where $Q^2_{included}$ and $Q^2_{excluded}$ are the Q^2 values of the endogenous latent variable when a selected exogenous latent variable is included in or excluded from the model.

The q^2 values of 0.02, 0.15, or 0.35 demonstrate that a certain exogenous construct has a small, medium, or large predictive relevance for an endogenous construct (Hair et al. 2014, p. 184).

4.10 Ethics considerations

Our study complies with the guidelines established by the Human Research Ethics Committee of University of Technology Sydney (UTS HREC). We submitted our human ethics application on 14 May 2015 and received ethics approval on 04 September 2015 (see Appendix 1).

4.11 Conclusion

We have seen that the choice of research philosophy has a significant impact on and is likely to determine the choice of research approach, research strategy and the design of the research. We embraced a positivist philosophy to guide this study, and therefore followed a deductive approach, chose a quantitative strategy, and employed a cross-sectional survey design for the current research. Data was collected from marketing and/or sales managers, product managers, brand managers, and the like who have been working in Australian firms and have been involved in NPD projects. After three months and a half, we received 104 usable responses from 297 eligible potential respondents. PLS-SEM approach was employed, and SmartPLS 3 software was used to test the hypotheses developed in Chapter 3. The hypothesis testing results are presented in the next chapter.

CHAPTER 5 DATA ANALYSIS & RESULTS

5.1 Introduction

The purpose of this chapter is to analyze collected data so as to test the hypotheses developed in Chapter 3. Before analyzing data with PLS-SEM technique, we examine it for outliers, missing data, data distribution, and nonresponse bias. We then describe the characteristics of the sample. Next, we assess the measurement models regarding internal consistency reliability, indicator reliability, convergent validity, and discriminant validity. After that, three structural models are used to test the hypotheses. We also carry out importance-performance matrix analysis (IPMA) to gain further insights into our research results. Finally, we conduct several statistical tests to identify whether our collected data suffers from common method bias.

5.2 Data examination

As mentioned in the previous chapter, after carefully screening collected data, we achieve the sample size of 106 observations. Before carrying out any data analysis with PLS-SEM technique, we examine the data in terms of outliers, missing data, data distribution, and nonresponse bias.

5.2.1 Detecting outliers

An outlier is an extreme or unusual answer to a question, or extreme or unusual answers to all questions (Hair et al. 2014). Detecting outliers is essential because they may distort the results of many statistical procedures (Hair et al. 2010; Meyers, Gamst & Guarino 2013). As proposed by Meyers, Gamst & Guarino (2013), there are two main types of outlier: univariate outliers and multivariate outliers. A univariate outlier is the

one that resides on a single variable (Meyers, Gamst & Guarino 2013). A multivariate outlier is a case with 'an extreme combination of values on two or more variables' (Meyers, Gamst & Guarino 2013, p. 131).

At first, we employ boxplot technique of IBM SPSS 20 to identify univariate outliers. In the boxplot, a case marked with an asterisk is considered univariate outlier (Meyers, Gamst & Guarino 2013).

No outlier is detected for 52 indicators of 16 latent variables. However, four control variables were found to have many outliers (see Appendix 5). Project Budget variable has the cases of 66, 104, 98, 96, 97, 70, 4, and 8 as univariate outliers. Project Size variable has the observations of 66 and 69 as univariate outliers. Project Length variable has the case 104 as a univariate outlier. Firm Size variable had the observations of 97, 104, 96, 22, 66 and 7 as univariate outliers. Taken together, we had 11 cases identified as univariate outliers.

However, we have not decided to remove the 11 above-mentioned outliers for three reasons. First, if we omit all of these outliers from the data set, the sample size will be substantially reduced from 106 to 95, this will decrease the statistical power (Hair et al. 2010). Second, these outliers may simply be a part of reality (Mooi & Sarstedt 2011). Some extremely large companies can employ more than 10,000 employees and conduct big NPD projects with the budget more than AUD 10 million and the length more than 3 years. If we delete them, we may lose insights into the characteristics of the population, which would not be disclosed in the normal analysis (Hair et al. 2010; Mooi & Sarstedt 2011). Lastly, our research employs multivariate data analyses, which involve more than two variables. Therefore, identifying multivariate outliers is more appropriate than detecting univariate ones.

To identify potential multivariate outliers, we used the Mahalanobis distance suggested by Meyers, Gamst & Guarino (2013). Any case with a Mahalanobis distance value equal to or greater than a critical value of chi-square is considered a multivariate outlier. Consulting the table of critical values of chi-square (Meyers, Gamst & Guarino 2013), using p = 0.001, df = 56 (52 items of 16 latent constructs and 4 control variables), the critical value of chi-square is 94.461.

Case 73 and 68 have Mahalanobis distance values of 103.71 and 97.51 respectively, which are greater than 94.461. These two cases, therefore, can be seen as multivarite outliers and are eliminated from the data set. As a consequence, the final data set used for further analyses consists of 104 observations or cases.

5.2.2 Missing data

Appendix 6 reveals that there are several missing values in the data set. More precisely, three items of ICT_2, Prod_Know_2, and Price_Know_3 have one missing value (0.96%), ProBudget variable has six missing values (5.77%), variable of ProSize has four missing values (3.85%), ProLength has three missing values (2.88%), and FirmSize has two missing values (1.92%). As recommended by Hair et al. (2014), if the number of missing values per indicator is less than 5%, mean value replacement may be useful to treat the missing values before running PLS-SEM. In our data set, none of the indicators has more than 5% of missing values, except control variable ProBudget has slightly more than 5%. Thus, we can use mean value replacement to deal with missing values.

5.2.3 Data distribution

PLS-SEM is a nonparametric method and requires no assumptions with respect to data distribution (Hair et al. 2014; Lowry & Gaskin 2014; Reinartz, Haenlein & Henseler 2009). Researchers frequently use the lack of data distribution assumptions to justify the choice of PLS-SEM in their research (Hair, Ringle & Sarstedt 2013; Reinartz, Haenlein & Henseler 2009). Accordingly, they do not provide any information about their data distribution, such as skewness and kurtosis (Hair, Ringle & Sarstedt 2013). The findings of Hair et al. (2012) revealed that only 19 of 204 studies (9.31%) which employed PLS-SEM technique reported their data distribution. However, data distribution has an important impact on the analyses (Hair, Ringle & Sarstedt 2013). The extremely non-normal data may make the evaluation of multivariate analysis results problematic, even though this issue is much less serious with PLS-SEM (Hair et al. 2014). Therefore, responding to the call for reporting data distribution of Hair et al. (2014) and Hair, Ringle & Sarstedt (2013), our study describes the data distribution as follows:

As suggested by Hair et al. (2014), if the skewness and kurtosis values of an indicator range from -1 to +1, this indicator meets the normal distribution requirement. Appendix 6 shows that 52 indicators of 16 latent constructs have the ranges of skewness and kurtosis values from -1.053 to +0.479 and from -1.375 to + 0.358 respectively. These values display a slight degree of non-normality. Nevertheless, the skewness and kurtosis values of four control variables exhibit a greater degree of non-normality.

5.2.4 Testing for nonresponse bias

To test for nonresponse bias, the answers regarding the latent variables and control variables in the research model of early respondents are compared with those of late

respondents because late respondents can be considered analogous to non-respondents (Armstrong & Overton 1977). Nevertheless, there is no general consensus on the definition of "late respondent" (Lindner, Murphy & Briers 2001). Following the recommendations of Lindner, Murphy & Briers (2001), in our research, the participants who responded after the last reminder are considered as late respondents (n = 34), and the informants who promptly replied after the first mailout are considered as early respondents (n = 44).

The two-tailed t-test for equality of means (Appendix 7) illustrates that only two of 52 indicators (Bulk_1 and Bulk_3) of 16 latent constructs are significantly different at the level of p = 0.05. There are no significant differences (p = 0.05) for four control variables between early and late respondents. Consequently, we can conclude nonresponse bias is not severe in our data set.

5.3 Descriptive empirical findings

As discussed earlier, our final data set consists of 104 observations. This section describes the characteristics of achieved sample as follows.

5.3.1 Characteristics of firms

The sample includes 104 firms, 81 of which (78%) are manufacturing firms, and the 23 remaining companies (22%) are service providers (we consider software publishing as manufacturer and electricity supply as service firm). The details of industry type of firms are presented in Table 5.1. We can see that the participating firms come from a wide range of industries in Australia, and thus enable the research results to be generalized to the broader population.

Table 5.1 Industry profile of the sample

ANZSIC 2006 Code [a]	Industry Type	Frequency	Percentage (%)
C.11	Food Product Manufacturing	9	8.65
C.11.113	Dairy Product Manufacturing	2	1.92
C.11.119	Other Food Product Manufacturing	1	0.96
C.12.121	Beverage Manufacturing	5	4.81
C.13.133	Textile Product Manufacturing	1	0.96
C.15.151	Pulp, Paper and Paperboard Manufacturing	2	1.92
C.18.181	Basic Chemical Manufacturing	8	7.69
C.18.183	Fertiliser and Pesticide Manufacturing	1	0.96
C.18.184	Pharmaceutical and Medicinal Product Manufacturing	5	4.81
C.18.189	Other Basic Chemical Product Manufacturing	4	3.85
C.20	Non-Metallic Mineral Product Manufacturing	3	2.88
C.23.231	Motor Vehicle and Motor Vehicle Part Manufacturing	4	3.85
C.24.241	Professional and Scientific Equipment Manufacturing	1	0.96
C.24.242	Computer and Electronic Equipment Manufacturing	3	2.88
C.24.243	Electrical Equipment Manufacturing	5	4.81
C.24.249	Other Machinery and Equipment Manufacturing	13	12.50
C.25.259	Other Manufacturing	12	11.54
D.26	Electricity Supply	1	0.96
J.54.542	Software Publishing	2	1.92
J.58.580	Telecommunications Services	11	10.58
M.69.692	Architectural, Engineering, and Technical Services	1	0.96
N.73.732	Packaging Services	2	1.92
Q.85	Medical and Other Health Care Services	4	3.85
S	Other Services	2	1.92
S.94.949	Other Repair and Maintenance Services	2	1.92
Total		**104**	**100.00**

[a]: ANZSIC 2006 Code is referenced from Australian-Bureau-of-Statistics (2013)

The firms of our sample vary in size, which ranges from 30 to 10,000 employees regarding full-time employees. The average number and the median number of employees are 308 and 115 respectively. It should be noted that as presented in Chapter

4, we requested the list broker to provide a list of firms that have at least 50 employees. However, in our data set, seven firms have less than 50 full-time employees. This can be explained that the firms provided by the list broker have more than 50 employees including full-time, part-time, and casual employees. Another explanation is that the respondents used NPD projects from previous employers that have less than 50 employees to answer the questionnaire. It also should be remembered that the criterion which firms should have at least 50 employees is not compulsory. We used this criterion to increase the likelihood that firms had conducted NPD projects. Hence, having seven responses from firms with less than 50 employees is still acceptable for our research.

At the time that the survey was conducted, these firms spent averagely 6.7% of their annual sales on new product development, and in turn, new products developed in the previous three years contributed an average of 16.9% of sales revenue to these companies. The study of American Productivity & Quality Center (APQC) and Product Development Institute (PDI) reveals that new products that are introduced during the previous three years account for an average of 27.3% of annual sales (Cooper & Edgett 2012). The Comparative Performance Assessment Study (CPAS) recently conducted by the Product Development & Management Association (PDMA) illustrates that the percentages of sales from new products launched within the last five years of North American, European, and Asian companies are 28.0%, 29.2%, and 38.9% respectively (Markham & Lee 2013). These findings suggest that the contribution of new products to sales revenue of Australian firms is lower than that of their North American, European, and Asian counterparts. Nevertheless, the fact that Australian companies generate 16.9% of annual sales revenues from new products with an average spend of 6.7% of annual sales for NPD confirms that the investments of Australian firms in developing new products are valuable to those firms.

5.3.2 Characteristics of respondents

There is a wide variety of job titles of participants (see Table 5.2). The majority of respondents are Marketing Managers (n = 26; 25%) and Sales Managers (n = 25; 24.04%), followed by Product Managers making up 13.46% (n = 14) of the sample. Seven informants (6.73%) are Brand Managers, and six of them (5.77%) are General Managers. There is the same number of respondents who have job titles of Marketing & Sales Managers as who are Project Leaders, and as who have job titles of Business Development Managers. Each type of these three job titles accounts for only 4.81% (n = 5) of the sample. Eleven remaining respondents (10.58%) are "other" managers such as Commercial Directors, Consumer Insight Managers, Category Managers, Media and Research Managers.

Table 5.2 Respondent titles

Title	Frequency	Percentage (%)
Marketing Manager	26	25.00
Sales Manager	25	24.04
Marketing & Sales Manager	5	4.81
Brand Manager	7	6.73
Product Manager	14	13.46
Project Leader	5	4.81
Business Development Manager	5	4.81
General Manager	6	5.77
Others	11	10.58
Total	**104**	**100.00**

The data also reveals that these managers had been in their respective positions for a considerable amount of time when the projects commenced, with mean = 3.77 years and median = 3.10 years.

The job titles and the years of work experience of informants indicate that they are senior people in their organizations, and thus have a high tendency to participate in NPD projects as well as have a sufficient level of knowledge of the company to complete the questionnaire.

5.3.3 Characteristics of NPD projects

There are various categories of NPD projects surveyed in our study (see Figure 5.1). The majority of the projects (n = 21; 20.2%) were conducted to develop new-to-the-firm products or new product lines of firms. Seventeen projects (16.3%) developed additions to existing product lines of firms, followed by projects that offered improvements or revisions to existing products of firms (n = 15; 14.4%). Projects that customized products according to the request of customers account for 12.5% (n = 13) of our sample. Twelve projects (11.5%) were identified as cost reduction exercises in which new products were designed in order to replace existing products, providing similar performance and benefits but at a lower cost. There is the same number of projects that developed new services as that developed new-to-the-world products or really new products to the market (n = 10; 9.6%). The minority of the projects were implemented to reposition existing products to new market segments or for new applications (n = 6; 5.8%).

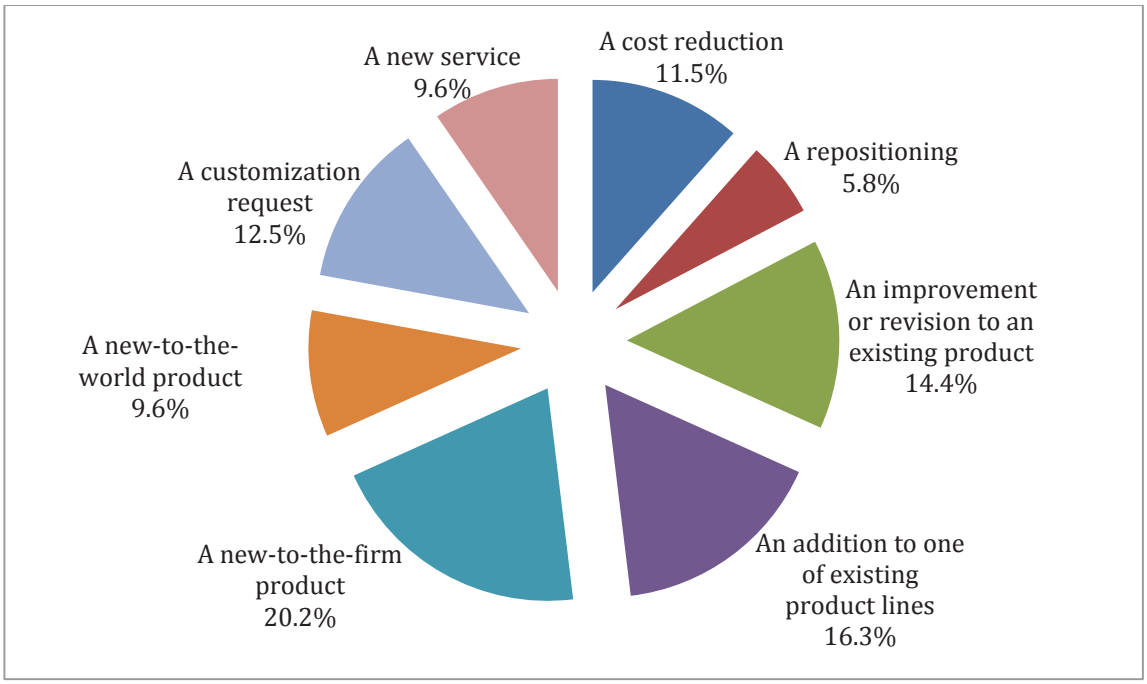

Figure 5.1 Percentage of various NPD project types

The data reveals that 48 surveyed projects (47.06%) targeted consumers or end users, 38 of them (37.25%) aimed at business-to-business customers, and 16 projects (15.69%) pursued both of these two kinds of customers. The data also suggests that each project employed an average of five full-time employees, spent AUD 437,450, and took 10.5 months. It is suggested that the number of core (or full-time) team members should not exceed eight, and five to seven are ideal numbers (Cooper 1998, 2005b). Therefore, we can see that the number of full-time employees employed to conduct NPD projects in Australia is consistent with that.

In terms of departments involved in NPD projects, 77 projects (74.04%) had the involvement of Production (or Manufacturing) department, 64 projects (61.54%) involved the Marketing department. Research and Development function participated in 61 projects (58.65%). Sales department took part in 55 projects (52.88%). Accounting (or Finance) unit and Maintenance (or Technical) Service function were involved in 44 (42.31%) and 38 (36.54%) projects respectively. Twenty-four projects (23.08%) had the

involvement of the Purchasing department. The minority of the projects (n = 6; 5.77%) involved "others" such as Innovation & Insights department, senior management, and project management. Figure 5.2 illustrates that Production (or Manufacturing), Marketing, Research and Development are the three departments that were most involved in NPD projects. This finding is in accordance with the notion that Marketing, Research and Development, and Manufacturing functions are crucial for the success of NPD projects (e.g., Griffin & Hauser 1996; Song & Xie 2000; Song, Montoya-Weiss & Schmidt 1997). Our finding is also entirely consistent with the research result of Fredericks (2005) that personnel from Manufacturing, Marketing, and Research & Development functions are core team members of NPD projects, whereas employees from Sales, Finance, and Purchasing units are considered as ad hoc NPD team members.

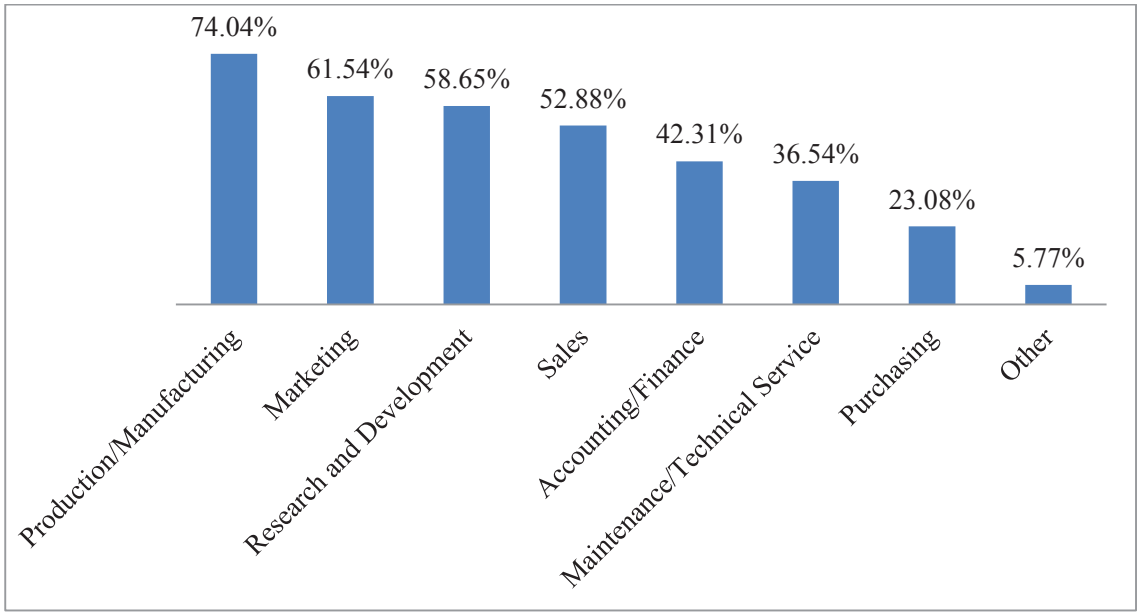

Figure 5.2 Involved departments in NPD project

This section provides information about the achieved sample with respect to the characteristics of firms, respondents, and NPD projects. The next section presents the assessment of measurement models of all constructs examined in our research.

5.4 Evaluation of measurement models

As discussed in Chapter 4, the measurement models of the constructs used in our study are assessed in terms of internal consistency reliability, indicator reliability, convergent validity, and discriminant validity. According to Hair et al. (2014), a PLS path model comprises two types of models: structural model and measurement model. The structural model depicts the relationships between the constructs or latent variables. The measurement model of each construct portrays the relationship between the construct and its indicators. To test all of the hypotheses developed in Chapter 3, we run three separate path models. Path model 1 (see Figure 5.3) displays the relationships between eight cross-functional integration mechanisms, five customer characteristics and NPD speed. Path model 2 (see Figure 5.4) shows the relationships between eight cross-functional integration mechanisms, five customer characteristics and new product advantage. Path model 3 (see Figure 5.5) depicts the relationships between eight cross-functional integration mechanisms, five customer characteristics and new product success. We do not present the measurement model of every construct in these three path models due to the limitation of the page size. By running three separate path models, the measurement model of each construct associated with cross-functional integration mechanisms and customer characteristics is assessed three times. Accordingly, the internal consistency reliability, indicator reliability, and convergent validity of these constructs are reported for three models. Regarding discriminant validity, if we run three separate path models as mentioned above, we cannot evaluate the discriminant validity of all independent variables and dependent variables because each model has only one dependent variable. Therefore, we run an aggregate path model that consists of eight cross-functional integration mechanisms and five customer

characteristics as independent variables, and three NPD outcomes as dependent variables so as to examine the discriminant validity of all these constructs.

To easily follow the results of measurement model assessment, a summary of all variables used in our study and their codes is presented as follows.

Table 5.3 Summary of constructs and their codes

	Construct	Code	Number of items	Code of item
Cross-functional integration mechanisms	Job rotation	Rotation	3	Rotation_1; Rotation_2; Rotation_3
	Cross-functional team use	CFTeam	4	CFTeam_1; CFTeam_2; CFTeam_3; CFTeam_4
	Cross-functional training	Training	3	Training_1; Training_2; Training_3
	Superordinate goals	Goal	4	Goal_1; Goal_2; Goal_3; Goal_4
	Co-location	Colocation	3	Colocation_1; Colocation_2; Colocation_3
	The use of Information and Communication Technology	ICT	3	ICT_1; ICT_2; ICT_3
	Informal coordination	Informal	4	Informal_1; Informal_2; Informal_3; Informal_4
	Joint reward systems	Reward	3	Reward_1; Reward_2; Reward_3
Customer characteristics	Customers with lead user characteristics	Lead	3	Lead_1; Lead_2; Lead_3
	Innovative customers	Inno	3	Inno_1; Inno_2; Inno_3
	Customers with product expertise	ProdKnow	3	ProdKnow_1; ProdKnow_2; ProdKnow_3
	Customers with price expertise	PriceKnow	3	PriceKnow_1; PriceKnow_2; PriceKnow_3
	Financially attractive customers	Bulk	3	Bulk_1; Bulk_2; Bulk_3
NPD outcomes	NPD speed	Speed	3	Speed_1; Speed_2; Speed_3
	New product advantage	Advantage	3	Advantage_1; Advantage_2; Advantage_3
	New product success	Success	4	Success_1; Success_2; Success_3; Success_4
Control variables	Firm Size	FirmSize		
	Project Budget	ProBudget		
	Project Length	ProLength		
	Project Size	ProSize		

5.4.1 Internal consistency reliability

Internal consistency reliability refers to the extent to which 'responses are consistent across the items within a measure' (Kline 2011, p. 69). In other words, it 'requires

indicators assigned to the same construct to reveal a strong mutual association' (Götz, Liehr-Gobbers & Krafft 2010, p. 695). To evaluate internal consistency reliability of reflective multi-item constructs, we use three criteria, namely Cronbach's alpha (α) (Cronbach 1951), composite reliability (ρ_c) (Werts, Linn & Jöreskog 1974), and rho A (ρ_A) (Dijkstra & Henseler 2015b). To be considered satisfactory, these three reliability values of each construct should be higher than 0.70 (Henseler, Hubona & Ray 2016).

Cronbach's alpha and composite reliability values are yielded by running PLS algorithm of SmartPLS 3 software (Ringle, Wende & Becker 2015). Rho A values are produced by running consistent PLS algorithm of that software. Table 5.4 shows that composite reliability and Cronbach's alpha values of all variables are greater than the cut-off threshold of 0.70. In addition to this, the values of rho A, 'a new and consistent reliability coefficient for PLS' (Dijkstra & Henseler 2015b, p. 300), which can help solve the problems of Cronbach's alpha and composite reliability, are also larger than 0.70. These results indicate that all constructs possess high levels of internal consistency reliability.

Table 5.4 Internal consistency reliability

Construct	Model 1[a]			Model 2[b]			Model 3[c]		
	Composite Reliability	Cronbach's Alpha	rho_A	Composite Reliability	Cronbach's Alpha	rho_A	Composite Reliability	Cronbach's Alpha	rho_A
Bulk	0.968	0.953	0.957	0.969	0.953	0.953	0.969	0.953	0.958
CFTeam	0.968	0.956	0.957	0.968	0.956	0.956	0.968	0.956	0.957
Colocation	0.927	0.879	0.888	0.925	0.879	0.882	0.927	0.879	0.883
Goal	0.967	0.955	0.957	0.967	0.955	0.955	0.967	0.955	0.957
ICT	0.979	0.967	0.968	0.979	0.967	0.967	0.979	0.967	0.968
Informal	0.931	0.909	0.923	0.933	0.909	0.927	0.935	0.909	0.923
Inno	0.974	0.959	0.959	0.973	0.959	0.959	0.973	0.959	0.959
Lead	0.954	0.929	0.941	0.955	0.929	0.939	0.955	0.929	0.938
PriceKnow	0.963	0.943	0.943	0.964	0.943	0.943	0.963	0.943	0.943
ProdKnow	0.979	0.967	0.967	0.979	0.967	0.967	0.978	0.967	0.967
Reward	0.977	0.964	0.968	0.971	0.964	0.968	0.977	0.964	0.968
Rotation	0.949	0.923	0.930	0.949	0.923	0.930	0.951	0.923	0.930
Training	0.945	0.914	0.920	0.944	0.914	0.917	0.945	0.914	0.918
Speed	0.931	0.889	0.895						
Advantage				0.972	0.956	0.957			
Success							0.956	0.938	0.945

[a]: Model with NPD speed as dependent variable

[b]: Model with new product advantage as dependent variable

[c]: Model with new product success as dependent variable

5.4.2 Indicator reliability

The indicator reliability indicates 'which part of an indicator's variance can be explained by the underlying latent variable' (Götz, Liehr-Gobbers & Krafft 2010, p. 694). The absolute standardized outer loading of each indicator is used to assess indicator reliability, and this value should be larger than 0.70 (Hair, Ringle & Sarstedt 2011). The indicator's outer loadings can also be seen as a measure of convergent validity at item or indicator level (Hair et al. 2014).

We ran the PLS algorithm to obtain the outer loadings of all indicators of all variables. The outer loadings of all indicators are found to be higher than 0.70 (see Appendix 8). This finding demonstrates that the reliability of each indicator is satisfactory.

5.4.3 Convergent validity

Convergent validity refers to the degree to which 'blocks of items strongly agree (i.e., converge) in their representation of the underlying construct they were created to measure' (Chin 2010, p. 674). The average variance extracted (AVE) can be used as a common measure of convergent validity at the construct level (Hair et al. 2014). The convergent validity of a construct is established if its AVE value is greater than 0.50 (Chin 2010; Hair et al. 2014; Hair, Ringle & Sarstedt 2011; Henseler, Ringle & Sinkovics 2009).

AVE of each construct is yielded by running the PLS algorithm of SmartPLS 3 software (Ringle, Wende & Becker 2015). Table 5.5 shows that the AVE values of all variables, which range from 0.771 to 0.939, are above the acceptable level of 0.5. Thus, we can conclude that the measures of all constructs achieve high levels of convergent validity.

Table 5.5 Average Variance Extracted (AVE)

Constructs	AVE (Model 1[a])	AVE (Model 2[b])	AVE (Model 3[c])
Financially attractive customers (Bulk)	0.911	0.912	0.913
Cross-functional team (CFTeam)	0.883	0.885	0.882
Co-location (Colocation)	0.809	0.806	0.808
Superordinate goal (Goal)	0.879	0.881	0.881
The use of Information and Communication Technology (ICT)	0.938	0.939	0.938
Informal coordination (Informal)	0.771	0.778	0.783
Innovative customers (Inno)	0.925	0.924	0.924
Customers with lead user characteristics (Lead)	0.874	0.875	0.875
Customers with price expertise (PriceKnow)	0.896	0.898	0.898
Customers with product expertise(ProdKnow)	0.939	0.939	0.938
Joint reward system (Reward)	0.934	0.918	0.933
Job rotation (Rotation)	0.861	0.804	0.866
Cross-functional training (Training)	0.852	0.848	0.852
NPD speed (Speed)	0.818		
New product advantage (Advantage)		0.920	
New product success (Success)			0.844

[a]: Model with NPD speed as dependent variable

[b]: Model with new product advantage as dependent variable

[c]: Model with new product success as dependent variable

5.4.4 Discriminant validity

Discriminant validity is defined as the extent to which a construct is sufficiently different from other constructs by empirical criteria (Hair et al. 2014; Henseler, Ringle & Sinkovics 2009). To evaluate discriminant validity of each construct, we use three standards: the cross loadings of the indicators, Fornell & Larcker criterion, and the heterotrait-monotrait ratio (HTMT) of the correlations. The reports of discriminant validity assessment are provided by utilizing PLS algorithm of SmartPLS 3 software (Ringle, Wende & Becker 2015).

The first criterion suggests the discriminant validity is established if the outer loading of an indicator on the associated construct larger than all of its loadings on other constructs (i.e., the cross loadings) (Barclay, Higgins & Thompson 1995; Chin 1998, 2010; Gefen & Straub 2005; Hair et al. 2014; Hair, Ringle & Sarstedt 2011). Appendix 9 discloses that outer loading of each item is higher than its cross loadings. Hence, the discriminant validity is established. However, it should be noted that this criterion is considered a bit more liberal with respect to establishing discriminant validity (Hair et al. 2014; Hair, Ringle & Sarstedt 2011).

The second or Fornell & Larcker criterion is a more conservative approach to evaluate discriminant validity (Hair et al. 2014). As proposed by Fornell & Larcker (1981), discriminant validity is established when the square root of each construct's AVE score larger than its correlation with any other constructs. In Table 5.6, the square root of the AVE of every reflective construct is on the diagonal, and the correlations between these constructs are in the lower left triangle. The square root of each construct's AVE is found to be well above its correlations with other constructs. Thus, the discriminant validity is established.

The third criterion currently developed by Henseler, Ringle & Sarstedt (2015) suggests if the heterotrait-monotrait ratio (HTMT) value of the correlations is higher than the threshold value of 0.85, there is a lack of discriminant validity. In Table 5.7, the highest HTMT value is $0.691 < 0.85$. And again, we can conclude that the discriminant validity is established.

These analyses provide support for the discriminant validity of the constructs' measures employed in our research. Among three aforementioned criteria, Fornell & Larcker criterion and $HTMT_{.85}$ criterion can be seen as 'the best assessment of discriminant

validity' and 'the standard for publication in marketing' (Voorhees et al. 2016, p. 119). We therefore can confidently conclude that the discriminant validity of 16 latent constructs of our study is established.

To sum up, after evaluating measurement models, all constructs' measures used in our research are reliable and valid with respect to internal consistency reliability, indicator reliability, convergent validity, and discriminant validity. We therefore continue to assess three structural models to test the developed hypotheses.

Table 5.6 Fornell & Larcker criterion

	Mean	SD	Advantage	Bulk	CFTeam	Colocation	Goal	ICT	Informal	Inno	Lead	PriceKnow	ProdKnow	Reward	Rotation	Speed	Success	Training
Advantage	4.833	1.376	**0.959**															
Bulk	4.026	1.896	0.290	**0.955**														
CFTeam	5.075	1.499	0.443	0.275	**0.940**													
Colocation	3.830	1.592	0.166	-0.049	-0.016	**0.900**												
Goal	4.916	1.456	0.583	0.139	0.583	0.046	**0.939**											
ICT	5.013	1.570	0.376	0.221	0.455	-0.177	0.432	**0.969**										
Informal	4.522	1.389	0.258	0.196	0.400	0.126	0.267	0.177	**0.885**									
Inno	4.285	1.464	0.342	0.146	0.211	0.091	0.326	0.092	0.019	**0.961**								
Lead	3.965	1.511	0.530	0.276	0.253	0.043	0.310	0.124	0.184	0.476	**0.936**							
PriceKnow	5.091	1.420	0.369	0.279	0.592	-0.013	0.445	0.217	0.377	0.210	0.382	**0.948**						
ProdKnow	4.951	1.484	0.572	0.316	0.537	0.019	0.549	0.224	0.473	0.366	0.453	0.607	**0.969**					
Reward	3.378	1.606	0.038	0.164	-0.203	0.138	-0.171	-0.042	0.204	0.174	0.188	-0.098	0.038	**0.966**				
Rotation	3.192	1.567	-0.004	-0.032	-0.245	0.228	-0.185	-0.145	0.006	0.165	0.152	-0.124	-0.044	0.440	**0.930**			
Speed	4.176	1.496	0.467	0.114	0.164	0.191	0.184	0.284	0.088	0.249	0.300	0.090	0.275	0.276	0.151	**0.904**		
Success	4.601	1.336	0.657	0.230	0.241	0.223	0.431	0.212	0.136	0.334	0.437	0.283	0.445	0.162	0.174	0.622	**0.919**	
Training	4.010	1.604	0.248	-0.074	0.132	-0.009	0.119	0.205	0.090	0.306	0.380	0.094	0.242	0.352	0.369	0.359	0.349	**0.923**

Note: Diagonal values in bold are square root of AVE scores.

Table 5.7 Heterotrait-Monotrait ratio (HTMT)

	Advantage	Bulk	CFTeam	Colocation	Goal	ICT	Informal	Inno	Lead	PriceKnow	ProdKnow	Reward	Rotation	Speed	Success	Training
Advantage																
Bulk	0.298															
CFTeam	0.460	0.283														
Colocation	0.177	0.072	0.069													
Goal	**0.605**	0.138	**0.612**	0.060												
ICT	0.390	0.232	0.477	0.191	0.455											
Informal	0.262	0.204	0.415	0.144	0.273	0.174										
Inno	0.355	0.155	0.218	0.104	0.338	0.092	0.065									
Lead	0.560	0.287	0.262	0.072	0.328	0.130	0.203	0.505								
PriceKnow	0.387	0.293	**0.622**	0.033	0.471	0.228	0.398	0.222	0.403							
ProdKnow	0.594	0.325	0.557	0.037	0.567	0.233	0.495	0.380	0.475	**0.634**						
Reward	0.044	0.175	0.215	0.153	0.182	0.053	0.224	0.182	0.195	0.108	0.049					
Rotation	0.046	0.071	0.264	0.263	0.200	0.157	0.088	0.171	0.166	0.138	0.050	0.458				
Speed	0.502	0.115	0.175	0.217	0.196	0.301	0.116	0.271	0.328	0.099	0.296	0.300	0.171			
Success	**0.691**	0.240	0.247	0.247	0.448	0.225	0.150	0.345	0.467	0.295	0.462	0.171	0.186	**0.684**		
Training	0.258	0.080	0.138	0.108	0.131	0.213	0.116	0.325	0.411	0.101	0.256	0.377	0.406	0.388	0.370	

5.5 Evaluation of structural models

As mentioned in Chapter 4, we follow a five-step procedure to assess structural models. Firstly, the structural models are assessed for collinearity. Second, we examine the structural model path coefficients (β). Third, the coefficient of determination (R^2) is evaluated. At the fourth step, we judge the predictive relevance (Q^2). The f^2 effect size (i.e., the relative impact of predictive accuracy) as well as the q^2 effect size (i.e., the relative impact of predictive relevance) are examined at the final step.

As discussed above, to test all of the developed hypotheses, we ran three separate path models (Figure 5.3, 5.4, and 5.5). For each model, we present collinearity assessment and the examination of path coefficients (β), R^2, Q^2, f^2, q^2. Accordingly, we do so three times in total. This may make our report longer and bog readers down in details. To make it succinct and easy to follow, we present collinearity assessment and the values of f^2, q^2 for all of three models, and report the examination of path coefficients (β), R^2, and Q^2 for every single model.

5.5.1 Collinearity assessment

Hair et al. (2014) argue that the path coefficients might be biased if there are high levels of collinearity among the predictor variables. Therefore, we should assess the structural model for collinearity. In the PLS-SEM context, a variance inflation factor (VIF) value of 5 or higher can specify a collinearity problem (Hair, Ringle & Sarstedt 2011). VIF values are yielded by running PLS algorithm of SmartPLS 3 software (Ringle, Wende & Becker 2015). Table 5.8 shows that all VIF values in three models are lower than 5. Hence, collinearity is not a problem for our structural models, and we can continue to

evaluate three structural models in terms of their path coefficients (β), their coefficients of determination (R^2) and their predictive relevance (Q^2).

Table 5.8 Collinearity assessment

Construct	VIF (Model 1[a])	VIF (Model 2[b])	VIF (Model 3[c])
Financially attractive customers (Bulk)	1.549	1.566	1.559
Cross-functional team (CFTeam)	2.438	2.479	2.489
Co-location (Colocation)	1.227	1.236	1.232
Firm Size (FirmSize)	1.410	1.472	1.393
Superordinate goals (Goal)	2.106	2.210	2.152
The use of Information and Communication Technology (ICT)	1.594	1.589	1.575
Informal coordination (Informal)	1.617	1.664	1.656
Innovative customers (Inno)	1.535	1.532	1.530
Customers with lead user characteristics (Lead)	1.751	1.734	1.715
Customers with price expertise (PriceKnow)	2.073	2.061	2.043
Project Budget (ProBudget)	2.192	2.183	2.196
Project Length (ProLength)	1.695	1.691	1.687
Project Size (ProSize)	1.267	1.213	1.265
Customers with product expertise(ProdKnow)	2.636	2.693	2.624
Joint reward system (Reward)	1.729	1.592	1.711
Job rotation (Rotation)	1.641	1.445	1.645
Cross-functional training (Training)	1.770	1.671	1.772

[a]: Model with NPD speed as dependent variable

[b]: Model with new product advantage as dependent variable

[c]: Model with new product success as dependent variable

5.5.2 Evaluation of structural model 1

To test the influence of eight cross-functional integration mechanisms and five customer characteristics on NPD speed, we ran path model 1 (Figure 5.3). This section presents the results of path coefficient (β), R^2, Q^2 of model 1.

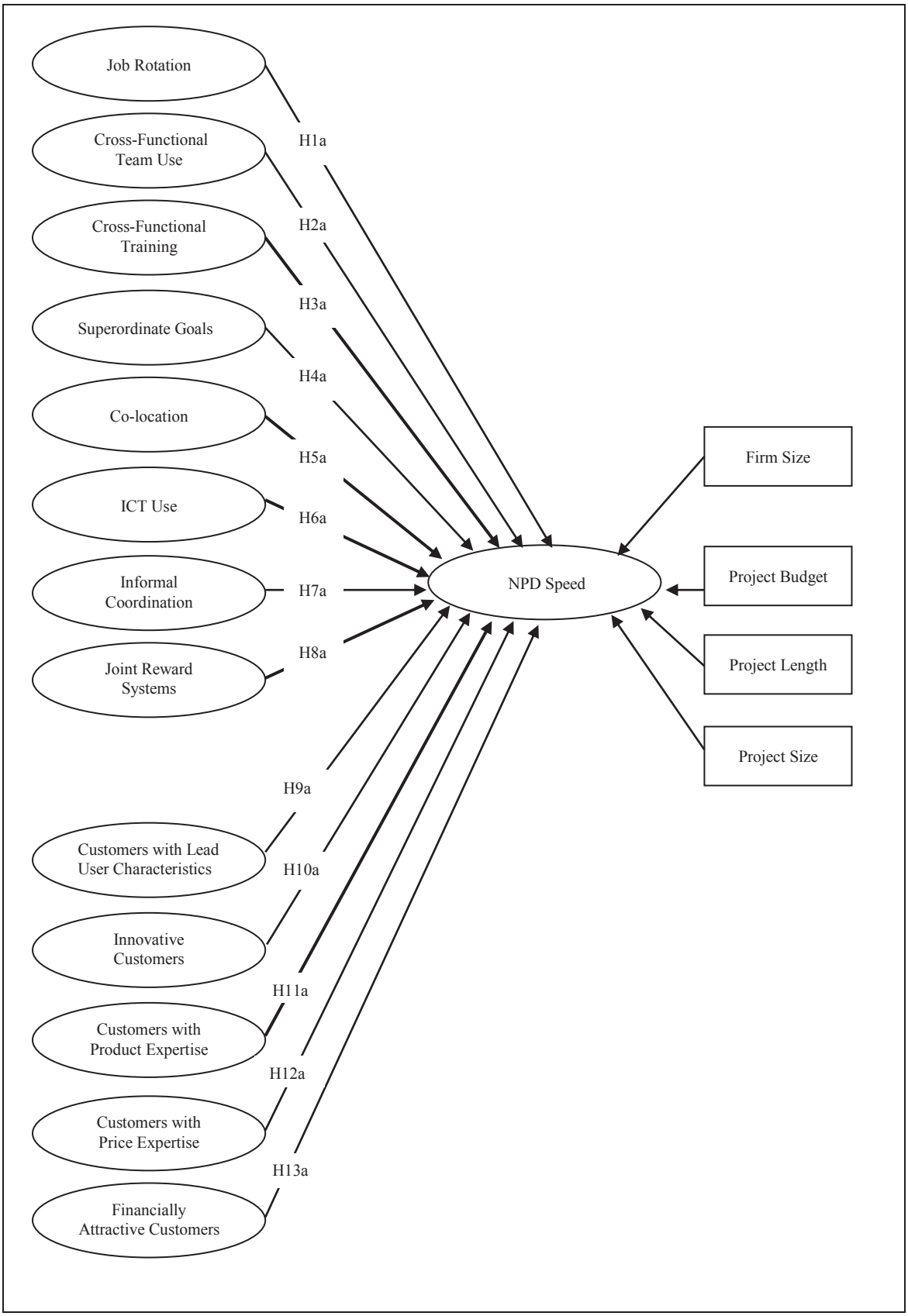

Figure 5.3 Model 1 – The effects of eight cross-functional mechanisms and five customer characteristics on NPD speed

5.5.2.1 Results of path coefficients (β)

In order to obtain path coefficients that demonstrate the strength of the relationships among variables, we ran the PLS algorithm of SmartPLS 3 (Ringle, Wende & Becker 2015). We then ran the PLS bootstrapping algorithm (see Garson 2016; Hair et al. 2014) to compute the empirical t values and p values which demonstrate whether estimated path coefficients are significant or not. The bootstrapping process also yields bootstrap confidence interval, a range 'into which the true population parameter will fall' at an assumed confidence level (e.g., 90%) (Hair et al. 2014, p. 136). Because it provides supplementary information about the stability of a certain coefficient estimate (Hair et al. 2014), we also put bootstrap confidence intervals in our report. Table 5.9 in the following displays the path coefficients, the t value, p value and confidence interval of each path coefficient.

Table 5.9 PLS testing results of model 1

Hypothesis	Linkage in the model	Path coefficient	t value	p value	90% Confidence interval	
					10.0%	90.0%
H1a (+)	Rotation -> Speed	-0.010	0.134	0.4467	-0.206	-0.013
H2a (+)	CFTeam -> Speed	0.041	0.400	0.3447	0.019	0.263
H3a (+)	**Training -> Speed**	**0.139***	**1.284**	**0.0997**	**0.028**	**0.302**
H4a (+)	Goal -> Speed	-0.001	0.012	0.4951	-0.207	-0.016
H5a (+)	**Colocation -> Speed**	**0.221*****	**2.387**	**0.0085**	**0.102**	**0.346**
H6a (+)	**ICT -> Speed**	**0.240****	**1.859**	**0.0316**	**0.096**	**0.443**
H7a (+)	Informal -> Speed	-0.108	0.958	0.1692	-0.302	-0.021
H8a (+)	**Reward -> Speed**	**0.171***	**1.588**	**0.0563**	**0.028**	**0.307**
H9a (+)	Lead -> Speed	0.109	1.111	0.1333	0.026	0.280
H10a (+)	Inno -> Speed	0.025	0.316	0.3760	0.017	0.214
H11a (+)	**ProdKnow -> Speed**	**0.200***	**1.538**	**0.0621**	**0.035**	**0.371**
H12a (+)	PriceKnow -> Speed	-0.128	1.263	0.1034	-0.276	-0.023
H13a (+)	Bulk -> Speed	0.028	0.340	0.3668	0.020	0.234
	FirmSize -> Speed	-0.154*	1.330	0.0918	-0.350	-0.066
	ProBudget -> Speed	0.345**	1.820	0.0345	0.039	0.521
	ProLength -> Speed	-0.239**	2.070	0.0193	-0.371	-0.071
	ProSize -> Speed	-0.025	0.372	0.3549	-0.178	-0.012
R^2 = 0.364						
Q^2 = 0.208						

* p < 0.10 ; ** p < 0.05 ; *** p < 0.01 (1-tailed tests)

It is important to note that we used one-tailed tests to test the significance of each path coefficient. According to Perry (1998, p. 79), 'the use of a directional hypothesis allows a one-tailed test of significance'. Furthermore, in the PLS-SEM context, 'a one-tailed test is recommended if the coefficient is assumed to have a sign (positive or negative), which should be reflected in the hypothesis that refers to the corresponding association' (Kock 2015b, p. 1). All hypotheses developed in our research are directional ones (each path coefficient is presumed to have a positive sign), the use of the one-tailed test is reasonable. We now report the results of hypothesis testing of model 1 based upon the results presented in Table 5.9.

Hypothesis 1a (H1a) states that job rotation positively affects NPD speed. Table 5.9 shows that there is a negative, insignificant coefficient ($\beta = -0.010$, $p > 0.10$), which demonstrates that there is no relationship between job rotation and NPD speed. Therefore, H1a is not supported.

Hypothesis 2a (H2a) proposes that the use of cross-functional teams positively affects NPD speed. The coefficient that is found to be positive but insignificant ($\beta = 0.041$, $p > 0.10$) indicates that there is no association between the use of cross-functional team and NPD speed. Hence, H2a is rejected.

Hypothesis 3a (H3a) suggests that cross-functional training positively affects NPD speed. The PLS result confirms that cross-functional training has a positive and significant impact on NPD speed ($\beta = 0.139$, $p < 0.10$), thus supporting H3a.

Hypothesis 4a (H4a) suggests that superordinate goals positively affects NPD speed. The coefficient is negative and insignificant ($\beta = -0.001$, $p > 0.10$), which suggests no connection between superordinate goals and NPD speed. We therefore reject H4a.

Hypothesis 5a (H5a) proposes that co-location positively affects NPD speed. There is a positive and significant coefficient ($\beta = 0.221$, $p < 0.01$), which corroborates that co-location has a positive and significant influence on NPD speed. Consequently, H5a is supported.

Hypothesis 6a (H6a) suggests that the use of Information and Communication Technology (ICT) positively affects NPD speed. The positive and significant coefficient ($\beta = 0.240$, $p < 0.05$) verifies that the use of ICT has a positive and significant effect on NPD speed. Accordingly, H6a is supported.

Hypothesis 7a (H7a) posits that informal coordination positively affects NPD speed. Table 5.9 shows that there is a negative, insignificant coefficient ($\beta = -0.108$, $p > 0.10$), which demonstrates that there is no association between informal coordination and NPD speed. Hence, we reject H7a.

Hypothesis 8a (H8a) suggests that joint reward systems positively affect NPD speed. The PLS result confirms that joint reward systems have a positive and significant impact on NPD speed ($\beta = 0.171$, $p < 0.10$), and thus supporting H8a.

Hypothesis 9a (H9a) proposes that customers with lead user characteristics positively affect NPD speed. There is no link between involving customers with lead user characteristics in NPD projects and NPD speed because the coefficient is positive but insignificant ($\beta = 0.109$, $p > 0.10$). As a result, H9a is not supported.

Hypothesis 10a (H10a) postulates that innovative customers positively affect NPD speed. Again, there is no relationship between involving innovative customers in NPD projects and NPD speed because the coefficient is positive but insignificant ($\beta = 0.025$, $p > 0.10$). Accordingly, we reject H10a.

Hypothesis 11a (H11a) suggests that customers with product expertise positively affect NPD speed. Involving customers with product expertise in NPD projects is found to have a positive and significant impact on NPD speed ($\beta = 0.200$, $p < 0.10$). H11a is therefore supported.

Hypothesis 12a (H12a) posits that customers with price expertise positively affect NPD speed. The linkage between involving customers with price expertise in NPD projects and NPD speed is not supported due to a negative and insignificant path coefficient ($\beta = -0.128$, $p > 0.10$). Hence, H12a is rejected.

Hypothesis 13a (H13a) predicts that financially attractive customers positively affect NPD speed. Again, the connection between involving financially attractive customers in NPD projects and NPD speed is not supported because the path coefficient is positive but insignificant ($\beta = 0.028$, $p > 0.10$). Thus, H13a is not supported.

In terms of the effects of control variables, firm size and project length negatively influence NPD speed ($\beta = -0.154$, $p < 0.10$, and $\beta = -0.239$, $p < 0.05$ respectively), whereas project budget has a positive impact on NPD speed ($\beta = 0.345$, $p < 0.05$). There is no relationship between project size and NPD speed.

5.5.2.2 Result of the coefficient of determination (R^2)

R^2 is an indicator of the predictive accuracy of structural models (Hair et al. 2014). Running the PLS algorithm of SmartPLS 3 software (Ringle, Wende & Becker 2015) produces the value of R^2. Table 5.9 reports that R^2 of NPD speed is 0.364. This means that 36.40% of the variance in NPD speed is explained by the model 1.

5.5.2.3 Result of the predictive relevance (Q^2)

Q^2 is used to measure the predictive relevance of structural models (Hair et al. 2014). Q^2 value is attained by running the PLS blindfolding algorithm of SmartPLS 3 software (Ringle, Wende & Becker 2015). Table 5.9 shows that the value of Q^2 is well above zero ($Q^2 = 0.208$), indicating that eight cross-functional integration mechanisms and five customer characteristics have predictive relevance for NPD speed.

5.5.2.4 Post hoc statistical power calculation

As mentioned in Chapter 4, our achieved sample size (104 observations) is smaller than the expected sample size (130 observations) which is calculated by using the "ten

times" rule of thumb. We therefore ran a post hoc statistical power test to assess whether our data achieved the commonly required statistical power of 80% (Hair et al. 2014) and is sufficient for decent data analyses. As suggested by Gaskin (2013), we employed the Post hoc Statistical Power Calculator developed by Soper (2016) so as to obtain the value of statistical power. Table 5.10 illustrates that the statistical power of 0.9997 is greater than 80%. Hence, we can confirm that our sample size is adequate for data analysis.

Table 5.10 Post hoc statistical power

Number of predictors	13
Observed R^2	0.364
Probability level	0.05
Sample size	104
Statistical Power	0.9997

5.5.3 Evaluation of structural model 2

To test the impact of eight cross-functional integration mechanisms and five customer characteristics on new product advantage, we ran path model 2 (Figure 5.4). This section displays the results of path coefficient (β), R^2, Q^2 of model 2.

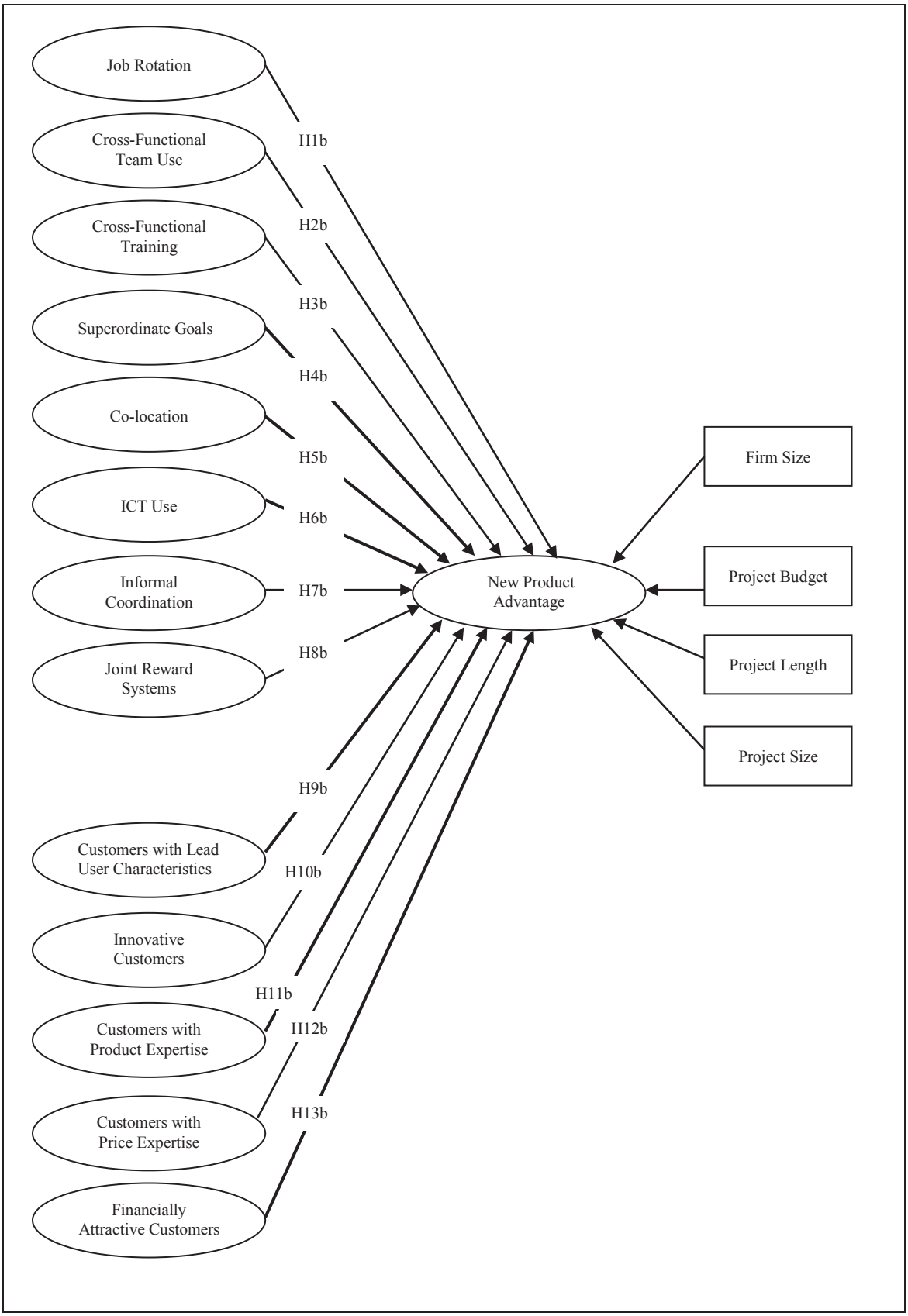

Figure 5.4 Model 2 – The effects of eight cross-functional mechanisms and five customer characteristics on new product advantage

5.5.3.1 Results of path coefficients (β)

As mentioned above, to attain path coefficients (β), t values, p values, and confidence intervals, we ran the PLS algorithm and PLS bootstrapping algorithm of SmartPLS 3 software (Ringle, Wende & Becker 2015). These values are displayed in Table 5.11, and the results of hypothesis testing of model 2 are reported in the following.

Table 5.11 PLS testing results of model 2

Hypothesis	Linkage in the model	Path coefficient	t value	p value	90% Confidence interval	
					10.0%	90.0%
H1b (+)	Rotation -> Advantage	-0.036	0.643	0.2600	-0.150	-0.011
H2b (+)	CFTeam -> Advantage	-0.008	0.113	0.4551	-0.196	-0.013
H3b (+)	Training -> Advantage	0.032	0.474	0.3179	0.012	0.178
H4b (+)	**Goal -> Advantage**	**0.299*** **	**2.917**	**0.0018**	**0.179**	**0.441**
H5b (+)	**Colocation -> Advantage**	**0.228*** **	**2.620**	**0.0044**	**0.112**	**0.332**
H6b (+)	**ICT -> Advantage**	**0.180** **	**1.704**	**0.0443**	**0.062**	**0.341**
H7b (+)	Informal -> Advantage	-0.045	0.689	0.2455	-0.177	-0.014
H8b (+)	Reward -> Advantage	0.002	0.030	0.4882	0.015	0.182
H9b (+)	**Lead -> Advantage**	**0.305*** **	**3.145**	**0.0008**	**0.191**	**0.441**
H10b (+)	Inno -> Advantage	-0.024	0.375	0.3537	-0.171	-0.013
H11b (+)	**ProdKnow -> Advantage**	**0.229** **	**1.846**	**0.0325**	**0.072**	**0.402**
H12b (+)	PriceKnow -> Advantage	-0.120*	1.324	0.0929	-0.255	-0.025
H13b (+)	**Bulk -> Advantage**	**0.139** **	**1.667**	**0.0478**	**0.046**	**0.266**
	FirmSize -> Advantage	-0.016	0.165	0.4346	-0.243	-0.013
	ProBudget -> Advantage	0.080	0.902	0.1835	0.015	0.230
	ProLength -> Advantage	0.117*	1.487	0.0686	0.025	0.228
	ProSize -> Advantage	0.045	0.848	0.1982	0.011	0.146
R^2 = 0.597						
Q^2 = 0.494						

* p < 0.10 ; ** p < 0.05 ; *** p < 0.01 (1-tailed tests)

Hypothesis 1b (H1b) states that job rotation positively affects new product advantage. Table 5.11 shows that there is a negative, insignificant coefficient (β = -0.036, p > 0.10), which demonstrates that there is no relationship between job rotation and new product advantage. Therefore, H1b is not supported.

Hypothesis 2b (H2b) proposes that the use of cross-functional teams positively affects new product advantage. The coefficient is negative and insignificant ($\beta = -0.008$, $p > 0.10$) indicating that there is no association between the use of cross-functional teams and new product advantage. Hence, H2b is rejected.

Hypothesis 3b (H3b) suggests that cross-functional training positively affects new product advantage. The coefficient is positive but insignificant ($\beta = 0.032$, $p > 0.10$), which indicates no connection between cross-functional training and new product advantage. We, therefore, reject H3b.

Hypothesis 4b (H4b) conjectures that superordinate goals positively affect new product advantage. The PLS result confirms that superordinate goals have a positive and significant impact on new product advantage ($\beta = 0.299$, $p < 0.01$), and thus supporting H4b.

Hypothesis 5b (H5b) supposes that co-location positively affects new product advantage. There is a positive and significant coefficient ($\beta = 0.228$, $p < 0.01$), which suggests that co-location has a positive and significant influence on new product advantage. Consequently, H5b is supported.

Hypothesis 6b (H6b) posits that the use of Information and Communication Technology (ICT) positively affects new product advantage. The positive and significant coefficient ($\beta = 0.180$, $p < 0.05$) verifies that the use of ICT has a positive and significant effect on new product advantage. Accordingly, H6b is supported.

Hypothesis 7b (H7b) states that informal coordination positively affects new product advantage. Table 5.11 shows that there is a negative, insignificant coefficient (β = -

0.045, $p > 0.10$), which demonstrates that there is no relationship between informal coordination and new product advantage. Hence, we reject H7b.

Hypothesis 8b (H8b) suggests that joint reward systems positively affect new product advantage. There is no link between joint reward systems and new product advantage because the coefficient is positive but insignificant ($\beta = 0.002$, $p > 0.10$). As a result, H8b is not supported.

Hypothesis 9b (H9b) proposes that customers with lead user characteristics positively affect new product advantage. The PLS result confirms that involving customers with lead user characteristics in NPD projects has a positive and significant impact on new product advantage ($\beta = 0.305$, $p < 0.01$), and thus supporting H9b.

Hypothesis 10b (H10b) supposes that innovative customers positively affect new product advantage. There is no relationship between involving innovative customers in NPD projects and new product advantage because the coefficient is negative and insignificant ($\beta = -0.024$, $p > 0.10$). Accordingly, we reject H10b.

Hypothesis 11b (H11b) expects that customers with product expertise positively affect new product advantage. Involving customers with product expertise in NPD projects is found to have a positive and significant impact on new product advantage ($\beta = 0.229$, $p < 0.05$). H11b is therefore supported.

Hypothesis 12b (H12b) suggests that customers with price expertise positively affect new product advantage. The PLS results demonstrate that involving customers with price expertise in NPD projects has significant but negative effect on new product advantage ($\beta = -0.120$, $p < 0.10$). Hence, H12b is rejected.

Hypothesis 13b (H13b) posits that financially attractive customers positively affect new product advantage. There is a positive and significant coefficient ($\beta = 0.139$, $p < 0.05$), which confirms that financially attractive customers have a positive and significant influence on new product advantage. Thus, H13b is supported.

Concerning the effects of control variables, project length positively affects new product advantage ($\beta = 0.117$, $p < 0.10$), whereas firm size, project budget, and project size have no relationship with new product advantage.

5.5.3.2 Result of the coefficient of determination (R^2)

As discussed previously, running the PLS algorithm of SmartPLS 3 software (Ringle, Wende & Becker 2015) produces the R^2 values. Table 5.11 reports that R^2 of new product advantage is 0.597. This indicates that 59.70% of the variance in new product advantage is explained by the model 2.

5.5.3.3 Result of the predictive relevance (Q^2)

Q^2 value is attained by running the PLS blindfolding algorithm of SmartPLS 3 software (Ringle, Wende & Becker 2015). Table 5.11 shows that the value of Q^2 is well above zero ($Q^2 = 0.494$), demonstrating that eight cross-functional integration mechanisms and five customer characteristics have predictive relevance for new product advantage.

5.5.3.4 Post hoc statistical power calculation

We used the Post hoc Statistical Power Calculator developed by Soper (2016) in order to calculate the value of statistical power. Table 5.12 displays that the achieved statistical power for running path model 2 is greater than 80%. Hence, we can confirm that our sample size is adequate for data analysis.

Table 5.12 Post hoc statistical power

Number of predictors	13
Observed R^2	0.597
Probability level	0.05
Sample size	104
Statistical Power	1

5.5.4 Evaluation of structural model 3

To test the impact of eight cross-functional integration mechanisms and five customer characteristics on new product success, we ran path model 3 (Figure 5.5). This section reports the results of path coefficient (β), R^2, Q^2 of model 3.

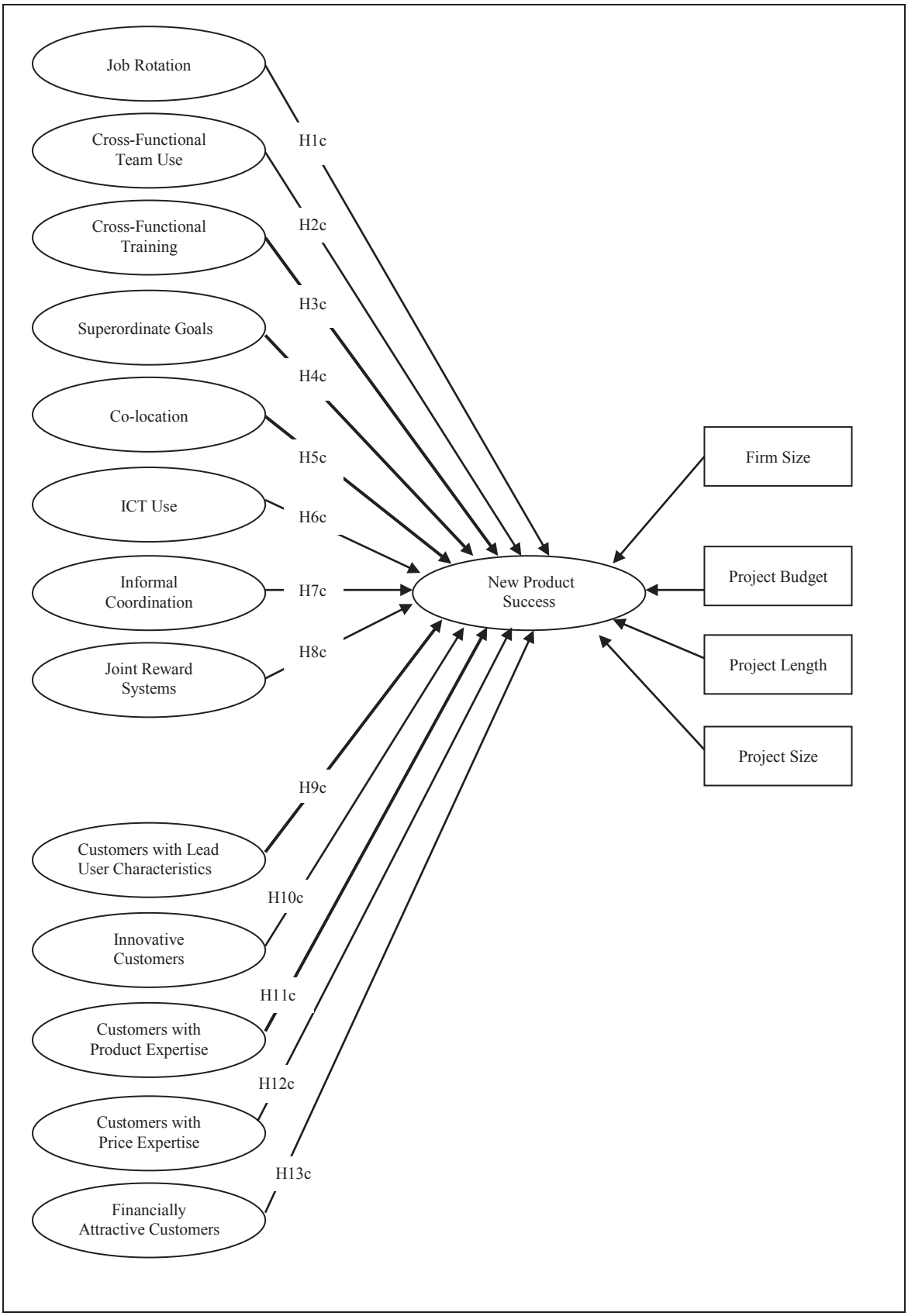

Figure 5.5 Model 3 – The effects of eight cross-functional mechanisms and five customer characteristics on new product success

5.5.4.1 Results of path coefficients (β)

As mentioned earlier, to attain path coefficients (β), t values, p values, and confidence intervals, we ran the PLS algorithm and PLS bootstrapping algorithm of SmartPLS 3 (Ringle, Wende & Becker 2015). These values are displayed in Table 5.13, and the results of hypothesis testing of model 3 are reported in the following.

Table 5.13 PLS testing results of model 3

Hypothesis	Linkage in the model	Path coefficient	t value	p value	90% Confidence interval	
					10.0%	90.0%
H1c (+)	Rotation -> Success	0.046	0.579	0.2813	0.018	0.219
H2c (+)	CFTeam -> Success	-0.115	0.907	0.1823	-0.340	-0.029
H3c (+)	**Training -> Success**	**0.183***	**1.358**	**0.0874**	**0.045**	**0.388**
H4c (+)	**Goal -> Success**	**0.277****	**2.237**	**0.0127**	**0.118**	**0.446**
H5c (+)	**Colocation -> Success**	**0.212****	**2.304**	**0.0107**	**0.095**	**0.338**
H6c (+)	ICT -> Success	0.062	0.748	0.2274	0.020	0.233
H7c (+)	Informal -> Success	-0.092	1.038	0.1497	-0.241	-0.020
H8c (+)	Reward -> Success	0.041	0.566	0.2858	0.018	0.202
H9c (+)	**Lead -> Success**	**0.156***	**1.531**	**0.0630**	**0.042**	**0.314**
H10c (+)	Inno -> Success	-0.015	0.224	0.4114	-0.187	-0.015
H11c (+)	**ProdKnow -> Success**	**0.219****	**1.698**	**0.0449**	**0.067**	**0.410**
H12c (+)	PriceKnow -> Success	0.027	0.346	0.3646	0.016	0.208
H13c (+)	Bulk -> Success	0.122	1.132	0.1289	0.031	0.314
	FirmSize -> Success	0.025	0.171	0.4321	0.013	0.363
	ProBudget -> Success	-0.049	0.378	0.3528	-0.341	-0.026
	ProLength -> Success	-0.025	0.302	0.3813	-0.225	-0.017
	ProSize -> Success	0.071	0.946	0.1720	0.020	0.213
R^2 = 0.431						
Q^2 = 0.325						

* p < 0.10 ; ** p < 0.05 ; *** p < 0.01 (1-tailed tests)

Hypothesis 1c (H1c) posits that job rotation positively affects new product success. Table 5.13 shows that there is a positive but insignificant coefficient (β = 0.046, p > 0.10), which demonstrates that there is no relationship between job rotation and new product success. Therefore, H1c is not supported.

Hypothesis 2c (H2c) proposes that the use of cross-functional teams positively affects new product success. The coefficient is negative and insignificant ($\beta = -0.115$, $p > 0.10$), indicating that there is no association between the use of cross-functional team and new product success. Hence, H2c is rejected.

Hypothesis 3c (H3c) suggests that cross-functional training positively affects new product success. The PLS results confirm that cross-functional training has a positive and significant impact on new product success ($\beta = 0.183$, $p < 0.10$), and thus supporting H3c.

Hypothesis 4c (H4c) predicts that superordinate goals positively affect new product success. The PLS results verify that superordinate goals have a positive and significant impact on new product success ($\beta = 0.277$, $p < 0.05$), and thus supporting H4c.

Hypothesis 5c (H5c) suggests that co-location positively affects new product success. There is a positive and significant coefficient ($\beta = 0.212$, $p < 0.05$), which corroborates that co-location has a positive and significant influence on new product success. Consequently, H5c is supported.

Hypothesis 6c (H6c) predicts that the use of Information and Communication Technology (ICT) positively affects new product success. The coefficient is positive but insignificant ($\beta = 0.062$, $p > 0.10$), which suggests no connection between the use of ICT and new product success. We therefore reject H6c.

Hypothesis 7c (H7c) states that informal coordination positively affects new product success. Table 5.13 shows that there is a negative, insignificant coefficient ($\beta = -0.092$, $p > 0.10$), which demonstrates that there is no association between informal coordination and new product success. Hence, we reject H7c.

Hypothesis 8c (H8c) suggests that joint reward systems positively affect new product success. There is no link between joint reward systems and new product success because the coefficient is found to be positive but insignificant ($\beta = 0.041$, $p > 0.10$). As a result, H8c is not supported.

Hypothesis 9c (H9c) proposes that customers with lead user characteristics positively affect new product success. The PLS results confirm that involving customers with lead user characteristics in NPD projects has a positive and significant impact on new product success ($\beta = 0.156$, $p < 0.10$), and thus supporting H9c.

Hypothesis 10c (H10c) suggests that innovative customers positively affect new product success. There is no relationship between involving innovative customers in NPD projects and new product success because the coefficient is negative and insignificant ($\beta = -0.015$, $p > 0.10$). Accordingly, we reject H10c.

Hypothesis 11c (H11c) posits that customers with product expertise positively affect new product success. Involving customers with product expertise in NPD projects is found to have a positive and significant impact on new product success ($\beta = 0.219$, $p < 0.05$). H11c is therefore supported.

Hypothesis 12c (H12c) suggests that customers with price expertise positively affect new product success. The linkage between involving customers with price expertise in NPD projects and new product success is not supported because of a positive but insignificant path coefficient ($\beta = 0.027$, $p > 0.10$). Hence, H12c is rejected.

Hypothesis 13c (H13c) postulates that financially attractive customers positively affect new product success. Again, the connection between involving financially attractive customers in NPD projects and new product success is not supported because the path

coefficient is positive but insignificant ($\beta = 0.122$, $p > 0.10$). Thus, H13c is not supported.

Regarding the impact of control variables, firm size, project budget, project length and project size have no impact on new product success.

5.5.4.2 Result of the coefficient of determination (R^2)

As mentioned above, running the PLS algorithm of SmartPLS 3 (Ringle, Wende & Becker 2015) produces the value of R^2. Table 5.13 reports that R^2 of new product success is 0.431. This shows that 43.10% of the variance in new product success is explained by the model 3.

5.5.4.3 Result of the predictive relevance (Q^2)

Q^2 value is obtained by running the PLS blindfolding algorithm of SmartPLS 3 software (Ringle, Wende & Becker 2015). Table 5.13 shows that the value of Q^2 is well above zero ($Q^2 = 0.325$), demonstrating that eight cross-functional integration mechanisms and five customer characteristics have predictive relevance for new product success.

5.5.4.4 Post hoc statistical power calculation

We used the Post hoc Statistical Power Calculator developed by Soper (2016) in order to calculate the value of statistical power. Table 5.14 displays that the achieved statistical power for running path model 3 is greater than 80%. Hence, we can confirm that our sample size is adequate for data analysis.

Table 5.14 Post hoc statistical power

Number of predictors	13
Observed R^2	0.431
Probability level	0.05
Sample size	104
Statistical Power	0.9999

5.5.5 Summary of the results of three models

We have presented the PLS testing results of three separate path models. To gain the holistic view of the research, a summary of the results of all three models is essential (see Table 5.15). Therefore, this section summarizes the findings and then reports the effect size f^2 and effect size q^2.

Table 5.15 PLS testing results of three models

	Model 1	Model 2	Model 3
Dependent Variable	**NPD speed**	**New product advantage**	**New product success**
Independent Variable	**Path Coefficient**	**Path Coefficient**	**Path Coefficient**
Co-location	**0.221*** **	**0.228*** **	**0.212** **
Superordinate goals	-0.001	**0.299*** **	**0.277** **
The use of ICT	**0.240** **	**0.180** **	0.062
Cross-functional training	**0.139* **	0.0320	**0.183* **
Joint reward systems	**0.171* **	0.002	0.041
Job rotation	-0.010	-0.036	0.046
The use of cross-functional teams	0.041	-0.008	-0.115
Informal coordination	-0.108	-0.045	-0.092
Customers with product expertise	**0.200* **	**0.229** **	**0.219** **
Customers with lead user characteristics	0.109	**0.305*** **	**0.156* **
Financially attractive customers	0.028	**0.139** **	0.122
Innovative customers	0.025	-0.024	-0.015
Customers with price expertise	-0.128	-0.120*	0.027
Control Variable			
Firm Size	-0.154*	-0.016	0.025
Project Budget	0.345**	0.08	-0.049
Project Length	-0.239**	0.117*	-0.025
Project Size	-0.025	0.045	0.071
R^2	**0.364**	**0.597**	**0.431**
Q^2	**0.208**	**0.494**	**0.325**

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$ (1-tailed tests)

5.5.5.1 Summary of structural model results

As can be seen in Table 5.15, job rotation, the use of cross-functional teams, and informal coordination are three cross-functional mechanisms that have no impact on NPD speed, new product advantage, and new product success, whereas co-location has a positive significant influence on all of these three NPD outcomes. Co-location therefore can be regarded as the most salient mechanism that leads to the success of

NPD projects. Three other mechanisms, namely superordinate goals, the use of ICT, and cross-functional training, positively affect two out of three outcomes of NPD projects. Specifically, superordinate goals influence new product advantage and new product success in a positive manner, the use of ICT has a positive effect on NPD speed and new product advantage, and cross-functional training positively impacts on NPD speed and new product success. Among these three mechanisms, superordinate goals have the strongest effects on NPD outcomes as they have the largest path coefficients, and can be seen as the second most effective mechanism after co-location. The final mechanism, namely joint reward systems, positively affect only NPD speed. In short, of eight cross-functional integration mechanisms suggested in our study, five mechanisms are found to have a positive impact on NPD outcomes, while three remaining mechanisms have no effect.

In the matter of customer characteristics, customers with product expertise are the most important customers for firms to involve in NPD projects as the involvement of these customers can enhance NPD speed, new product advantage, and new product success. Customers with lead user characteristics are the second most favoured customers, who can help firms increase new product advantage and new product success. Financially attractive customers positively affect new product advantage. In brief, of five customer characteristics proposed in our research, three customer characteristics are found to have positive effects on the outcomes of NPD process, whereas two other ones, namely innovative customers and customers with price expertise have no influence.

Concerning the effects of control variables, several significant relationships are detected. Firm size negatively affects NPD speed, whereas project budget positively impacts NPD speed. Project length increases new product advantage, but it slows down

NPD speed. There is no connection between project size and three outcomes of NPD projects.

The above is a summary of our findings, and the discussion of these results is left until Chapter 6 (i.e., the final chapter). This subsection is ended with the summary of the evaluation of all hypothesized relationships for the study (see Table 5.16).

Table 5.16 Summary of the hypothesis assessment

Hypothesis	Outcome
H1a: Job rotation positively affects NPD speed.	No support
H1b: Job rotation positively affects new product advantage.	No support
H1c: Job rotation positively affects new product success.	No support
H2a: The use of cross-functional teams positively affects NPD speed.	No support
H2b: The use of cross-functional teams positively affects new product advantage.	No support
H2c: The use of cross-functional teams positively affects new product success.	No support
H3a: Cross-functional training positively affects NPD speed.	Support
H3b: Cross-functional training positively affects new product advantage.	No support
H3c: Cross-functional training positively affects new product success.	Support
H4a: Superordinate goals positively affect NPD speed.	No support
H4b: Superordinate goals positively affect new product advantage.	Support
H4c: Superordinate goals positively affect new product success.	Support
H5a: Co-location positively affects NPD speed.	Support
H5b: Co-location positively affects new product advantage.	Support
H5c: Co-location positively affects new product success.	Support
H6a: The use of ICT positively affects NPD speed.	Support
H6b: The use of ICT positively affects new product advantage.	Support
H6c: The use of ICT positively affects new product success.	No support
H7a: Informal coordination positively affects NPD speed.	No support
H7b: Informal coordination positively affects new product advantage.	No support
H7c: Informal coordination positively affects new product success.	No support
H8a: Joint reward systems positively affect NPD speed.	Support
H8b: Joint reward systems positively affect new product advantage.	No support
H8c: Joint reward systems positively affect new product success.	No support

Hypothesis	Outcome
H9a: Customers with lead user characteristics positively affect NPD speed.	No support
H9b: Customers with lead user characteristics positively affect new product advantage.	Support
H9c: Customers with lead user characteristics positively affect new product success.	Support
H10a: Innovative customers positively affect NPD speed.	No support
H10b: Innovative customers positively affect new product advantage.	No support
H10c: Innovative customers positively affect new product success.	No support
H11a: Customers with product expertise positively affect NPD speed.	Support
H11b: Customers with product expertise positively affect new product advantage.	Support
H11c: Customers with product expertise positively affect new product success.	Support
H12a: Customers with price expertise positively affect NPD speed.	No support
H12b: Customers with price expertise positively affect new product advantage.	No support (Opposite)
H12c: Customers with price expertise positively affect new product success.	No support
H13a: Financially attractive customers positively affect NPD speed.	No support
H13b: Financially attractive customers positively affect new product advantage.	Support
H13c: Financially attractive customers positively affect new product success.	No support

5.5.5.2 Summary of effect size f^2 and effect size q^2

As discussed in Chapter 4, the f^2 effect size is calculated as follows:

$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}}$; where $R^2_{included}$ and $R^2_{excluded}$ are the R^2 values of the endogenous latent variable when a selected exogenous latent variable is included in or excluded from the model (Hair et al. 2014, p. 177).

The q^2 effect size is calculated as follows:

$q^2 = \frac{Q^2_{included} - Q^2_{excluded}}{1 - Q^2_{included}}$; where $Q^2_{included}$ and $Q^2_{excluded}$ are the Q^2 values of the endogenous latent variable when a selected exogenous latent variable is included in or excluded from the model (Hair et al. 2014, p. 183).

The values of f^2 are yielded by running the PLS algorithm of SmartPLS 3 software (Ringle, Wende & Becker 2015). Therefore, we ran three separate path models, and then extracted the f^2 values from SmartPLS reports and put them in table 5.17.

With reference to q^2 values, at the time that we analysed our data, SmartPLS 3 did not had the capability to automatically produce these values yet. Therefore, we ran the PLS blindfolding algorithm (see Carson 2016; Hair et al. 2014) to get $Q^2_{included}$ and $Q^2_{excluded}$ and then calculated q^2 by using the above-mentioned formula.

For example, to compute the q^2 value for an independent variable named co-location (code: colocation) in the model 1 (NPD speed is dependent variable), we carried out the following steps. First, we ran the PLS blindfolding algorithm for model 1 to gain $Q^2_{included}$ of 0.208. Second, we excluded the construct of co-location from model 1 and again ran the PLS blindfolding algorithm to gain $Q^2_{excluded}$ of 0.177. Finally, q^2 was computed as (0.208 – 0.177) / (1 - 0.208) = 0.039.

For each q^2 value, we performed the same procedure above to compute it. All of the q^2 values are presented in Table 5.17.

Table 5.17 Results of f^2 value and q^2 value

Independent Variables	Dependent Variables								
	NPD speed (Model 1[a])			New product advantage (Model 2[b])			New product success (Model 3[c])		
	Path Coeff.	f^2	q^2	Path Coeff.	f^2	q^2	Path Coeff.	f^2	q^2
Rotation	-0.01	0.000	0.000	-0.036	0.002	-0.005	0.046	0.002	-0.001
CFTeam	0.041	0.001	-0.009	-0.008	0.000	-0.005	-0.115	0.009	0.004
Training	0.139*	0.017	0.000	0.032	0.002	-0.013	0.183*	0.033	0.015
Goal	-0.001	0.000	-0.006	0.299***	0.100	0.080	0.277**	0.063	0.045
Colocation	0.221***	0.063	0.039	0.228***	0.104	0.074	0.212**	0.064	0.045
ICT	0.240**	0.057	0.029	0.180**	0.051	0.039	0.062	0.004	0.002
Informal	-0.108	0.011	0.003	-0.045	0.003	-0.011	-0.092	0.009	0.004
Reward	0.171*	0.027	0.015	0.002	0.000	-0.011	0.041	0.002	-0.005
Lead	0.109	0.011	0.001	0.305***	0.133	0.088	0.156*	0.025	0.012
Inno	0.025	0.001	-0.007	-0.024	0.001	-0.003	-0.015	0.000	-0.001
ProdKnow	0.200*	0.024	0.018	0.229**	0.049	0.044	0.219**	0.032	0.024
PriceKnow	-0.128	0.012	0.008	-0.120*	0.017	0.009	0.027	0.001	-0.002
Bulk	0.028	0.001	-0.009	0.139**	0.031	0.003	0.122	0.017	0.007

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$ (1-tailed tests)

[a]: Model with NPD speed as dependent variable

[b]: Model with new product advantage as dependent variable

[c]: Model with new product success as dependent variable

Regarding cross-functional integration mechanisms, as can be seen in Table 5.17, cross-functional training has a small effect and predictive relevance for both NPD speed and new product success. The superordinate goals construct is found to have a small impact on and small predictive relevance for new product advantage and new product success. Co-location has a small influence on as well as small predictive relevance for all of three dependent variables. The use of Information and Communication Technology has small effect on and small predictive relevance for both NPD speed and new product advantage. Joint reward systems are found to have a small influence on and small predictive relevance for NPD success.

With respect to customer characteristics, the independent variable of customers with lead user characteristics has a medium impact on new product advantage but a small effect on new product success. This construct also has small predictive relevance for both new product advantage and new product success. The exogenous variable of customers with product expertise has a small influence on as well as small predictive relevance for all of three endogenous variables. The construct of financially attractive customers is found to have a small impact on and small predictive relevance for new product advantage.

5.6 Additional analyses

This section presents two additional analyses. Firstly, we carry out importance-performance matrix analysis (IPMA) which can provide more insight into our research results. Secondly, as mentioned in Chapter 4, we conduct several statistical tests to identify whether our collected data suffers from common method bias or not.

5.6.1 Importance-Performance Matrix Analysis (IPMA)

IPMA is helpful for researchers who employ PLS-SEM to extend their findings (Hair et al. 2014). Importance refers to 'the absolute total effect on the final endogenous variable in the path diagram' (Carson 2016, p. 129). Performance is 'the size of latent variable scores' (Carson 2016, p.129). In an importance-performance matrix analysis, latent variable scores are rescaled to range from 0 to 100, whereby 0 indicates the lowest performance, 100 denotes the highest performance, and 50 refers to the average performance. To calculate the importance and performance values of independent variables, we ran the IPMA algorithm of software SmartPLS 3 (Ringle, Wende & Becker 2015) for three models and reported the results in Table 5.18. For the details of

IPMA technique, please refer to the comprehensive explications of Hair et al. (2014) and Carson (2016).

Table 5.18 Results of Importance-Performance Matrix Analysis

Independent variables	Dependent Variables					
	NPD speed (Model 1[a])		New product advantage (Model 2[b])		New product success (Model 3[c])	
	Importance	Performance	Importance	Performance	Importance	Performance
CFTeam	0.040	67.830	-0.008	67.838	-0.103	67.599
Informal	-0.112	56.717	-0.045	60.459	-0.088	58.660
Colocation	0.205	47.862	0.192	48.574	0.178	47.016
Reward	0.159	39.550	0.002	40.537	0.034	39.596
Training	0.129	50.308	0.028	50.991	0.152	50.510
Rotation	-0.010	34.974	-0.022	21.944	0.040	35.872
Goal	-0.001	64.482	0.283	64.951	0.255	64.996
ICT	0.229	66.966	0.159	66.836	0.053	66.944
PriceKnow	-0.135	67.289	-0.117	68.204	0.025	67.344
Inno	0.026	54.771	-0.022	54.865	-0.014	54.959
Lead	0.109	50.107	0.279	49.754	0.138	49.456
ProdKnow	0.202	65.908	0.214	65.882	0.198	65.982
Bulk	0.022	50.131	0.101	50.385	0.086	50.382

[a]: Model with NPD speed as dependent variable

[b]: Model with new product advantage as dependent variable

[c]: Model with new product success as dependent variable

As shown in Table 5.18, two mechanisms, namely the use of cross-functional teams and informal coordination have almost no relevance to the enhancement of NPD speed, new product advantage, and new product success due to their small and/or negative importance values. However, performance values of cross-functional team use are relatively high (67.830 for model 1, 67.838 for model 2, and 67.599 for model 3), and those of informal coordination are well above the average (56.717 for model 1, 60.459 for model 2, and 58.660 for model 3). On the contrary, co-location, which strongly

affects the three NPD outcomes due to its high importance value, has performance values below the average (47.862 for model 1, 48.574 for model 2, and 47.016 for model 3). In a similar vein, joint reward systems are important for firms to accelerate NPD processes, but its performance value in the model with NPD speed as a dependent variable is considerably lower than the average (39.550). Cross-functional training is essential to increase NPD speed and new product success, but its performance values are only slightly above the average (50.308 for model 1, 50.991 for model 2, and 50.510 for model 3). Job rotation that is not pertinent to the improvement of NPD performances (its importance values are small and/or negative) has small performance values (34.974 for model 1, 21.944 for model 2, and 35.872 for model 3). Superordinate goals, which are useful for increasing new product advantage and new product success, have fairly high performance values (64.951 for model 2, and 64.996 for model 3). Similarly, the use of ICT, which helps enhance NPD speed and new product advantage, possesses quite high performance values (66.966 for model 1, and 66.836 for model 2).

Turning now to the customer characteristics, customers with price expertise and innovative customers are not germane to NPD speed, new product advantage, and new product success due to their small and/or negative importance values. Nonetheless, the performance values of these two kinds of customers are high. The performance values of customers with price expertise are the highest ones in comparison with those of other customer characteristics (67.289 for model 1, 68.204 for model 2, and 67.344 for model 3). The performance values of innovative customers are fairly above the average (54.771 for model 1, 54.865 for model 2, and 54.959 for model 3). In contrast, involving customers with lead user characteristics in the NPD process is vital for enhancing new product advantage and new product success due to its high importance values. Its performances are, however, below the average (49.754 for model 2, and

49.456 for model 3). Customers with product expertise are crucial for NPD projects because they help enhance NPD speed, new product advantage, and NPD success. In accordance with this, the construct of customers with product expertise has relatively high performance values (65.908 for model 1, 65.882 for model 2, and 65.982 for model 3). With regard to financially attractive customers who are only useful in improving new product advantage, performance values of this kind of customers are about average (50.131 for model 1, 50.385 for model 2, and 50.382 for model 3).

5.6.2 Testing common method bias (CMB)

So as to examine common method bias in our research, we performed three different statistical analyses, namely Harman's single-factor test (Podsakoff et al. 2003; Podsakoff & Organ 1986), common method factor test (Liang et al. 2007; Podsakoff et al. 2003), and full collinearity assessment (Kock 2015a; Kock & Lynn 2012). Each type of test was conducted for all of three models (model 1 with NPD speed as a dependent variable, model 2 with new product advantage as a dependent variable, and model 3 with new product success as a dependent variable). We report these three statistical tests in the following.

5.6.2.1 Harman's single-factor test

We used IBM SPSS 20 and loaded all measures into an unrotated principal component analysis (PCA) to conduct the test. Generally, if a single factor is extracted more than 50% of the variance, CMB may be presented (Eichhorn 2014; Gaskin 2011; Hempelmann & Engelen 2015). The largest variance explained by one factor is 26.425% for model 1, is 28.760% for model 2, and is 27.303% for model 3. These

results are lower than the threshold of 50%, indicating that CMB is not serious in this study.

5.6.2.2 Common method factor test

We used SmartPLS 3 (Ringle, Wende & Becker 2015) to perform this test, which requires that a common method factor is added to the examined model. We do not aim at elucidating this complex technique in details but refer interested readers to the work of Liang et al. (2007).The results of CMB analysis are reported in Appendix 10, 11, and 12.

According to Liang et al. (2007, p. 87):

> Evidence of common method bias can be obtained by examining the statistical significance of factor loadings of the method factor and comparing the variances of each observed indicator explained by its substantive construct and the method factor. The squared values of the method factor loadings were interpreted as the percent of indicator variance caused by method, whereas the squared loadings of substantive constructs were interpreted as the percent of indicator variance caused by substantive constructs. If the method factor loadings are insignificant and the indicators' substantive variances are substantially greater than their method variances, we can conclude that common method bias is unlikely to be a serious concern.

The reports disclose that the average indicator variance caused by substantive factors is 0.881 for model 1 (see Appendix 10), 0.887 for model 2 (see Appendix 11), and 0.882 for model 3 (see Appendix 12), whereas the average indicator variance caused by common method factor is 0.002 for all of three models. We can see that the indicators' variances explained by their principal constructs are considerably greater than those explained by method factor. In addition to this, most method factor loadings are statistically insignificant. We therefore can contend that CMB is not a big issue for our research.

5.6.2.3 Full collinearity assessment

We used WarpPLS 5.0 (Kock 2015c, 2015d) to carry out full collinearity test because only this software can accommodate the assessment. For the details of how to conduct a full collinearity test, please refer to Kock & Lynn (2012). If all variance inflation factor (VIF) values from a full collinearity test are below the threshold of 3.3, the research can be considered free from common method bias (Kock 2015a). Table 5.19 shows that the highest VIF value is 2.564 for model 1, is 2.711 for model 2, and is 2.592 for model 3. These values are lower than 3.3, and thus indicating that CMB is not a serious concern for our study.

Table 5.19 Full collinearity assessment

Construct	VIF (Model 1[a])	VIF (Model 2[b])	VIF (Model 3[c])
Random	1.217	1.197	1.200
Trainin	1.804	1.766	1.816
Goal	2.165	2.330	2.315
Rotatio	1.532	1.530	1.541
Colocat	1.233	1.235	1.235
CFTeam	2.481	2.478	2.502
Reward	1.791	1.745	1.749
ICT	1.680	1.647	1.577
Informa	1.682	1.682	1.700
Bulk	1.409	1.421	1.437
ProdKno	2.564	2.711	2.592
PriceKn	2.038	2.050	2.026
Lead	1.732	1.942	1.756
Inno	1.596	1.596	1.594
Speed	1.461		
Advanta		2.305	
Success			1.724

Note: Random = random variable; Trainin = cross-functional training; Goal = superordinate goal; Rotatio = job rotation; Colocat = co-location; CFTeam = cross-functional team; Reward = joint reward system; ICT = Use of Information and Communication Technology; Informa = informal coordination; Bulk = Financially attractive customers; ProdKno = customers with product expertise; PriceKn = customers with price expertise; Lead = customers with lead user characteristics; Inno = Innovative customers; Speed = NPD speed; Advanta = new product advantage; Success = new product success.

[a]: Model with NPD speed as dependent variable

[b]: Model with new product advantage as dependent variable

[c]: Model with new product success as dependent variable

5.7 Conclusion

After carefully examining collected data, two outliers are removed, and our final data set used for further analyses consists of 104 observations. None of the indicators has more than 5% of missing values. Our data exhibits only a slight degree of non-normality, and nonresponse bias is not serious in the data set. We then assessed measurement models of the constructs used in our study. All constructs' measures are reliable and valid with respect to internal consistency reliability, indicator reliability, convergent validity, and discriminant validity. We therefore continued to evaluate three

structural models to test the developed hypotheses. In total, 16 out of 39 hypotheses are supported. These findings demonstrate that co-location, superordinate goals, the use of ICT, cross-functional training, and joint reward systems are mechanisms that positively affect NPD performance. The results also disclose that involving customers with product expertise, customers with lead user characteristics, and financially attractive customers can help firms improve NPD outcomes. Concerning common method bias, three statistical tests are conducted and reveal that our study is unlikely to suffer from it. In the next chapter, we discuss the research findings.

CHAPTER 6 DISCUSSION & IMPLICATIONS

6.1 Introduction

This is the final chapter of our thesis. Our research aimed to identify factors driving NPD success, a primary concern of practitioners involved in NPD projects. Therefore, this chapter starts with a discussion of the results along with suggested practical implications. Theoretical implications, which are of academic interest, are suggested after that. Finally, we acknowledge the limitations of the research and propose directions for future research.

6.2 Discussion of the results and managerial implications

6.2.1 Overall results of cross-functional integration mechanisms

One of the important findings is that not all of the integration mechanisms are effective. Five mechanisms, namely co-location, superordinate goals, the use of information and communication technology, cross-functional training, and joint reward systems have positive and significant relationships with NPD performance, whereas three other mechanisms, namely job rotation, the use of cross-functional teams, and informal coordination do not. This section starts with a discussion of the most effective mechanism, then continues with the less effective ones, and ends with mechanisms having no effects on NPD outcomes.

6.2.1.1 Co-location - the most effective mechanism

Our results suggest that co-location is the most effective integration mechanism because it positively affects all three NPD outcomes, i.e., NPD speed, new product advantage, and new product success. The reason why co-location is effective is that it facilitates

communication (Kay et al. 2005; Smith 2007), especially face-to-face or oral communication between NPD team members (Jain, Triandis & Weick 2010; Schilling 2013). This finding is consistent with some of the earliest work on R&D teams, e.g., Allen & Fustfeld (1975). In their important study, they found that the probability of NPD team members communicating was extremely high at close physical proximities, but once the separation between the team members reached about 10 meters, the probability of them interacting dropped to almost zero. This suggests that a primary requirement for effective NPD teams is to locate them physically close to each other. This enhances communication between these interdependent team members, e.g., members get a better understanding of the issues and priorities and "thought-worlds" of other departments (e.g., Dougherty 1992). As a result of team members' increased communication, NPD team members should work more effectively together, and under conditions of lower conflict within the NPD team. This in turn can foster the speed of NPD projects. Our result is therefore closely akin to that of Carbonell & Rodriguez (2006a), Lakemond & Berggren (2006), and Zenun, Loureiro & Araujo (2007), who found that co-location or team proximity had a positive impact on the development time of new products.

Also, our results demonstrate that co-location can help increase new product advantage. This result is consistent with the view that NPD teams are information processing subsystems within firms (e.g., Atuahene-Gima & Evangelista 2000; Kyriazis et al. 2017; Massey & Kyriazis 2014), and co-location promotes information and knowledge sharing as well as idea exchange (e.g., Griffin & Hauser 1996; Lee & Markham 2013). This increases the likelihood that innovative ideas can be generated (Huth 2008; Kahn & McDonough 1997a; Leenders, Kratzer & van-Engelen 2004). These novel ideas can then help firms develop new products which offer superior values to customers.

In addition, by improving both NPD speed and new product advantage, co-location can increase the likelihood that new products are successful. Our finding is therefore in line with that of Sethi & Nicholson (2001), who indicated that physical proximity had a positive and significant relationship with new product market performance in terms of sales and market share.

In summary, we found that co-location is the most powerful mechanism to increase all three of our NPD performance dependent variables. However, firms developing new products do not appear to realise the importance of co-location. Our data suggests that co-location among firms conducting NPD is lower than optimal, because mean score for co-location in our research is 3.83 out of a possible 7.0, where lower numbers represent lower co-location, and higher numbers represent close co-location. We therefore recommend that firms should consider using this integration mechanism more extensively by locating their NPD team members within close physical proximity to each other. For example, firms can locate NPD team members on the same floor in the same building (Maltz & Kohli 2000). By doing so, it will enhance the performance of NPD projects.

6.2.1.2 Superordinate goals - the second most effective mechanism

The use of superordinate goals is a direct result of the fact that large firms tend to departmentalise (e.g., into Marketing, R&D, Manufacturing). Subsequently, senior management set goals and objectives for each department. However, some individual departmental goals may be incompatible. For example, Marketing may require a technologically simple product to satisfy a market need, but R&D may wish to develop a technologically more advanced product. In addition, resource dependence theory suggests that departments within firms are in an internal market where individual

departments are in competition with each other for the limited resources available. Thus there is the possibility of dysfunctional NPD if each department pursues its own functional goals. The use of superordinate goals aligns these departments under common objectives, and rewards them for joint achievement, rather than individual department-level achievements. Thus superordinate goals provide a powerful incentive for NPD team members from different departments to work effectively together on NPD projects.

The use of superordinate goals is the second most useful mechanism because they help firms improve new product advantage and new product success. Superordinate goals can help firms enhance new product advantage because committing to the overall goals enables NPD team members to use their collective authority so as to acquire and utilize internal expertise from other departments to solve their problems. As posited by Atuahene-Gima (2003), different departments possess quality ideas, knowledge and information. Accordingly, from these resources, team members can find novel solutions that increase new product advantage.

Superordinate goals can help reduce inter-functional conflict and improve cross-functional cooperation (Huth 2008), which can promote information and knowledge sharing among NPD team members, and therefore increase the commercial success of new products (Lee & Markham 2013; Moorman & Miner 1997).

Nevertheless, the use of superordinate goals has no effect on NPD speed. It can be explained that in reality, NPD team members not only commit to the overall project goals but also have their functional goals as well as personal goals. When there is an incompatibility between functional/personal goals and the overall goals, they may try to figure out how they can harmonize these goals. Harmonizing the conflicting goals may

be a time-consuming process that slows down the project progress. As a result, superordinate goals cannot improve the speed of NPD projects. Our finding is therefore similar to that of Atuahene-Gima (2003), who demonstrated that superordinate goals had no impact on the speed of product development projects.

In short, the use of superordinate goals is important because it can help enhance new product advantage and new product success. Importantly, senior managers seem to realise the importance of superordinate goals. Our data reveals that the mean score for superordinate goals is 4.916 out of a possible 7.0, where lower numbers represent lower levels of committing to the overall goals of NPD team members, and higher numbers represent higher levels of that of NPD team members. Hence, we suggest that managers should maintain this level of committing to the overall goals of NPD team members, at the least. If they can, they should put more effort into building commitment and agreement across functional areas so as to align the efforts of various functions towards common goals, and in turn, NPD team members strongly commit to the overall goals. This can help increase new product advantage and NPD success.

6.2.1.3 ICT use - the third most important mechanism

The third most helpful mechanism is the use of ICT because it has a positive influence on NPD speed and new product advantage. Using ICT tools such as telephone, video-conferencing, email, and the internet enhances cross-functional integration and information sharing among NPD team members, thereby speeding up the NPD process. However, our result is in conflict with that of Barczak, Sultan & Hultink (2007), who found that the use of information technology (IT) tools such as email, web meetings, scheduling and tracking projects software, and so forth had no effect on speed to market of new products. These authors measured the construct “IT usage” by calculating the

number of IT tools used in the NPD process. Taking a different approach, we measured our construct of ICT use by the frequency of using ICT tools. The difference in construct measures may be the reason for the discrepancy between our finding and that of Barczak, Sultan & Hultink (2007).

Also, ICT use can help firms better understand their market, and by facilitating communication and collaboration, ICT allows NPD team members to mesh various perspectives on the market opportunities and the new product concepts under development (Durmuşoğlu & Barczak 2011), thereby increasing the advantages of new products developed.

Nonetheless, ICT use has no influence on new product success in our study. There are three possible reasons for this. First, ICT is simply a communication-based initiative, thus it is likely to influence NPD speed, and new product advantage, because it improves coordination between the staff/departments involved in the NPD project. However, our findings suggest there seems little reason to expect ICT use to improve the commercial success of new products, as success depends on more than just improved internal coordination. Market success will be determined by more proximate causes, e.g., the relative price of the new product, its performance vis-à-vis the competitors' products. Second, ICT tools cannot solve problems associated with trust formation (Gassmann & von-Zedtwitz 2003; Schilling 2010). We therefore suspect our surveyed firms may confront these matters when they use ICT tools, but they may not have good solutions to those. This impedes the development of interpersonal trust among NPD team members. Accordingly, firms will be less likely to manufacture successful new products since Dayan & Di-Benedetto (2010) found that interpersonal trust had a significant and positive influence on new product success. Finally, the firms

in our research may often replace their ICT systems by upgrading existing ICT tools or using new and advanced ones to catch up with modern trends. This may incur high costs. The new systems may not be straightforward for NPD team members to learn and use them effectively, or they may not be applied in a productive manner (Kawakami, Barczak & Durmuşoğlu 2015). Any of these circumstances can decrease the success of NPD projects. Our third explanation is supported by Kawakami, Barczak & Durmuşoğlu (2015), who found that frequently replacing information technology tools negatively affected NPD performance. Our finding is therefore consistent with that of Kawakami, Barczak & Durmuşoğlu (2015), who found that frequently using information technology tools had no effect on NPD performance in terms of revenues from new products and market share. However, our result is dissimilar from that of Barczak, Sultan & Hultink (2007), who found that IT usage had a positive impact on market performance of new products. As discussed above, the difference in construct measures may be the reason for the discrepancy between our finding and these authors' results.

We can see that ICT use is important for NPD speed and new product advantage. Firms in our sample are aware of the importance of ICT tools in developing new products and use them frequently but approximately 28% points less than the maximum possible score of 7.0. The reason for this is that the mean score of ICT use is 5.013 out of a possible 7.0, where lower numbers represent that ICT tools are used less frequently, and higher numbers represent that these tools are used more frequently. Thus, we propose that practitioners should maintain this level of using ICT tools, at the very least. In addition to this, as discussed above, frequently replacing ICT systems may have a negative impact on NPD success. We therefore suggest that managers should not replace their ICT systems frequently if their systems still work well. We also suggest

that firms consider greatly using co-location because it not only enhances NPD performance as we mentioned previously but also solves the problems related to trust formation (Dayan & Di-Benedetto 2010), which cannot be solved by using ICT tools. This can increase the effectiveness of ICT tools and then enhance new product success.

6.2.1.4 The effects of cross-functional training

Cross-functional training is the fourth most effective mechanism. It has a positive influence on NPD speed and new product success. The reason why cross-functional training improves NPD speed is that it enables employees from different departments to "speak the same language", improve their understanding of 'the goals, perspectives, and priorities' of the other departments involved in NPD (Maltz & Kohli 2000, p. 481), and 'build trust and sensitivity toward one another' (Cadogan et al. 2005, p. 522). This can help reduce inter-functional conflict and improve cross-functional cooperation, which helps employees carry out their NPD activities smoothly, and this enhances NPD speed.

Our result that cross-functional training positively influences new product success is also consistent with the information processing perspective (e.g., Galbraith 1973, 1977). Cross-functional training can promote information and knowledge sharing among NPD team members, and therefore increase new product success in terms of financial performance (Lee & Markham 2013; Moorman & Miner 1997).

However, cross-functional training has no relationship with new product advantage. A possible reason is suggested by Crawford & Di-Benedetto (2011) that the training sessions of firms may not bring all of the NPD team members up to a sufficient level of knowledge and skills required to help them generate novel ideas. Therefore, whilst it helps them work well together and increase NPD speed, cross-functional training cannot

help them work in a manner that increases the likelihood that they will produce a product with significant advantages. Another explanation is that firms in our sample may mainly provide internal training and offer the lower levels of external training such as attending industrial conferences or suppliers' training. Focusing on internal training limits the capacity of team members to acquire diverse knowledge and innovative ideas beyond their firm boundaries, and may increase the occurrences of groupthink within NPD teams. This phenomenon is more likely to hinder the creativity of the NPD team (Leenders, Kratzer & van-Engelen 2004), thereby impeding the likelihood that firms produce new products with advantages over competing products.

In brief, although cross-functional training is helpful for the improvement of NPD speed and new product success, firms developing new products seem not to realise its importance to NPD performance. Our data suggests that cross-functional training among firms conducting NPD is not ideal, because the mean score for cross-functional training in our research is 4.010 out of a possible 7.0, where lower numbers represent lower levels of using cross-functional training, and higher numbers represent higher levels of using cross-functional training. Therefore, we suggest that firms should pay more attention to this mechanism and improve the training programs so that the training can bring NPD team members up to the sufficient knowledge and hone their needed skills. Firms also need to offer more external training (e.g., industrial conferences, suppliers' training) to diminish the risk of groupthink phenomenon. By doing so, cross-functional training can increase new product advantage and NPD success.

6.2.1.5 The effects of joint reward systems

Using joint reward systems has only a minor effect on NPD performance because it only influences NPD speed. As noted earlier, different departments may have different

objectives, thus joint reward systems help align the objectives and responsibilities of employees in different functions, which can help decrease conflict and enhance cooperation as well as integration between various functional areas. Also, consistent with information processing theory (e.g., Galbraith 1973, 1977), joint reward systems are likely to enhance the flow of information (Cadogan et al. 2005) and promote information sharing among employees of different departments (Coombs & Gomez-Mejia 1991). By decreasing conflict, enhancing cooperation and integration, and fostering information sharing among employees, joint reward systems can smooth the way for them to increase NPD speed.

There are two possible explanations as to why joint reward systems have no impact on new product advantage and new product success. First, the use of joint reward systems among the firms in our sample is lower than optimal, because the mean score of this construct is 3.378 out of a possible 7.0, where lower numbers represent lower levels of joint reward system use, and higher numbers represent higher levels of using these systems. The low levels of using the team-based rewards may be enough to encourage NPD team members to work well together, and thereby increasing the speed of the NPD process as discussed above. But these low levels may not be sufficient to motivate them to work in a more innovative and effective manner. Consequently, firms cannot produce new products that offer many advantages to customers and are successful.

Second, joint reward systems lead to the presence of the so-called "free riders" (Abdel-Kader & Lin 2009; Gomez-Mejia & Balkin 1989; Wageman & Baker 1997). They are individuals who 'provide low work inputs to a group task and receive the same reward as other group members' (Gomez-Mejia & Balkin 1989, p. 432). As stated by Albanese & van-Fleet (1985, p. 244), 'it often is true that people, acting rationally, try to

minimize their costs relative to the benefits they receive'. Therefore, when some NPD team members understand that they still earn the same reward as others, they may try to reduce their endeavours. This leads to a negative effect on team performance (Gomez-Mejia & Balkin 1989). Huth (2008) also found that team rewards have no relationship with team creativity and team efficiency. Accordingly, the use of joint reward systems may induce a free-rider phenomenon, which hampers the performance and creativity of the NPD team, thereby preventing the enhancement of new product advantage and new product success.

Based on these reasons, we suggest that firms should consider the increasing use of this mechanism so that it can motivate NPD team members to work in a more innovative and effective manner. Additionally, we propose that firms should increase peer pressure and mutual monitoring because these ways can help avoid free-rider problems (Kandel & Lazear 1992; Wageman & Baker 1997). By doing so, firms can enhance new product advantage and new product success.

6.2.1.6 Mechanisms with no effects

Three remaining devices, namely job rotation, cross-functional team use, and informal coordination have no effect on all of three NPD outcomes. However, we do not intend to propose that firms should not employ them. Instead of this, we recommend firms use these tools in a more appropriate manner. In the following, we explain why these three mechanisms are ineffective and suggest several managerial actions that may help improve the effectiveness of these tools.

Regarding job rotation, there are four possible reasons for the insignificant relationships between it and NPD outcomes in our study. First, when firms implement job rotation,

firms have to spend time and money on new training requirements (Campion, Cheraskin & Stevens 1994; van-Dam 2005), and employees also have to spend much of their time to learn new jobs (Azizi, Zolfaghari & Liang 2010; Campion, Cheraskin & Stevens 1994). Training and learning new tasks, therefore, may hinder NPD speed and make the projects longer.

Second, a poor application of job rotation may make employees feel isolated or rejected, which can hamper cooperation among them (Rouziès et al. 2005). In addition to this, if these employees have a high level of "relative functional identification" (Fisher, Maltz & Jaworski 1997), i.e., they identify more strongly with their own departments (e.g., Marketing, Sales, R&D) than with the organization as a whole, they may quickly slip back into their old thought-worlds. Consequently, they are less likely to cooperate with people from other departments. Again, this makes cooperation among them more problematic. Song, Xie & Dyer (2000) found that job rotation did not increase collaborating behavior of marketing managers. Leenders & Wierenga (2002) also verified that job rotation did not lead to the higher levels of Marketing-R&D integration. Firms in our sample may not use job rotation appropriately, and their employees may have high levels of relative functional identification. Therefore, the cooperative working environment in these firms cannot be improved and NPD performances suffer from this.

Third, rotating employees across functional areas may cause role ambiguity and role conflict, which lead to role stress of them (Garrett, Buisson & Yap 2006). Working under stress does not allow employees to perform their duties in a timely and innovative manner. As a result, NPD speed cannot be accelerated, and new products cannot offer superior value to customers and are unlikely to be successful.

Finally, in case that employees are assigned to work in other departments for a long time, they may lose their knowledge, skills, and expertise (Azizi, Zolfaghari & Liang 2010; Casad 2012; Rouziès et al. 2005). If job rotation is carried out too quickly, employees cannot obtain sufficient knowledge (Leenders & Wierenga 2002). If job rotation occurs too frequently, employees have no chance to fully exploit their capabilities (Azizi, Zolfaghari & Liang 2010). Our surveyed firms may have such problems when they perform job rotation. Any of these issues may lead to impaired task performance of employees, and again, NPD performance suffer from this.

Accordingly, we propose that firms should clarify the roles, responsibilities, and the rights of employees when they are assigned to work in other departments. This can help reduce the role ambiguity and role conflict of them. Firms also do not assign their employees to work in other functions for a long time, or implement this practice too quickly and too frequently. By doing so, this can improve the performance of employees as well as NPD performance.

Concerning the use of cross-functional teams, we suggest five possible explanations as to why this practice has no significant relationships with NPD outcomes in our study. First, as stated by Brethauer (2002, p. 20), 'a team cannot just be thrown together and be expected to perform'. To work effectively, members of an NPD team should communicate well and cooperate with each other (Cooper 1998). Locating them close to each other, training, and rewarding them based on team's achievements are crucial for good teamwork (Cooper 1998, 2001; Griffin & Hauser 1996; Rouziès et al. 2005). However, as discussed earlier, the use of co-location, cross-functional training, and joint reward systems among firms in our sample is lower than optimal. The low levels of

using these mechanisms may hamper the effectiveness of teamwork, which reduces the performance of NPD projects.

Second, effective communication and cooperation among NPD team members also depends on the personal characteristics of each individual on the team (Schilling 2013). For instance, Kichuk & Wiesner (1997) found that personality factors such as low neuroticism and high agreeableness can be useful in creating NPD teams. Neuroticism refers to traits such as 'anxiety, depression, anger, embarrassment, emotionality, and insecurity' (p. 200). Agreeableness refers to traits such as 'courteous, flexible, trusting, good natured, cooperative, forgiving, soft-hearted, and tolerant' (p. 200). It is possible that firms in our sample may not select the right members from different functions for NPD teams. Accordingly, the NPD teams cannot achieve a good performance and NPD projects cannot be successful.

Third, Cooper (2013) reported that in 78.1% of US firms, NPD team members were assigned to do many other tasks, and in 88.6% of US companies, they had to work on many projects. Smith (2007) argued that if team members are assigned to more than two projects, this will reduce their working efficiency because they lose their focus, accountability, and commitment. Our surveyed firms may be in similar circumstances to their counterparts in the US. Their NPD team members may have to take part in many projects or do too much other work. This jeopardizes the efficiency and effectiveness of teamwork, thereby impeding the success of NPD projects.

Fourth, some scholars have suggested that NPD team members should be kept from the beginning to the end of the project (e.g., Cooper 2005a, 2005b; Cooper 2013), since changing members from stage to stage may lead to losses in levels of 'momentum, passion, knowledge, and accountability' (Cooper 2005b, p. 242). Furthermore,

maintaining a cross-functional team to manage a certain post-launch product can increase its success because NPD team members 'already have intimate knowledge and experience with the product and its market drivers and positioning' (Haines 2013, p. 343). Cooper (2013) found that more than 50% of US firms did not employ the approach of beginning-to-end teams. The participating companies in our research may be in the same situation. They do not embrace this approach and therefore cannot produce successful new products.

The final possible reason seems to be beyond the control of surveyed firms. Due to the changes in global trends and market conditions, the use of cross-functional teams may be out of date. Kay et al. (2013) reported that in the 1988-2003 period, PDMA's Outstanding Corporate Innovator Award winners intensively focused on cross-functional team use, but in the 2004-2010 period, the winners paid more attention to the use of virtual teams.

Based on the above-mentioned reasons, we suggest that firms should use co-location, cross-functional training, and joint reward systems because these mechanisms not only enhance NPD performance but also improve the effectiveness of the cross-functional team use. If increasing the use of these devices cannot improve the effectiveness of using cross-functional teams, firms should try to select the right members for NPD teams, keep the team from the beginning to the end of the projects, and should not assign team members to do many other tasks or join many projects. These ways may help improve the performance of NPD teams and NPD projects.

For the final mechanism, informal coordination, there are three possible reasons for the insignificant relationships between it and NPD outcomes. Firstly, informal coordination can be regarded as a substitute for other formal integration mechanisms such as cross-

functional team use, job rotation and so on (Griffin & Hauser 1996). To put it another way, it compensates for the low use of formal devices (Willem, Buelens & Scarbrough 2006). Accordingly, we can argue that if some formal tools are used extensively, they may reduce the effectiveness of informal coordination. Leenders & Wierenga (2002) found that when ICT tools or cross-functional teams were greatly used, informal social systems became less effective. The firms in our sample may be in the same situation. As noted previously, our sampled firms use ICT tools relatively frequently. Cross-functional teams are also used at a high level (the mean score is 5.075 out of a possible 7.0, where lower numbers represent lower levels of using cross-functional teams, and higher numbers represent higher levels of using these teams). Extensively using ICT tools and cross-functional teams may prevent the significant and positive effects of informal coordination on NPD outcomes.

Secondly, as discussed in Chapter 3, informal coordination is based on voluntary collaboration. Members in a social or professional network, therefore, have no responsibility to provide any information or knowledge that is requested by other members in that same network. Even if members of that social or professional network are willing to share information or knowledge, the information or knowledge that they are able to share may not be useful for NPD team members to solve problems associated with NPD. This is because people tend to share 'knowledge that is already in common' (Willem & Buelens 2009, p. 157). Accordingly, based upon unhelpful information or knowledge, NPD team members cannot improve their task performance as well as NPD outcomes.

Finally, informal communication may be time-consuming (Olson, Walker & Ruekert 1995; Willem, Buelens & Scarbrough 2006), and may therefore take a long time for

NPD team members to obtain their needed information. Informal communication may also be unverifiable (Rouziès et al. 2005). Sicotte & Langley (2000) found that the variable of horizontal communication, which includes not only informal communication but also accurate information, positively affected R&D project performance. This implies that the accuracy of information is important for NPD performance. NPD team members of our sampled firms may not acquire their needed information in a timely and accurate manner, and this cannot enhance their task performance as well as NPD outcomes.

As discussed above, heavy use of ICT tools and cross-functional teams may make informal coordination less effective. We cannot suggest firms diminish the use of ICT tools because it is essential for enhancing NPD performance. Firms therefore should consider a choice between cross-functional team use and informal coordination. If cross-functional team use can positively affect NPD outcomes, firms do not need to pay attention to informal coordination. In case that cross-functional team use still does not work, it might be wise to attempt to use informal coordination. Using these two mechanisms concurrently may waste time and money of firms.

6.2.2 Overall results of customer characteristics

Our findings also suggest that not all kinds of customers are appropriate to be involved in NPD projects. Customers with product expertise, customers with lead user characteristics, and financially attractive customers can help firms enhance NPD speed, new product advantage, and new product success. Innovative customers and customers with price expertise have no influence on these three NPD outcomes. This section also starts with a discussion of the most useful customers to include in the NPD process,

then continues with the less important ones, and ends with customers having no effects on NPD outcomes.

6.2.2.1 Customers with product expertise - the best partners of firms

Among five customer characteristics, customers with product expertise are the best partners for firms to involve in NPD projects because they help increase NPD speed, new product advantage, and new product success. Customers with product expertise can help increase NPD speed for three reasons. First, they can provide reliable information about the product issues that firms are trying to understand when firms conduct NPD (Griffin 2013). That trustworthy information can help reduce uncertainty in NPD projects and therefore speed up the NPD process. Second, customers with product expertise can help firms early recognize the prospective problems and shortcomings in the product design stage (Bin 2013), thereby saving the time for redesigning new products. Finally, such customers possess an inherent ability to uncover the weaknesses of products that the testing groups of firms could never have envisaged (Cooper 2001), and therefore can help reduce the time for testing new products.

Regarding the significant and positive relationship between customers with product expertise and new product advantage, these customers are highly demanding and expect new products to be more superior or advanced than the existing products, and therefore frequently complain about the disadvantages of the current products (Alam 2005). By possessing good knowledge about the products, they can clearly articulate their needs and propose outstanding solutions to the problems of these products. Based upon their constructive complaints and helpful suggestions, firms can generate novel ideas to manufacture new products which offer many advantages to customers.

Also, involving customers with product expertise in NPD projects can help increase new product success for two reasons. First, such customers themselves tend to buy new products (Steenkamp & Gielens 2003) because they wish to obtain and transfer new product information, as well as usage experience, to other customers (Feick & Price 1987). Inviting them to participate in NPD projects allows firms to signal them about the new product attributes, thereby increasing the likelihood that they make a purchase. Second, customers with product expertise can be regarded as opinion leaders in the marketplace (Feick & Price 1987; Steenkamp & Gielens 2003), and therefore can help diffuse good information about the new products, thereby enhancing the adoption of new products by a large number of potential customers.

The mean score of the construct "customers with product expertise" is 4.951 out of a possible 7.0, where lower numbers represent lower levels of product expertise, and higher numbers represent higher levels of product expertise. This means customers involved in NPD projects of our surveyed firms have a relatively high level of product expertise. Because of the vital role of this kind of customers in enhancing NPD performance, we suggest that firms should continue to look for customers with high levels of product expertise (i.e., customers who are very knowledgeable about the products of firms) and invite them to participate in the NPD process. This can greatly enhance the outcomes of NPD projects.

6.2.2.2 Customers with lead user characteristics - the second most important partners

The second most important customers to be involved in NPD projects are the ones with lead user characteristics because they help enhance new product advantage and new product success. Customers with lead user characteristics can help develop new

products or services that offer superior value to customers because they are a promising source of 'novel product concepts' (von-Hippel 1986, p. 791) or 'innovative new product opportunities' (Alam 2005, p. 259). They can also offer an insightful and reliable understanding of customers' needs to firms (Carbonell, Rodriguez-Escudero & Pujari 2012). In addition, their novel knowledge is understandable for NPD teams and can be easily incorporated into new products (Mahr, Lievens & Blazevic 2014). Our result is therefore similar to that of Carbonell, Rodriguez-Escudero & Pujari (2012), who found that lead users had a positive impact on new service advantage.

Customers with lead user characteristics can also help firms achieve new product success in terms of financial performance because data from these customers enables firms to discover profitable new opportunities (Alam 2011). Our finding is therefore consistent with that of Gruner & Homburg (2000), who found that customers with lead user characteristics positively affected new product success. This result also provides support for the finding of Lilien et al. (2002) that the annual sales of new products developed from lead users' ideas were more than eight times higher than those of new products developed from traditional market research techniques.

Nevertheless, customers with lead user characteristics cannot help firms increase NPD speed. Our result is analogous with that of Carbonell, Rodriguez-Escudero & Pujari (2012), who found that there is no significant relationship between involving lead users and the speed to market of new services. Two reasons why involving customers with lead user characteristics in NPD projects has no effect on NPD speed may be identified. First, detecting customers with lead user characteristics is a challenging and time-consuming task (Enkel, Perez-Freije & Gassmann 2005; Hienerth & Lettl 2017; Mahr, Lievens & Blazevic 2014; Olson & Bakke 2001; Prügl & Schreier 2006; Spann et al.

2009). They are rare in most industries, and the procedure for tracking down them consists of multiple complex steps (Cooper 2001; Mahr, Lievens & Blazevic 2014). Accordingly, firms may spend a lot of effort and time identifying customers with lead user characteristics, and this may hinder the pace of developing new products. In their case study, Olson & Bakke (2001, p. 392) found that Cinet, a leading IT systems-integrators in Norway, 'planned to use focus groups on customers in the future, but would not necessarily recruit lead users due to the extra time needed to find them'.

Second, the development time saved by involving customers with lead user characteristics in NPD projects varies according to the NPD stages in which they are involved (Carbonell, Rodriguez-Escudero & Pujari 2012). For example, Herstatt & von-Hippel (1992) documented that in comparison with traditional market research methods, lead user technique helped Hilti AG, a leading manufacturer of construction products in Europe, reduce the time for developing new product concepts. Lilien et al. (2002), however, found that at 3M company, the lead user method costed much more time than conventional methods at the stage of idea generation. Hence, we suspect that the time saved at some NPD phases by involving customers with lead user characteristics cannot compensate for the time wasted at other stages due to involving them, and this cannot help accelerate the NPD process.

The mean score of the construct "customers with lead user characteristics" is 3.965 out of a possible 7.0, where lower numbers represent lower levels of lead user characteristics, and higher numbers represent higher levels of lead user characteristics. This means customers involved in NPD projects of our sampled firms have the moderate level of lead user characteristics. This can imply that Australian firms cannot find customers with higher levels of lead user characteristics to include them in NPD

projects due to the scarcity of these customers and the difficulty of identifying them. Even though we understand that detecting this kind of customer is not straightforward, we would still encourage firms to try to look for customers with higher levels of lead user characteristics and invite them to participate in NPD projects for two reasons. First, these customers outperform customers with product expertise in helping firms increase new product advantage (in our research model with new product advantage as dependent variable, the path coefficient of the construct "customers with lead user characteristics" is 0.305, which is higher than that of the construct "customers with product expertise", which is 0.229). Second, as mentioned in Chapter 2, they are ahead of market trends. Accordingly, involving them in NPD projects may help firms develop highly innovative products or even new-to-the-world products.

6.2.2.3 The effects of financially attractive customers

Financially attractive customers have a minor effect on NPD performance because involving them in NPD projects only has a positive influence on new product advantage. Such customers can help increase new product advantage because they can provide funds for research and development activities of firms (Coviello & Joseph 2012), thereby helping firms produce new products with high levels of innovativeness that offer superior value to customers.

There are three possible explanations as to why these customers have no relationships with NPD speed and new product success. First, the mean score of the construct "financially attractive customers" is 4.026 out of a possible 7.0, where lower numbers represent lower levels of financial attractiveness of customers, and higher numbers represent higher levels of their financial attractiveness. This means customers involved in NPD projects of our surveyed firms have only the moderate level of financial

attractiveness. This level can help increase new product advantage, but it may not be sufficient to help firms speed up the NPD process and enhance new product success.

Second, it has been argued that R&D spending has no relationship with the profitability of NPD projects (Cooper 2001). Therefore, funds for R&D activities provided by financially attractive customers may help firms develop new products that offer many advantages to customers but may not help improve new product success.

Finally, our surveyed firms may be highly dependent on financially attractive customers, and as suggested by resource dependence theory, these customers can exert their power and drive the NPD efforts of firms (Yli-Renko & Janakiraman 2008). This may endanger the autonomy of firms (Yli-Renko & Janakiraman 2008), thereby hampering the speed of NPD projects. These customers may also control the product prices, and this may reduce the profits yielded by new products. Additionally, heavily relying on these customers may 'curtail opportunities to develop new and diverse products for other customers or new markets' (Yli-Renko & Janakiraman 2008, p. 134), and therefore diminish the likelihood that new products are successful.

Our result that involving financially attractive customers has no effect on new product success is dissimilar from that of Gruner & Homburg (2000), who found that financially attractive customers positively affected new product success. These authors measured the construct "financially attractive customers" by using two indicators: (1) 'the representativeness of customers for target market segment', and (2) 'customers' reputation in the market' (p. 9). Unlike them, based upon the work of Coviello & Joseph (2012) and Rocca, Caruana & Snehota (2012), we used the extent to which customers buy products in large volumes as a proxy for measuring their financial attractiveness.

The difference in construct measures may be the reason for the discrepancy between our finding and that of Gruner & Homburg (2000).

Based upon the reasons above, we suggest that firms invite financially attractive customers to participate in NPD projects because these customers can help enhance new product advantage. Nevertheless, firms should be wary of the risk that these customers may control and drive the NPD process, and therefore hinder NPD speed and new product success.

6.2.2.4 Types of customers with no effects

Two remaining kinds of customers, namely innovative customers and customers with price expertise, have no effect on all of three NPD outcomes. Nonetheless, we do not intend to propose that firms should not consider using them, but rather we recommend firms try to involve them in a more appropriate manner. In the following, we explain why these customers cannot help improve NPD performance and suggest several managerial actions that may help firms involve them in NPD projects in a more effective manner.

There are three possible reasons for the insignificant relationships between innovative customers and NPD outcomes in our study. First, our surveyed firms may heavily rely on this type of customer, and as postulated by resource dependence theory, these firms are more likely to expose themselves to the risk that these customers drive the NPD process (Coviello & Joseph 2012). This may impede the speed of NPD projects.

Second, Gruner & Homburg (2000) reported that integrating customers during the middle stages (e.g., project definition, engineering) yielded no performance effect. Similarly, Chang & Taylor (2016) have currently conducted a meta-analysis and

revealed that involving customers in the development stage has no impact on new product innovativeness, slows down the speed to market of new products, and negatively affects new product financial performance. It is possible that the firms in our sample may not involve innovative customers in the right stages of NPD projects, and therefore they cannot help firms improve their NPD performance.

Finally, this kind of customer may have needs that are different from the majority of customers (Gruner & Homburg 2000), and their novel solutions may not be appropriate for the mass market. Involving these customers can mislead the firms and therefore hampers the performance of their NPD projects.

Based on the aforementioned reasons, we suggest that when firms intend to involve innovative customers in NPD projects, they should be cautious about the risk that such customers may drive the NPD process. We also recommend firms to try to involve these customers in the right stages of NPD projects to exploit their knowledge and expertise. For example, engaging them in the stages of idea generation and concept development may help firms develop novel concepts for new products. Finally, firms should survey and interview other customers to identify whether the needs or novel solutions of innovative customers are suitable for other customers of the target market. By doing so, involving innovative customers may help firms enhance NPD performance.

Regarding customers with price expertise, there are three possible explanations as to why these customers have no effects on NPD outcomes. First, as discussed in Chapter 3, customers with price expertise can help firms quickly identify the suppliers that offer the best price for them and rapidly determine the appropriate prices for new products, thereby reducing the development time of new products. However, in reality, saving the time on selecting the right suppliers and determining the suitable prices may not be

sufficient to lessen the time to market of new products. Therefore, these customers cannot help firms in our sample enhance NPD speed.

Second, customers with price expertise can suggest the best suppliers regarding the prices or costs of the required inputs (e.g., components, raw materials, and services), but they cannot assure the good delivery performance of these suppliers. The suppliers may not provide the inputs in a timely manner, and this impedes the development time of new products. Again, NPD speed cannot be improved by involving these customers in NPD projects.

Finally, these customers cannot guarantee the best suppliers in terms of the prices or costs of inputs provide the required inputs with high quality. A discrete choice analysis experiment conducted by Verma & Pullman (1998, p. 746) revealed that 'even though managers understand and perceive quality to be more important than cost, in practice, they do not choose [a] supplier based on quality'. We suspect that based upon consultation with customers with price expertise, our surveyed firms choose the suppliers who supply low-cost inputs, but consequently the quality of these inputs may be low. The poor quality inputs lead to the low quality products. As a result, firms may introduce new products with a good price but low quality, which jeopardizes the advantage of new products. In addition to this, even though customers nowadays appear to be more sensitive to product prices, quality has been and still be the first criterion for buying decision (Kumar & Phrommathed 2005). Consequently, a low quality product will not be accepted by a large number of prospective customers. This may be the reason why involving customers in NPD projects cannot enhance new product success.

The reasons discussed above lead to the suggestion that when firms consult customers with price expertise about the suppliers, firms should pay attention to not only the prices

or costs of the inputs but also the quality of them and the delivery performance of the suppliers. By doing so, firms can select the best suppliers in terms of the prices and quality of the required inputs as well as the delivery performance of the suppliers. Cooperating with such suppliers enables firms to produce new products faster with lower costs and higher quality. In addition to this, customers with price expertise can help firms set appropriate prices for the new products. Consequently, the new products are more likely to be successful.

6.2.3 Managerial actions according to NPD objectives

The above discussion advances our understanding of the effects of cross-functional integration mechanisms and customer characteristics on NPD outcomes. It also explains why some mechanisms and customer characteristics have no impact on NPD performance. Moreover, it recommends how practitioners improve the effectiveness of integration mechanisms and customer characteristics. This section provides further suggestions that can help firms achieve their different objectives when they conduct NPD. To this end, based on the sizes of path coefficients reported in Table 5.15, we rank the effectiveness of cross-functional integration mechanisms and customer characteristics as follows (see Table 6.1).

Table 6.1 Rankings of the effectiveness of cross-functional integration mechanisms and customer characteristics

Rank	NPD Objectives					
	Enhancing NPD speed		Enhancing new product advantage		Enhancing new product success	
	Integration mechanism	Customer characteristic	Integration mechanism	Customer characteristic	Integration mechanism	Customer characteristic
Rank 1	The use of ICT	Customers with product expertise	Superordinate goals	Customers with lead user characteristics	Superordinate goals	Customers with product expertise
Rank 2	Co-location		Co-location	Customers with product expertise	Co-location	Customers with lead user characteristics
Rank 3	Joint reward systems		The use of ICT	Financially attractive customers	Cross-functional training	
Rank 4	Cross-functional training					

Note: Cross-functional team use, job rotation, and informal coordination have no effect on NPD speed, new product advantage, and new product success.
Involving innovative customers and customers with price expertise have no effect on NPD speed, new product advantage, and new product success.

Generally, Table 6.1 displays that both cross-functional integration mechanisms and customer characteristics positively impact on each NPD outcome. Therefore, firms should put time and effort into both of these areas to meet their objectives when they conduct NPD, and maximize the likelihood that new products are successful.

For firms wishing to enhance NPD speed, there are four integration mechanisms that can help firms to do so. Among them, using ICT tools is the best option, followed by locating NPD team members within close physical proximity to each other. The next two important mechanisms are joint reward systems and cross-functional training. Using a specific mechanism incurs costs (Leenders & Wierenga 2002), using these four mechanisms concurrently may therefore incur high costs for firms. Accordingly, we suggest that firms with the limited resources should use only two most effective mechanisms, which are ICT use and co-location. Using them not only help firms increase NPD speed but also reduce the costs for firms. Regarding customer characteristics, only customers with product expertise can help firms speed up the NPD

process. Therefore, firms should focus on looking for the customers with the higher level of product expertise and inviting them to participate in NPD projects to accelerate the NPD process.

For firms wishing to produce new products that offer many advantages or superior value to customers, three integration mechanisms and three kinds of customers can help firms do so. Among three mechanisms, superordinate goals are the most effective mechanism that help firms increase new product advantage, followed by co-location. Using ICT tools is the least effective mechanism. Depending on the available resources of firms, firms can use all of these three mechanisms, or just use one or two of them according to their effectiveness because using all of three mechanisms simultaneously may incur great costs. Concerning customer characteristics, customers with lead user characteristics are the best partners, followed by customers with product expertise and then financially attractive customers. Hence, we encourage firms to try to look for customers with the higher levels of lead user characteristics, even though these customers are rare and identifying them is a challenging task. In case that firms cannot find this kind of customers, customers with the high level of product expertise are a good alternative. We also suggest that firms, particularly those with the limited resources, should involve financially attractive customers in their NPD projects because these customers may provide financial support for their R&D activities, which enhance the advantages of new products.

For firms wishing to increase the success of new products, three integration mechanisms and two kinds of customers can help firms do so. Among three mechanisms, again, superordinate goals are the most effective mechanism that help firms improve new product success, followed by co-location. Cross-functional training is the least effective

mechanism. Regarding customer characteristics, customers with product expertise and customers with lead user characteristics are good partners, but customers with product expertise are better ones. Depending on the available resources of firms, firms may use only one or two of the three mechanisms and involve only one kind of customer according to their effectiveness. Nevertheless, because the financial success of new products is not only the most important objective (Awwad & Akroush 2016) but also the ultimate goal of NPD projects (Cankurtaran, Langerak & Griffin 2013; Huang, Soutar & Brown 2004), we encourage firms to use all of the three mechanisms and involve both of the two kinds of customers to maximize new product success.

6.2.4 The effects of control variables

Concerning the effects of control variables on three different outcomes of NPD projects, some significant relationships are detected. Firstly, firm size is found to negatively affect NPD speed. The reason may be that larger firms have more bureaucratic inertia (Schilling 2010, 2013), which jeopardizes the speed of the NPD process. Another possible explanation is that in bigger firms, communication and coordination among various functional areas become more difficult, and this leads to the delays of decision-making (Ledwith 2009; Schilling 2010, 2013), which hamper NPD speed. Secondly, project budget has positive impacts on NPD speed. This is reasonable because a higher budget implies the more resources (e.g., money) are available for that project, and the availability of resources has been found to speed up NPD process (Cankurtaran, Langerak & Griffin 2013). A higher project budget also indicates that senior management pay more attention to that project (Ernst, Hoyer & Rübsaamen 2010), and top management support or organizational support is positively associated with NPD speed (Cankurtaran, Langerak & Griffin 2013; Chen, Damanpour & Reilly 2010).

Finally, project length positively affects new product advantage but has a negative influence on NPD speed. This is plausible because a longer project may reflect a more challenging project (Cooper 1998), which aims to develop a highly innovative product. This argument is supported by Cooper (2001, p. 47) that 'the desire to move quickly often lead to a reactive, unimaginative, and undifferentiated product'. And because it is a challenging project, it may slow down NPD progress.

Regarding the insignificant relationships between control variables and NPD outcomes, the fact that project size has no effect on NPD speed suggests that the links between cross-functional integration mechanisms and NPD speed as well as the relationships between customer characteristics and NPD speed are robust across the range of project sizes.

In a similar vein, the fact that firm size, project budget, and project size have no impact on new product advantage proposes that the links between cross-functional integration mechanisms and new product advantage as well as the relationships between customer characteristics and new product advantage are robust across the range of firm sizes, project budgets, and project sizes.

In the same way, the fact that none of four control variables significantly affects new product success offers that the links between cross-functional integration mechanisms and new product success as well as the relationships between customer characteristics and new product success are robust across the range of firm sizes, project budgets, project lengths, and project sizes.

6.3 Theoretical implications

Our research has some important theoretical implications. Recall that there are two theoretical frameworks, namely the information processing perspective and resource dependence theory, which were employed to underpin our study. Based upon these frameworks, we proposed and evaluated the effects of eight cross-functional integration mechanisms and five customer characteristics on three different outcomes of NPD projects. Our results indicate that five out of eight cross-functional integration devices and three out of five customer characteristics have a significant and positive impact on at least one NPD outcome, thereby providing support for the salience and complementarity of these two theories in understanding NPD projects. This also reinforces the notion that research on a complex social system, such as the NPD process, should be guided by multiple theoretical lenses (e.g., Coviello & Joseph 2012; Kyriazis et al. 2017).

As discussed earlier, co-location is the most effective mechanism because it positively affects all of three NPD outcomes. The use of ICT is also important. The reason is that it can help enhance NPD speed and new product advantage. These findings suggest that ICT tools can be used as an alternative to co-location in case that co-location is unfeasible, for example, "global products" or multinational NPD projects (Hameri & Nihtila 1997; Rafii 1995). However, the use of ICT tools is less effective than co-location because ICT use cannot help increase new product success. Our findings therefore provide support for the prediction of Pinto, Pinto & Prescott (1993) that ICT tools are less useful than co-location in circumstances that are non-routine, because NPD projects typically entail numerous non-routine activities (Huth 2008; Pinto, Pinto & Prescott 1993; Soderquist & Kostopoulos 2012). These results, however, challenge

the proposition of Chen, Damanpour & Reilly (2010) that advances in information technology reduce the significance of co-location. The fact that co-location is more advantageous than ICT tools also corroborates the statement of Olson & Olson (2000, p. 173) that 'distance will continue to matter'.

Superordinate goals have a positive influence on new product advantage and new product success. Joint reward systems improve NPD speed. These findings are interesting because using these two mechanisms concurrently may help improve all three NPD outcomes. This provides support for the notion that joint rewards or team-based rewards are significantly associated with the attainment of superordinate goals (e.g., Gomez-Mejia & Balkin 1989; Le-Meunier-FitzHugh, Massey & Piercy 2011; Xie, Song & Stringfellow 2003).

Cross-functional training is found to have positive relationships with NPD speed and new product success. This finding verifies that we cannot make an NPD team by simply throwing people in different functional areas together and expect they perform. Cross-functional training is a mechanism to help NPD team members work well together, and this will speed up the NPD process and lead to the success of new products. The insignificance of job rotation implies that although it is a kind of cross-functional training (Maltz & Kohli 2000), it may be inappropriate for the enhancement of NPD performance.

The absence of direct effects of cross-functional team use and informal coordination on all of three NPD outcomes proposes that the effectiveness of these two mechanisms may be affected by other mechanisms as we discussed above. There may also be additional influences that we did not take into account in the current study. Hence, it is important for researchers to examine the effects of these two mechanisms in a

contingent manner (e.g., depending on other mechanisms such as, co-location, ICT use, cross-functional training, or joint reward systems).

Turning now to the customer characteristics, as mentioned above, customers with product expertise are the best partners for firms to involve in NPD projects, and customers with lead user characteristics are the second most crucial partners. The important roles of customers with lead user characteristics are emphasized in numerous studies (e.g., Carbonell, Rodriguez-Escudero & Pujari 2012; Gruner & Homburg 2000; Herstatt & von-Hippel 1992; Lilien et al. 2002). Nevertheless, as discussed earlier, these customers are scarce and identifying them is difficult, and this leads to the limitation of involving them in the NPD process. Hence, our finding that customers with product expertise have a strong effect on all of three NPD outcomes is important. This suggests that customers with product expertise can be used as an efficient and effective alternative to customers with lead user characteristics because they are not rare, and detecting them is not difficult in comparison with customers with lead user characteristics.

Recall that Gruner & Homburg (2000) measured the construct "technically attractive customers" by two items, namely customers' innovativeness and customers' know-how. The authors found that this construct had no relationship with new product success. We disaggregated their construct into two distinct variables, namely innovative customers and customers with product expertise. Our results reveal that innovative customers have no effect on three NPD outcomes. Customers with product expertise, however, positively affect all three NPD outcomes. These findings are interesting because they imply that in some circumstances, decomposing a construct into various variables may provide a clearer picture of research problems. For example, Rijsdijk, Langerak &

Hultink (2011) disaggregated the construct “product advantage” into two variables of product meaningfulness and product superiority. Massey & Kyriazis (2014) decomposed variable “interdependence” into two different constructs, namely the perceived dependence of Marketing Managers on the Technically Trained Managers, and the perceived dependence of Technically Trained Managers on the Marketing Managers. By doing so, the authors provided deeper insights into NPD. In the current study, decomposing the construct “technically attractive customers” helps us detect an important kind of customers that was missed in previous research of Gruner & Homburg (2000), namely customers with product expertise. These customers are vital for firms developing new products because they can help firms improve NPD speed, new product advantage, and new product success.

The significant influence of financially attractive customers on new product advantage stresses the important role of these customers as a revenue base for R&D activities of firms. Nevertheless, the fact that these customers have no effect on NDP speed and new product success suggests these customers can control and drive the NPD process as postulated by resource dependence theory.

Despite their intuitive appeal, innovative customers and customer with price expertise have no impact on all three NPD outcomes. These findings imply that other factors, which were not taken into account in our research, may diminish the effects of these customers on NPD performance. The NPD stages in which customers are involved in NPD projects were found to affect the relationship between customer involvement and NPD performance (e.g., Chang & Taylor 2016; Gruner & Homburg 2000). Accordingly, we argue that the NPD stages in which these customers are involved may be one of such factors. For clarity, we give an example. Engaging innovative customers

in the stages of idea generation and concept development can help firms develop novel concepts for new products. Involving customers with price expertise in the commercialization stage can help firm determine appropriate prices for new products, thereby increasing the likelihood of product success. If firms do not involve these customers in the appropriate NPD stages, that is involving innovative customers in the commercialization stage and involving customers with price expertise in the stages of idea generation and concept development, this may lead to the insignificant relationships between these customers and NPD performance.

6.4 Limitations and directions for future research

Our research has some limitations. First, its research design is cross-sectional. This approach is helpful for testing hypotheses (Swink & Song 2007). Nonetheless, it makes cause-effect inferences on examined constructs problematic (Bonner, Ruekert & Walker 2002; Bryman & Bell 2015; Xie, Song & Stringfellow 2003), even though we use some control variables to 'approximate the rigorous test for causality' as suggested by Neuman (2003, p. 267). Given that NPD is conducted over long periods, a longitudinal design in future research is helpful to better examine the dynamics between cross-functional integration mechanisms, customer characteristics, and NPD outcomes.

Second, there is no general consensus on the definition of "financially attractive customers". Therefore, based on the work of Rocca, Caruana & Snehota (2012), we used the extent to which customers buy products in large volumes as a proxy for measuring their financial attractiveness. This may be a non-standard operationalization of this construct. Further studies that develop a better scale to measure the financial attractiveness of customers can help eliminate this limitation.

Third, our sample includes firms across a wide range of industries. Nevertheless, it consists of firms in only Australia. Hence, international replications may yield interesting results and help determine whether our findings can extend to other countries.

Fourth, our findings are based on single-informant reports and perceptual data. As discussed in Chapter 4, using the key informant method may cause common method bias. Using retrospective perceptual data may have the shortcomings related to subjectivity (Carbonell & Rodriguez 2006b). Even though the key informant method and retrospective perceptual data are commonly used in marketing and NPD research (Calantone & Di-Benedetto 2007; Carbonell & Rodriguez 2006b; Kandemir, Calantone & Garcia 2006), and common method bias is not serious in our study, further studies using multiple informants and objective criteria are helpful to validate our findings.

Finally, our collected data exhibits a slight degree of non-normality. Non-normal data may distort the data analysis results, even though this issue is much less serious with PLS-SEM (Hair et al. 2014), and it may diminish the effects and the predictive relevance of exogenous constructs on endogenous constructs. Consequently, this may lead to the result that most cross-functional integration mechanisms and customer characteristics in our study have a small impact on and small predictive relevance for NPD speed, new product advantage, and new product success.

Several other directions for future research are also identified. As mentioned above, most integration mechanisms and customer characteristics in our research have a small impact on and small predictive relevance for NPD outcomes. We suspect that there may be other linkage devices or customer characteristics, which we did not take into account, have a greater effect on and larger predictive relevance for NPD outcomes Thus, there is

a lot of room for investigating the effects of other linkage devices (e.g., centralization, formalization) and other customer characteristics such as customers with emergent nature (Hoffman, Kopalle & Novak 2010) on NPD performance.

As we discussed earlier, the impact of cross-functional team use on NPD outcomes may be affected by other mechanisms such as co-location, cross-functional training, and joint reward systems. Similarly, the influence of informal coordination on the outcomes of NPD projects may be impacted by cross-functional team use or the use of ICT tools. It will be interesting if future research tests the interaction effects between various cross-functional integration mechanisms. This can help provide insight into the effectiveness of not only every single mechanism but also a set of related mechanisms.

It is recommended that firms should consider inviting customers with multiple characteristics to participate in NPD projects (Alam 2005, 2011). For example, customers with product expertise also possess lead user characteristics may be more useful than customers with a single characteristic. Therefore, an investigation into the interaction effects between different customer characteristics will be helpful. This can advance our knowledge about the effectiveness of customers with multiple characteristics.

Koufteros, Vonderembse & Jayaram (2005) found that concurrent engineering (a kind of internal integration) had a positive impact on customer integration, which in turn positively affected product innovation performance and product quality. Based on their findings, we suggest that some internal integration mechanisms may increase the effectiveness of customers with a specific characteristic when they are involved in NPD projects. For instance, co-locating team members can help them share and discuss novel ideas from customers with lead user characteristics in an easy way and in a timely

manner, and this can increase the effectiveness of this kind of customer in NPD projects. Accordingly, future research that examines the interaction effects between cross-functional integration mechanisms and customer characteristics can provide insight into which integration mechanisms can help firms most exploit the knowledge and capability of various kinds of customers.

Finally, our findings indicate that innovative customers and customers with price expertise have no influence on NPD performance. As discussed above, this can lead to the proposition that firms may not involve these customers in the right stages of NPD projects. This then raises the question: for a specific kind of customers, in which NPD stages should firms involve them? Gruner & Homburg (2000) can answer which kinds of customers affect new product success, and in which stages that customers are involved influence new product success. However, the authors could not address the above question. Hence, future research on the interaction effects between customer characteristics and the NPD stages in which customers are involved will help shed light on this issue.

6.5 Conclusion

The success of new products has long been acknowledged to be crucial for the survival and development of organizations. Therefore, the objective of this research is to identify which cross-functional integration mechanisms and which customer characteristics affect NPD performance. Data collected from 104 NPD projects in Australia indicates that co-location, superordinate goals, ICT use, cross-functional training, and joint reward systems have a significant and positive impact on NPD performance. The results also reveal that involving customers with product expertise, customers with lead user characteristics, and financially attractive customers can help firms improve NPD

outcomes. By examining the effects of eight cross-functional integration mechanisms and five customer characteristics on three different outcomes of NPD projects, our research provides a more comprehensive picture of the factors driving NPD performance than existing studies in the research stream. It also suggests that firms should try to utilize both the effective cross-functional integration mechanisms and the right customers to achieve their NPD objectives and maximize the likelihood that new products are successful. As every other study, our research is not without limitations. The limitations and the unexpected but interesting findings of the current study set a foundation for further research on the complex relationships between cross-functional integration mechanisms, customer characteristics, and NPD outcomes.

APPENDICES

Appendix 1. Human ethics approval

UTS HREC Letter of Noting

Research.Ethics@uts.edu.au

4/09/2015

Vi Tran; Graham.Massey@uts.edu.au; Jan.Hohberger@uts.edu.au; Paul.Burke@uts.edu.au; Research.Ethics@uts.edu.au

Dear Applicant,

The Faculty has considered your Nil/Negligible Risk Declaration Form for your project titled, "A Study of New Product Development in Australia", and agree your research does not require review from the UTS Human Research Ethics Committee. Please keep a copy of your Declaration form on file to show you have considered risk.

For tracking purposes, you have been provided with an ethics application number, which is UTS HREC 2015000168.

I also refer you to the AVCC guidelines relating to the storage of data, which require that data be kept for a minimum of 5 years after publication of research. However, in NSW, longer retention requirements are required for research on human subjects with potential long-term effects, research with long-term environmental effects, or research considered of national or international significance, importance, or controversy. If the data from this research project falls into one of these categories, contact University Records for advice on long-term retention.

You should consider this your official letter of noting.

Instructions for saving the declaration form can be downloaded from: http://www.research.uts.edu.au/policies/restricted/human/forms.html#instructions
To access this application, please follow the URLs below:

* if accessing within the UTS network: http://rmprod.itd.uts.edu.au/RMENet/HOM001N.aspx
* if accessing outside of UTS network: https://remote.uts.edu.au , and click on "RMENet – Research Master Enterprise" after logging in.

If you or anyone connected with this research have any queries please do not hesitate to contact Research.Ethics@uts.edu.au

Yours sincerely,
Professor Marion Haas
Chairperson
UTS Human Research Ethics Committee
C/- Research & Innovation Office
University of Technology, Sydney
E: Research.Ethics@uts.edu.au
I: http://www.research.uts.edu.au/policies/restricted/ethics.html
P: PO Box 123, BROADWAY NSW 2007
[Level 14, Building 1, Broadway Campus]
CB01.14.08.04

REF: E28

Appendix 2. Invitation letter

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UTS CRICOS PROVIDER CODE 00099F

November, 2015

INVITATION LETTER

A Study of New Product Development in Australia

Dear,

My name is Vi Tran and I am a PhD student at the University of Technology Sydney. I am conducting research into factors affecting new product development projects in Australia and would welcome your assistance. The research will take about15 minutes of your time. Any information you provide will be completely confidential so that you remain anonymous. I have asked you to participate because your job title indicates that you may be able to provide information regarding new product development projects.

You are under no obligation to participate in this research, but if you are interested in participating, please indicate your consent by completing the enclosed questionnaire and returning it to me. Please note there are no right or wrong answers. All I am interested in is answers that best reflect your opinions.

If you kindly agree to take part in my study, at the end of this research project, an executive summary of the results will be made available to you, and you can contact me on: Vi.Tran@student.uts.edu.auto request it.

Yours sincerely,

Vi Tran

NOTE:
This study has been approved by the University of Technology Sydney Human Research Ethics Committee. If you have any complaints or reservations about any aspect of your participation in this research which you cannot resolve with the researcher, you may contact the Ethics Committee through the Research Ethics Officer (ph: +61 2 9514 9772 Research.Ethics@uts.edu.au), and quote this number (UTS HREC 2015000168). Any complaint you make will be treated in confidence and investigated fully and you will be informed of the outcome.

Appendix 3. Information sheet

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UTS CRICOS PROVIDER CODE 00099F

November, 2015

INFORMATION SHEET

A Study of New Product Development in Australia

WHO IS DOING THE RESEARCH?

My name is Vi Tran and I am a PhD student at UTS. My principal supervisor is Dr Graham Massey, an academic at Marketing Discipline Group, UTS Business School.

WHAT IS THIS RESEARCH ABOUT?

This research examines how best to coordinate the work of new product development teams within firms, and which customer characteristics affect the outcomes of new product development (NPD) projects.

IF I SAY YES, WHAT WILL IT INVOLVE?

I will ask you to answer a questionnaire that will take approximately 15 minutes to complete.

ARE THERE ANY RISKS/INCONVENIENCE?

There are no risks involved.

WHY HAVE I BEEN ASKED?

You are able to give me the information I need to find out about the factors that affect the outcomes of NPD projects

DO I HAVE TO SAY YES?

You don't have to say yes.

WHAT WILL HAPPEN IF I SAY NO?

Nothing. I will thank you for your time so far and won't contact you about this research again.

IF I SAY YES, CAN I CHANGE MY MIND LATER?

You can change your mind at any time and you don't have to say why. I will thank you for your time so far and won't contact you about this research again.

WHAT IF I HAVE CONCERNS OR A COMPLAINT?

If you have concerns about the research that you think I or my supervisor can help you with, please feel free to contact us.

Research student:	Principal Supervisor:
Vi Tran	**Dr Graham Massey**
Marketing Discipline Group	Marketing Discipline Group
University of Technology Sydney	University of Technology Sydney
PO Box 123, Broadway, NSW 2007	PO Box 123, Broadway, NSW 2007
Mobile phone: +61 4 2303 4363	Phone: +61 2 9514 3480
Email: Vi.Tran@student.uts.edu.au	Email: Graham.Massey@uts.edu.au

If you would like to talk to someone who is not connected with the research, you may contact the Research Ethics Officer via Research.Ethics@uts.edu.au, and quote this number (UTS HREC 2015000168).

Appendix 4. Questionnaire

STUDY OF NEW PRODUCT DEVELOPMENT IN AUSTRALIA

Part 1: General Information

1. Have you ever been involved in new product development (NPD) projects? (New products can be either new goods or new services).

   ☐ Yes ➢ Continue question 2

   ☐ No ➢ Unfortunately, this survey is targeting people other than yourself. Thanks for your time.

2. Were customers involved in any of those NPD projects?

   ☐ Yes ➢ Please focus **only on the projects which involved customers** and continue question 3.

   ☐ No ➢ Unfortunately, this survey is targeting people other than yourself. Thanks for your time.

3. Does your current firm conduct new product development?

   ☐ Yes ➢ Please focus on your **most recently completed NPD project** to answer the following questions. If you are new to your current firm, you can use a new product development project from a previous employer as the focus of your answers. It does not matter if the project you choose was a success or a failure.

   ☐ No ➢ Please use **a NPD project from a previous employer** to answer the following questions. It does not matter if the project you choose was a success or a failure.

4. From the list below, please tick only **one** option that **best** describes the NPD project on which you will be focusing for this survey.

   A cost reduction (a new product that replaces existing products, providing similar performance but at a lower cost) ☐

   A repositioning (an existing product retargeted at a new market) ☐

   An improvement or revision to an existing product of your firm ☐

   An addition to one of existing product lines of your firm ☐

   A new-to-the-firm product (a new product line of your firm) ☐

   A new-to-the-world product (a really new product to the market) ☐

   A customization request for one of your products from one of your customers ☐

   A new service for your customers ☐

5. Please give a brief overview of **this specific project** in terms of:
   - **Type of customer** (*Please tick as many as apply)*

     ☐ Consumers (end users) ☐ Business-to-Business customers

     ☐ Other: *(please specify)* _____
   - **Project budget** (AUD actual spend): _____
   - **The number of full-time** (and full-time equivalent) **project members**: _____
   - **Project length**: _____ years _____ months

6. Which of the following **departments** were involved in the project that you have based your answers on? *(Please tick as many as apply)*

   ☐ Research and Development ☐ Production/Manufacturing

   ☐ Sales ☐ Marketing

   ☐ Accounting/Finance ☐ Maintenance/Technical Service

   ☐ Purchasing ☐ Other: *(please specify)* _____

Part 2: Means of Coordinating the Work of your firm's NPD Team

7. Now I am interested in **how your company attempts to get members of different departments working together effectively**. Please pick a number from the scale to state your opinion and write it in the space provided.

	Scale							
Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**

- Within my firm, employees from one department participate in training programs that acquaint them with the work of people in other departments. _____
- Employees in different departments receive on-going training on how to improve their relationship with people in other departments within my firm. _____
- The company I work for requires employees from one department participate in training sessions with people from other departments. _____

8. Now I am interested in **the extent to which NPD team members shared the same goals during the project**. Please pick a number from the scale to state your opinion.

	Scale							
Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**

- During our NPD project, team members were all committed to the same project goals. _____
- During the project, NPD team members focused on the overall goals of the project. _____
- Every NPD team member behaved in ways that supported the overall goals of the project. _____
- The NPD project had specific objectives and each team member treated those goals as if they were their own personal goals. _____

9. Now I am interested in **the extent to which your firm allows staff to work temporarily in other departments**. Please pick a number from the scale to state your opinion.

	Scale							
Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**

- In my firm, employees from one department are often temporarily placed to work in other departments. _____
- My firm uses job rotation of staff to connect different departments. _____
- Job rotation of staff across different departments is normal practice within my firm. _____

10. Now I am interested in **how closely the NPD team members were located in your firm**. Please pick a number from the scale to state your opinion.

	Scale							
Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**

- NPD team members shared office space with each other when working on this project. _____
- The work sites of NPD team members were located within close physical proximity of each other. _____
- Overall, NPD team members were located closely to each other during the project. _____

11. Now I am interested in **the range of different departments within the NPD team**. Please pick a number from the scale to state your opinion.

	Scale							
Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**

- Members of the NPD team came from a variety of departments within my firm. _____
- The NPD team consisted of members from different departments. _____
- During the project, various departments jointly carried out product development activities. _____
- There were many different departments involved in the NPD project. _____

12. The following statements refer to **whether employees were rewarded for working effectively with other departments during the project**. Please pick a number from the scale to state your opinion.

	Scale							
Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**

- On the NPD project, employees from one department were rewarded for how effectively they worked together with other departments. _____
- Employees in a department earned rewards when they worked well with other departments during the NPD project. _____
- When employees from a department worked with other departments and contributed to the overall goals of the project, they received valuable rewards. _____

13. Now I am interested in **the use of information and communication technology (ICT) such as telephone, video-conferencing, email, and the internet during the NPD project**. Please pick a number from the scale to state your opinion.

	Scale							
Never	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Very Frequently**

- Employees from one department frequently used ICT to coordinate their product development activities with those of other departments. _____
- On the NPD project, employees from one department regularly used ICT to interact with people in other departments. _____
- During the project, employees from one department used ICT frequently to exchange work-related information with people in other departments. _____

14. Now I am interested in **the extent to which NPD team members managed their work with other departments by using personal contacts**. Please pick a number from the scale to state your opinion.

Scale								
Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**

- During the NPD project, employees from one department coordinated their activities with the other departments informally, via personal contacts. _____
- Employees from one department worked directly with their personal contacts without consulting their supervisors during the NPD project. _____
- On the project, employees from one department directly contacted colleagues whom they know well in other departments when they needed information. _____
- Cooperation among employees from different departments during the NPD project was based on personal contacts. _____

Part 3: Characteristics of Customers on the Project

Now please focus on **the customers who were most involved in the NPD project of your firm** to answer the following questions.

15. The following statements are about **the extent to which your customers buy your products in bulk**. Please pick a number from the scale to state your opinion.

Scale								
Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**

- The people who buy our products tend to make bulk purchases. _____
- Our customers usually buy our products in large volumes. _____
- Overall, the customers of my firm are bulk buying customers. _____

16. Now I am interested in **your customers' knowledge with the products of your firm**. Please pick a number from the scale to state your opinion.

Scale								
Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**

- Our customers have a very good knowledge of our products. _____
- The people who buy our products tend to know a great deal about them. _____
- Overall, our customers are very knowledgeable about our products. _____

17. The following statements are about **your customers' knowledge of product prices in the market**. Please pick a number from the scale to state your opinion.

				Scale				
Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**

- Our customers have a very clear idea of the prices charged by us and our competitors for our products. _____
- The customers of my firm are considered experts when it comes to knowing the prices of products in the market. _____
- We believe that our customers are very knowledgeable about the prices of products in the market. _____

18. The following statements refer to **whether your customers identify new needs, solutions and applications for your products earlier than the rest of the market**. Please pick a number from the scale to state your opinion.

				Scale				
Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**

- Our customers are usually ahead of the rest of the market in recognizing new needs, solutions and applications for our products. _____
- The people who buy our products are always suggesting new solutions and applications for our products. _____
- The customers of our firm are regarded as pioneers in proposing solutions and applications for our products. _____

19. Now I am interested in **how willing your customers are to try new products, services, and technologies**. Please pick a number from the scale to state your opinion.

				Scale				
Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**

- If our customers hear about a new product, service or technology, they always like to try it earlier than other users. _____
- Among their peers, our customers are usually the first to explore new products, services, or technologies. _____
- If a new product, service or technology is introduced in the market, our customers are often ahead of other users in trying it. _____

Part 4: Outcomes of the Project

20. Now I am interested in **how fast the NPD project you have been writing about was completed**. Please pick a number from the scale to state your opinion.

	Scale							
Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**

- We launched this new product on or ahead of our schedule. _____
- We completed the NPD project faster than we expected. _____
- The development time of this product was faster than our typical product development time. _____

21. The following statements refer to **the advantages of your new product relative to competitors' products**. Please pick a number from the scale to state your opinion.

	Scale							
Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**

- Compared to competitive products, our new product provided many more benefits to the customers. _____
- Our new product offered much more value to the customers than competing products did. _____
- Overall, our new product offered many advantages in comparison with competing products. _____

22. The following statements refer to **the success of your new product in terms of financial performance**. Please pick a number from the scale to state your opinion.

	Scale							
Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**

- Our new product succeeded in achieving our budget objectives. _____
- Profits from our new product exceeded the minimum acceptable return for projects like this in our company. _____
- The sales and profits of our new product had a profound impact on our company. _____
- Our new product was successful with respect to financial performance. _____

Part 5: Further Information about the Project

23. Please write down the **job title** you held **during** the project: _____

24. **How long** had you been in this position when the project commenced:

    _____ years _____ months

25. At the time of the project, what was your firm's **primary business activity** (e.g., food product manufacturing, machinery and equipment manufacturing, telecommunications services, etc.)?_____

26. During the project, **how many** full-time (and full-time equivalent) **employees** did your company have in Australia? _____

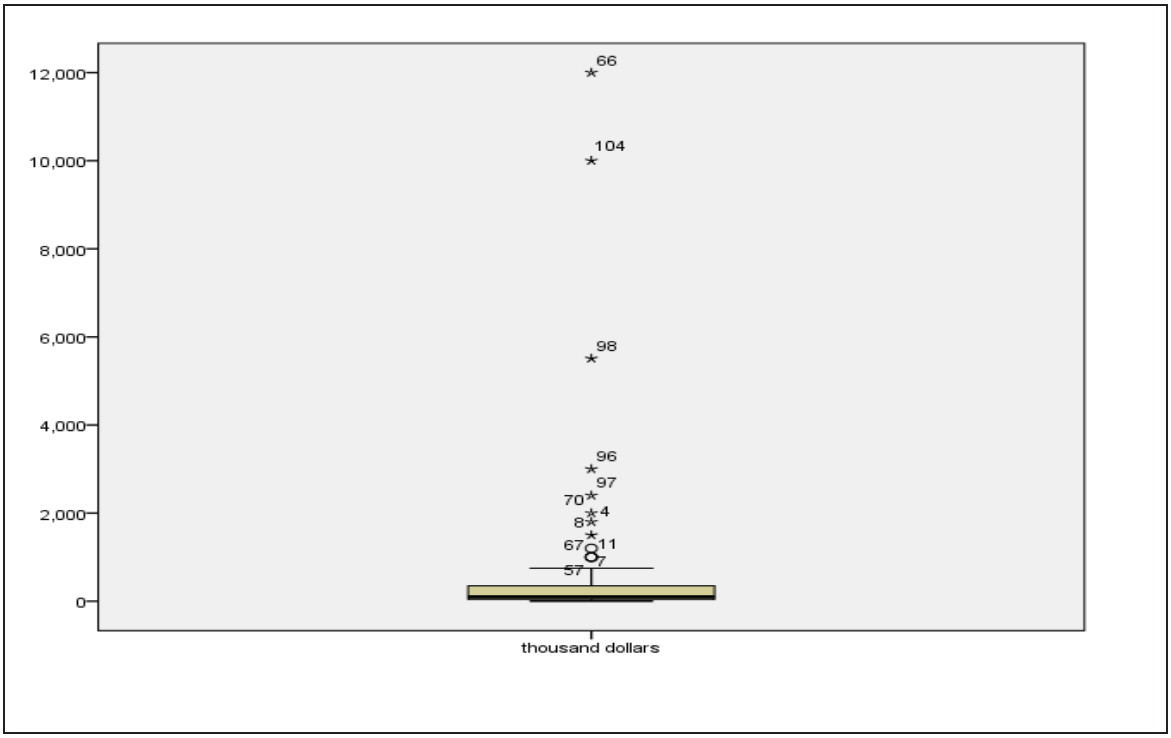
27. During the project, what **approximate percent** of your firm's annual sales was spent on new product development? _____ %

28. During the project, what was your company's **approximate percent** of sales revenue provided by new products developed in the previous 3 years? _____ %

Thank you so much for your time!

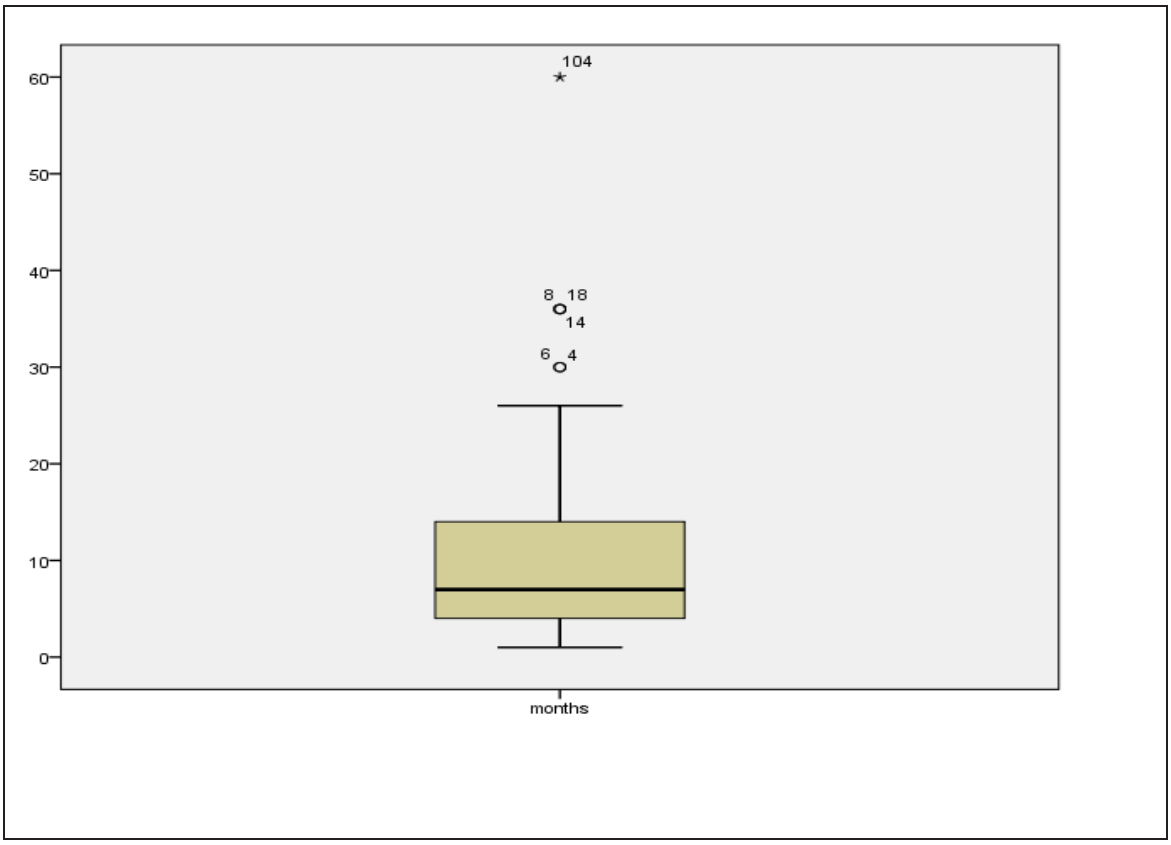
Please feel free to contact me on: Vi.Tran@student.uts.edu.au to request an executive summary of the results.

Appendix 5. Outliers of control variables

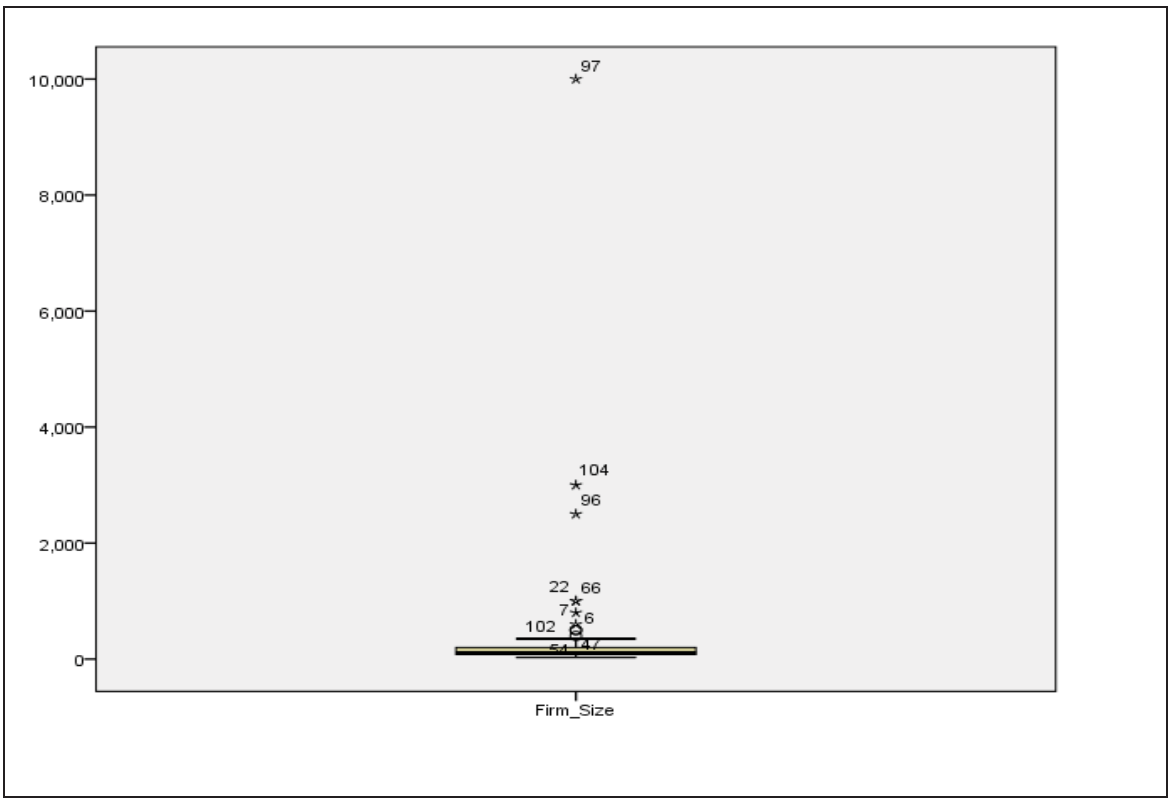


Boxplot of Pro_Budget (thousand dollars)

Boxplot of Pro_Size



Boxplot of Pro_Length (months)



Boxplot of Firm_Size

Appendix 6. Missing data & data distribution

Variables	Number of valid cases	Mean	Std. Deviation	Missing Data		Skewness	Kurtosis
				Number	Percent		
Training_1	104	3.84	1.741	0	0.00%	.020	-1.159
Training_2	104	3.95	1.808	0	0.00%	-.168	-1.309
Training_3	104	4.24	1.658	0	0.00%	-.327	-1.144
Goal_1	104	5.13	1.599	0	0.00%	-.731	-.660
Goal_2	104	5.09	1.565	0	0.00%	-.673	-.666
Goal_3	104	4.97	1.484	0	0.00%	-.458	-.815
Goal_4	104	4.48	1.558	0	0.00%	-.341	-.440
Rotation_1	104	3.69	1.746	0	0.00%	.128	-1.136
Rotation_2	104	3.00	1.701	0	0.00%	.434	-.894
Rotation_3	104	2.88	1.609	0	0.00%	.448	-.881
Colocation_1	104	3.37	1.746	0	0.00%	.224	-1.077
Colocation_2	104	4.05	1.765	0	0.00%	-.042	-1.259
Colocation_3	104	4.08	1.804	0	0.00%	-.107	-1.230
CFTeam_1	104	5.13	1.593	0	0.00%	-.576	-.737
CFTeam_2	104	5.21	1.587	0	0.00%	-.757	-.270
CFTeam_3	104	4.97	1.592	0	0.00%	-.733	-.130
CFTeam_4	104	4.99	1.604	0	0.00%	-.473	-.786
Reward_1	104	3.60	1.692	0	0.00%	.352	-1.104
Reward_2	104	3.46	1.654	0	0.00%	.371	-.849
Reward_3	104	3.08	1.641	0	0.00%	.479	-.606
ICT_1	104	4.85	1.600	0	0.00%	-.759	-.355
ICT_2	103	5.14	1.633	1	0.96%	-.719	-.451
ICT_3	104	5.05	1.615	0	0.00%	-.770	-.362
Informal_1	104	4.72	1.567	0	0.00%	-.482	-.909
Informal_2	104	4.03	1.692	0	0.00%	-.193	-.749
Informal_3	104	4.90	1.458	0	0.00%	-.500	-.487
Informal_4	104	4.43	1.544	0	0.00%	-.339	-.808
Bulk_1	104	4.11	2.000	0	0.00%	-.133	-1.375
Bulk_2	104	4.01	1.998	0	0.00%	-.118	-1.239
Bulk_3	104	3.96	1.955	0	0.00%	-.136	-1.305
Prod_Know_1	104	5.05	1.603	0	0.00%	-.685	-.578
Prod_Know_2	103	4.89	1.455	1	0.96%	-.590	-.460
Prod_Know_3	104	4.92	1.525	0	0.00%	-.723	-.308
Price_Know_1	104	5.45	1.506	0	0.00%	-1.053	.358
Price_Know_2	104	4.66	1.524	0	0.00%	-.754	-.136
Price_Know_3	103	5.14	1.456	1	0.96%	-.844	-.172
Lead_1	104	4.22	1.526	0	0.00%	-.082	-1.207
Lead_2	104	3.78	1.678	0	0.00%	-.083	-.976
Lead_3	104	3.89	1.642	0	0.00%	-.028	-1.184
Inno_1	104	4.41	1.505	0	0.00%	-.249	-.861
Inno_2	104	4.17	1.554	0	0.00%	-.263	-.530
Inno_3	104	4.27	1.509	0	0.00%	-.177	-.846
Speed_1	104	4.61	1.657	0	0.00%	-.209	-1.090
Speed_2	104	3.93	1.731	0	0.00%	.071	-1.178
Speed_3	104	3.99	1.573	0	0.00%	-.060	-.789
Advantage_1	104	4.90	1.458	0	0.00%	-.481	-.564
Advantage_2	104	4.80	1.437	0	0.00%	-.658	-.153
Advantage_3	104	4.80	1.410	0	0.00%	-.502	-.631
Success_1	104	5.04	1.414	0	0.00%	-.385	-.943
Success_2	104	4.69	1.449	0	0.00%	-.343	-.686

Variables	Number of valid cases	Mean	Std. Deviation	Missing Data		Skewness	Kurtosis
				Number	Percent		
Success_3	104	3.91	1.489	0	0.00%	-.155	-.530
Success_4	104	4.76	1.471	0	0.00%	-.394	-.811
ProBudget (thousand dollars)	98	437.45	1220.651	6	5.77%	5.984	41.832
ProSize	100	5.09	3.325	4	3.85%	1.778	4.163
ProLength (months)	101	10.51	9.631	3	2.88%	2.209	6.747
FirmSize	102	308.23	1045.389	2	1.92%	8.310	75.200

Appendix 7. Independent-samples t test

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	Sig. (2-tailed)
Training_1	Equal variances assumed	.012	.913	-.160	.874
	Equal variances not assumed			-.160	.873
Training_2	Equal variances assumed	1.115	.294	-.088	.930
	Equal variances not assumed			-.087	.931
Training_3	Equal variances assumed	6.782	.011	.484	.630
	Equal variances not assumed			.471	.639
Goal_1	Equal variances assumed	.401	.528	-.077	.939
	Equal variances not assumed			-.078	.938
Goal_2	Equal variances assumed	.010	.921	.142	.887
	Equal variances not assumed			.143	.886
Goal_3	Equal variances assumed	1.922	.170	-.458	.648
	Equal variances not assumed			-.450	.654
Goal_4	Equal variances assumed	1.620	.207	-.627	.532
	Equal variances not assumed			-.619	.538
Rotation_1	Equal variances assumed	2.421	.124	-1.594	.115
	Equal variances not assumed			-1.626	.108
Rotation_2	Equal variances assumed	.100	.753	-.145	.885
	Equal variances not assumed			-.144	.886
Rotation_3	Equal variances assumed	.493	.485	-.296	.768
	Equal variances not assumed			-.299	.766
Colocation_1	Equal variances assumed	1.217	.273	.370	.713
	Equal variances not assumed			.375	.708
Colocation_2	Equal variances assumed	.062	.803	-.401	.690
	Equal variances not assumed			-.400	.690
Colocation_3	Equal variances assumed	.008	.928	-.146	.884
	Equal variances not assumed			-.146	.884
CFTeam_1	Equal variances assumed	5.215	.025	1.128	.263
	Equal variances not assumed			1.094	.278
CFTeam_2	Equal variances assumed	4.752	.032	1.613	.111
	Equal variances not assumed			1.567	.122
CFTeam_3	Equal variances assumed	4.599	.035	.806	.423
	Equal variances not assumed			.780	.438
CFTeam_4	Equal variances assumed	6.750	.011	1.085	.281
	Equal variances not assumed			1.054	.296
Reward_1	Equal variances assumed	.045	.833	-.074	.941
	Equal variances not assumed			-.074	.941
Reward_2	Equal variances assumed	.027	.871	-.066	.948
	Equal variances not assumed			-.066	.948
Reward_3	Equal variances assumed	.292	.591	-.035	.973
	Equal variances not assumed			-.035	.972
ICT_1	Equal variances assumed	.084	.773	1.192	.237
	Equal variances not assumed			1.210	.230
ICT_2	Equal variances assumed	.112	.739	1.059	.293
	Equal variances not assumed			1.067	.290
ICT_3	Equal variances assumed	.552	.460	.546	.587
	Equal variances not assumed			.556	.580
Informal_1	Equal variances assumed	2.606	.111	-.206	.838
	Equal variances not assumed			-.210	.834
Informal_2	Equal variances assumed	.120	.730	.110	.912
	Equal variances not assumed			.111	.912

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	Sig. (2-tailed)
Informal_3	Equal variances assumed	.039	.844	.717	.475
	Equal variances not assumed			.716	.476
Informal_4	Equal variances assumed	.008	.930	.169	.866
	Equal variances not assumed			.169	.866
Bulk_1	Equal variances assumed	1.723	.193	2.272	.026
	Equal variances not assumed			2.238	.029
Bulk_2	Equal variances assumed	2.915	.092	1.504	.137
	Equal variances not assumed			1.479	.144
Bulk_3	Equal variances assumed	3.114	.082	2.186	.032
	Equal variances not assumed			2.140	.036
Prod_Know_1	Equal variances assumed	.018	.893	.360	.720
	Equal variances not assumed			.360	.720
Prod_Know_2	Equal variances assumed	.837	.363	.166	.868
	Equal variances not assumed			.164	.870
Prod_Know_3	Equal variances assumed	.162	.688	.135	.893
	Equal variances not assumed			.134	.894
Price_Know_1	Equal variances assumed	2.103	.151	.803	.425
	Equal variances not assumed			.789	.433
Price_Know_2	Equal variances assumed	12.301	.001	-.493	.623
	Equal variances not assumed			-.469	.641
Price_Know_3	Equal variances assumed	8.044	.006	-.117	.907
	Equal variances not assumed			-.111	.912
Lead_1	Equal variances assumed	.779	.380	-.423	.674
	Equal variances not assumed			-.418	.677
Lead_2	Equal variances assumed	.176	.676	-.356	.723
	Equal variances not assumed			-.353	.725
Lead_3	Equal variances assumed	1.982	.163	-.554	.581
	Equal variances not assumed			-.544	.588
Inno_1	Equal variances assumed	1.345	.250	-.108	.914
	Equal variances not assumed			-.110	.913
Inno_2	Equal variances assumed	4.333	.041	-.018	.985
	Equal variances not assumed			-.019	.985
Inno_3	Equal variances assumed	2.121	.149	-.240	.811
	Equal variances not assumed			-.247	.806
Speed_1	Equal variances assumed	2.983	.088	1.635	.106
	Equal variances not assumed			1.686	.096
Speed_2	Equal variances assumed	2.846	.096	1.748	.085
	Equal variances not assumed			1.790	.078
Speed_3	Equal variances assumed	3.344	.071	.398	.692
	Equal variances not assumed			.388	.699
Advantage_1	Equal variances assumed	.455	.502	.587	.559
	Equal variances not assumed			.584	.561
Advantage_2	Equal variances assumed	.123	.727	-.230	.819
	Equal variances not assumed			-.231	.818
Advantage_3	Equal variances assumed	.010	.921	.177	.860
	Equal variances not assumed			.178	.859
Success_1	Equal variances assumed	.011	.917	1.900	.061
	Equal variances not assumed			1.901	.061
Success_2	Equal variances assumed	.430	.514	.627	.533
	Equal variances not assumed			.624	.535
Success_3	Equal variances assumed	1.583	.212	.647	.519
	Equal variances not assumed			.645	.521
Success_4	Equal variances assumed	.592	.444	1.695	.094
	Equal variances not assumed			1.691	.095

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	Sig. (2-tailed)
ProBudget (thousand dollars)	Equal variances assumed	8.935	.004	-1.637	.106
	Equal variances not assumed			-1.500	.142
ProSize	Equal variances assumed	1.061	.306	1.987	.051
	Equal variances not assumed			2.047	.044
ProLength (months)	Equal variances assumed	.338	.563	-.136	.892
	Equal variances not assumed			-.135	.893
FirmSize	Equal variances assumed	9.318	.003	-1.644	.104
	Equal variances not assumed			-1.424	.164

Appendix 8. Outer loadings

Outer loadings of Model 1 (NPD speed as dependent variable)

	Bulk	CFTeam	Colocation	Goal	ICT	Informal	Inno	Lead	PriceKnow	ProdKnow	Reward	Rotation	Speed	Training
Bulk_1	0.948													
Bulk_2	0.946													
Bulk_3	0.969													
CFTeam_1		0.954												
CFTeam_2		0.964												
CFTeam_3		0.885												
CFTeam_4		0.954												
Colocation_1			0.779											
Colocation_2			0.937											
Colocation_3			0.970											
Goal_1				0.946										
Goal_2				0.940										
Goal_3				0.950										
Goal_4				0.914										
ICT_1					0.966									
ICT_2					0.965									
ICT_3					0.975									
Informal_1						0.879								
Informal_2						0.912								
Informal_3						0.769								
Informal_4						0.943								

Outer loadings of Model 1 (NPD speed as dependent variable)

	Bulk	CFTeam	Colocation	Goal	ICT	Informal	Inno	Lead	PriceKnow	ProdKnow	Reward	Rotation	Speed	Training
Inno_1							0.961							
Inno_2							0.956							
Inno_3							0.968							
Lead_1								0.952						
Lead_2								0.904						
Lead_3								0.947						
Price_Know_1									0.923					
Price_Know_2									0.956					
Price_Know_3									0.959					
Prod_Know_1										0.964				
Prod_Know_2										0.960				
Prod_Know_3										0.983				
Reward_1											0.967			
Reward_2											0.974			
Reward_3											0.957			
Rotation_1												0.864		
Rotation_2												0.954		
Rotation_3												0.962		
Speed_1													0.904	
Speed_2													0.920	
Speed_3													0.889	
Training_1														0.896
Training_2														0.952
Training_3														0.921

Outer loadings of model 2 (New product advantage as dependent variable)

	Advantage	Bulk	CFTeam	Colocation	Goal	ICT	Informal	Inno	Lead	PriceKnow	ProdKnow	Reward	Rotation	Training
Advantage_1	0.951													
Advantage_2	0.954													
Advantage_3	0.973													
Bulk_1		0.956												
Bulk_2		0.947												
Bulk_3		0.962												
CFTeam_1			0.951											
CFTeam_2			0.965											
CFTeam_3			0.904											
CFTeam_4			0.942											
Colocation_1				0.747										
Colocation_2				0.949										
Colocation_3				0.980										
Goal_1					0.957									
Goal_2					0.947									
Goal_3					0.947									
Goal_4					0.902									
ICT_1						0.969								
ICT_2						0.963								
ICT_3						0.975								
Informal_1							0.899							
Informal_2							0.869							

Outer loadings of model 2 (New product advantage as dependent variable)

	Advantage	Bulk	CFTeam	Colocation	Goal	ICT	Informal	Inno	Lead	PriceKnow	ProdKnow	Reward	Rotation	Training
Informal_3							0.883							
Informal_4							0.877							
Inno_1								0.964						
Inno_2								0.952						
Inno_3								0.969						
Lead_1									0.942					
Lead_2									0.918					
Lead_3									0.946					
Price_Know_1										0.932				
Price_Know_2										0.943				
Price_Know_3										0.969				
Prod_Know_1											0.962			
Prod_Know_2											0.962			
Prod_Know_3											0.983			
Reward_1												0.988		
Reward_2												0.944		
Reward_3												0.941		
Rotation_1													0.810	
Rotation_2													0.949	
Rotation_3													0.924	
Training_1														0.879
Training_2														0.935
Training_3														0.948

Outer loadings of model 3 (New product success as dependent variable)

	Bulk	CFTeam	Colocation	Goal	ICT	Informal	Inno	Lead	PriceKnow	ProdKnow	Reward	Rotation	Success	Training
Bulk_1	0.960													
Bulk_2	0.941													
Bulk_3	0.966													
CFTeam_1		0.941												
CFTeam_2		0.956												
CFTeam_3		0.914												
CFTeam_4		0.945												
Colocation_1			0.824											
Colocation_2			0.911											
Colocation_3			0.958											
Goal_1				0.955										
Goal_2				0.947										
Goal_3				0.952										
Goal_4				0.900										
ICT_1					0.966									
ICT_2					0.965									
ICT_3					0.975									
Informal_1						0.904								
Informal_2						0.887								
Informal_3						0.817								
Informal_4						0.929								
Inno_1							0.966							
Inno_2							0.949							
Inno_3							0.968							

Outer loadings of model 3 (New product success as dependent variable)

	Bulk	CFTeam	Colocation	Goal	ICT	Informal	Inno	Lead	PriceKnow	ProdKnow	Reward	Rotation	Success	Training
Lead_1								0.933						
Lead_2								0.927						
Lead_3								0.946						
Price_Know_1									0.915					
Price_Know_2									0.956					
Price_Know_3									0.970					
Prod_Know_1										0.967				
Prod_Know_2										0.955				
Prod_Know_3										0.983				
Reward_1											0.972			
Reward_2											0.967			
Reward_3											0.958			
Rotation_1												0.893		
Rotation_2												0.935		
Rotation_3												0.963		
Success_1													0.892	
Success_2													0.956	
Success_3													0.868	
Success_4													0.955	
Training_1														0.893
Training_2														0.946
Training_3														0.930

Appendix 9. Cross loadings

	Advantage	Bulk	CFTeam	Colocation	Goal	ICT	Informal	Inno	Lead	PriceKnow	ProdKnow	Reward	Rotation	Speed	Success	Training
Advantage_1	**0.951**	0.297	0.471	0.100	0.566	0.384	0.239	0.300	0.507	0.399	0.564	0.023	-0.051	0.389	0.634	0.226
Advantage_2	**0.953**	0.304	0.406	0.211	0.553	0.332	0.285	0.331	0.522	0.340	0.553	0.061	0.012	0.495	0.585	0.214
Advantage_3	**0.973**	0.232	0.396	0.166	0.558	0.366	0.218	0.354	0.495	0.321	0.528	0.026	0.028	0.460	0.672	0.275
Bulk_1	0.242	**0.957**	0.262	-0.056	0.075	0.202	0.208	0.166	0.247	0.256	0.264	0.167	-0.011	0.062	0.200	-0.093
Bulk_2	0.329	**0.945**	0.309	-0.054	0.215	0.190	0.193	0.111	0.286	0.290	0.369	0.094	-0.061	0.126	0.238	-0.087
Bulk_3	0.247	**0.964**	0.207	-0.029	0.086	0.244	0.161	0.150	0.249	0.249	0.255	0.222	-0.010	0.132	0.214	-0.032
CFTeam_1	0.380	0.261	**0.949**	-0.051	0.552	0.467	0.366	0.158	0.180	0.540	0.503	-0.208	-0.257	0.143	0.179	0.082
CFTeam_2	0.403	0.231	**0.963**	-0.042	0.574	0.489	0.336	0.154	0.193	0.562	0.481	-0.249	-0.250	0.142	0.177	0.111
CFTeam_3	0.436	0.274	**0.904**	0.041	0.592	0.317	0.431	0.252	0.256	0.536	0.525	-0.178	-0.255	0.119	0.270	0.157
CFTeam_4	0.436	0.265	**0.944**	-0.016	0.480	0.449	0.362	0.216	0.305	0.583	0.505	-0.140	-0.170	0.207	0.264	0.138
Colocation_1	0.092	-0.151	-0.100	**0.792**	0.028	-0.112	0.005	0.144	0.087	0.010	-0.022	0.171	0.382	0.138	0.207	0.129
Colocation_2	0.161	-0.005	0.012	**0.930**	0.040	-0.207	0.147	0.042	0.034	-0.021	0.034	0.095	0.115	0.189	0.186	-0.064
Colocation_3	0.185	0.003	0.029	**0.968**	0.053	-0.155	0.167	0.072	0.006	-0.021	0.032	0.117	0.154	0.185	0.213	-0.062
Goal_1	0.549	0.126	0.530	-0.004	**0.955**	0.437	0.263	0.330	0.312	0.424	0.494	-0.173	-0.174	0.129	0.374	0.131
Goal_2	0.486	0.137	0.581	-0.009	**0.947**	0.484	0.338	0.249	0.238	0.447	0.503	-0.182	-0.260	0.147	0.358	0.059
Goal_3	0.525	0.156	0.547	0.077	**0.949**	0.417	0.235	0.301	0.273	0.426	0.510	-0.173	-0.124	0.186	0.439	0.106
Goal_4	0.611	0.108	0.533	0.095	**0.902**	0.302	0.183	0.334	0.330	0.380	0.545	-0.121	-0.147	0.216	0.433	0.141
ICT_1	0.356	0.233	0.471	-0.148	0.438	**0.967**	0.171	0.065	0.101	0.222	0.225	-0.057	-0.157	0.244	0.186	0.171
ICT_2	0.356	0.203	0.421	-0.225	0.406	**0.964**	0.178	0.082	0.102	0.186	0.193	-0.034	-0.171	0.285	0.213	0.194
ICT_3	0.379	0.207	0.434	-0.143	0.412	**0.975**	0.166	0.116	0.155	0.224	0.232	-0.034	-0.098	0.294	0.217	0.227
Informal_1	0.277	0.184	0.332	0.099	0.251	0.240	**0.902**	0.059	0.132	0.331	0.468	0.241	0.053	0.066	0.137	0.151
Informal_2	0.162	0.139	0.307	0.098	0.171	0.097	**0.880**	-0.067	0.161	0.254	0.321	0.185	0.033	0.110	0.109	0.068

	Advantage	Bulk	CFTeam	Colocation	Goal	ICT	Informal	Inno	Lead	PriceKnow	ProdKnow	Reward	Rotation	Speed	Success	Training
Informal_3	0.300	0.220	0.474	0.118	0.375	0.186	**0.861**	0.012	0.155	0.394	0.453	0.051	-0.115	0.024	0.086	-0.015
Informal_4	0.127	0.129	0.266	0.133	0.090	0.054	**0.897**	0.048	0.219	0.334	0.397	0.266	0.073	0.138	0.157	0.120
Inno_1	0.340	0.151	0.207	0.076	0.337	0.104	-0.012	**0.964**	0.397	0.195	0.384	0.139	0.156	0.234	0.354	0.322
Inno_2	0.291	0.141	0.224	0.078	0.316	0.053	0.040	**0.952**	0.483	0.241	0.356	0.201	0.150	0.233	0.261	0.281
Inno_3	0.351	0.129	0.181	0.106	0.288	0.101	0.030	**0.968**	0.499	0.176	0.318	0.167	0.168	0.250	0.339	0.279
Lead_1	0.543	0.339	0.276	0.078	0.259	0.121	0.221	0.482	**0.941**	0.398	0.529	0.242	0.128	0.344	0.399	0.371
Lead_2	0.472	0.184	0.231	0.033	0.381	0.116	0.182	0.426	**0.919**	0.359	0.373	0.135	0.139	0.221	0.433	0.345
Lead_3	0.467	0.241	0.199	0.004	0.235	0.111	0.107	0.426	**0.947**	0.310	0.358	0.144	0.162	0.269	0.397	0.349
Price_Know_1	0.371	0.281	0.583	-0.019	0.449	0.217	0.364	0.207	0.268	**0.926**	0.591	-0.137	-0.176	0.088	0.231	0.091
Price_Know_2	0.349	0.248	0.537	0.010	0.393	0.185	0.369	0.213	0.452	**0.948**	0.588	-0.025	-0.064	0.113	0.321	0.108
Price_Know_3	0.326	0.267	0.565	-0.033	0.427	0.218	0.335	0.174	0.357	**0.969**	0.543	-0.123	-0.118	0.051	0.247	0.066
Prod_Know_1	0.562	0.253	0.522	0.026	0.567	0.190	0.434	0.353	0.396	0.570	**0.964**	0.016	-0.022	0.277	0.482	0.269
Prod_Know_2	0.546	0.356	0.535	0.004	0.492	0.249	0.508	0.327	0.464	0.593	**0.959**	0.034	-0.069	0.250	0.359	0.207
Prod_Know_3	0.554	0.317	0.505	0.023	0.533	0.215	0.438	0.382	0.461	0.603	**0.983**	0.061	-0.040	0.271	0.446	0.223
Reward_1	0.074	0.195	-0.189	0.147	-0.176	-0.080	0.174	0.198	0.215	-0.072	0.091	**0.968**	0.435	0.256	0.184	0.333
Reward_2	0.002	0.134	-0.211	0.103	-0.219	-0.055	0.198	0.143	0.160	-0.149	-0.014	**0.972**	0.441	0.276	0.117	0.335
Reward_3	0.033	0.142	-0.190	0.147	-0.105	0.012	0.219	0.161	0.169	-0.066	0.029	**0.958**	0.401	0.269	0.165	0.352
Rotation_1	0.007	-0.129	-0.215	0.153	-0.150	-0.135	0.002	0.122	0.148	-0.135	-0.023	0.327	**0.881**	0.086	0.140	0.344
Rotation_2	0.020	0.020	-0.207	0.226	-0.127	-0.102	0.040	0.183	0.133	-0.104	-0.014	0.465	**0.943**	0.176	0.171	0.353
Rotation_3	-0.038	-0.011	-0.264	0.242	-0.239	-0.173	-0.031	0.145	0.148	-0.116	-0.085	0.414	**0.963**	0.142	0.169	0.335
Speed_1	0.505	0.210	0.174	0.122	0.184	0.340	0.002	0.199	0.257	0.091	0.260	0.211	0.064	**0.904**	0.569	0.341
Speed_2	0.361	0.040	0.093	0.282	0.096	0.194	0.072	0.225	0.187	0.032	0.196	0.313	0.164	**0.920**	0.551	0.315
Speed_3	0.390	0.045	0.175	0.119	0.217	0.226	0.178	0.256	0.373	0.122	0.289	0.230	0.193	**0.888**	0.569	0.315
Success_1	0.537	0.238	0.176	0.157	0.320	0.273	0.119	0.195	0.335	0.176	0.335	0.181	0.160	0.593	**0.891**	0.324
Success_2	0.672	0.242	0.272	0.231	0.477	0.175	0.110	0.364	0.438	0.320	0.476	0.121	0.152	0.549	**0.956**	0.308

	Advantage	Bulk	CFTeam	Colocation	Goal	ICT	Informal	Inno	Lead	PriceKnow	ProdKnow	Reward	Rotation	Speed	Success	Training
Success_3	0.571	0.134	0.189	0.227	0.338	0.147	0.185	0.324	0.440	0.277	0.429	0.181	0.238	0.533	**0.868**	0.374
Success_4	0.622	0.227	0.238	0.201	0.433	0.193	0.089	0.331	0.386	0.255	0.384	0.118	0.091	0.618	**0.956**	0.281
Training_1	0.149	-0.048	0.106	-0.026	0.156	0.153	0.069	0.272	0.342	0.060	0.219	0.351	0.363	0.260	0.248	**0.892**
Training_2	0.222	-0.082	0.103	-0.037	0.055	0.213	0.088	0.313	0.374	0.034	0.200	0.404	0.360	0.400	0.357	**0.947**
Training_3	0.296	-0.069	0.154	0.035	0.136	0.192	0.090	0.261	0.336	0.163	0.253	0.227	0.307	0.313	0.341	**0.930**

Appendix 10. Common method bias analysis for model 1

Construct	Indicator	Substantive Factor Loading (R1)	$R1^2$	Method Factor Loading (R2)	$R2^2$
Bulk	Bulk1	0.974**	0.949	-0.034	0.001
	Bulk2	0.915**	0.837	0.063	0.004
	Bulk3	0.982**	0.964	-0.038	0.001
CFTeam	CFTe1	0.998**	0.995	-0.063	0.004
	CFTe2	1.014**	1.028	-0.067	0.004
	CFTe3	0.832**	0.692	0.094	0.009
	CFTe4	0.926**	0.857	0.024	0.001
Colocation	Colo1	0.781**	0.610	-0.022	0.000
	Colo2	0.937**	0.879	0.000	0.000
	Colo3	0.969**	0.939	0.017	0.000
Goal	Goal1	0.956**	0.914	-0.013	0.000
	Goal2	0.943**	0.890	-0.005	0.000
	Goal3	0.962**	0.926	-0.016	0.000
	Goal4	0.895**	0.800	0.025	0.001
ICT	ICT1	0.966**	0.932	0.004	0.000
	ICT2	0.973**	0.947	-0.019	0.000
	ICT3	0.968**	0.937	0.014	0.000
Informal	Info1	0.888**	0.789	0.023	0.001
	Info2	0.926**	0.857	-0.098	0.010
	Info3	0.831**	0.690	0.084	0.007
	Info4	0.926**	0.857	-0.078	0.006
Inno	Inno1	0.961**	0.923	0.009	0.000
	Inno2	0.948**	0.899	0.005	0.000
	Inno3	0.975**	0.950	-0.013	0.000
Lead	Lead1	0.893**	0.798	0.078	0.006
	Lead2	0.915**	0.838	0.006	0.000
	Lead3	1.004**	1.009	-0.095**	0.009
PriceKnow	Price1	0.885**	0.784	0.044	0.002
	Price2	0.950**	0.902	0.010	0.000
	Price3	1.006**	1.013	-0.054	0.003
ProdKnow	Prod1	0.954**	0.910	0.010	0.000
	Prod2	0.959**	0.920	0.003	0.000
	Prod3	0.993**	0.987	-0.014	0.000
Reward	Rewa1	0.967**	0.935	0.021	0.000
	Rewa2	0.976**	0.952	-0.046*	0.002
	Rewa3	0.956**	0.914	0.023	0.001
Rotation	Rota1	0.864**	0.746	-0.015	0.000
	Rota2	0.955**	0.912	0.039	0.002
	Rota3	0.961**	0.924	-0.038	0.001

Construct	Indicator	Substantive Factor Loading (R1)	$R1^2$	Method Factor Loading (R2)	$R2^2$
Speed	Speed1	0.886**	0.786	0.035	0.001
	Speed2	0.964**	0.929	-0.096*	0.009
	Speed3	0.864**	0.747	0.057	0.003
Training	Train1	0.898**	0.807	-0.021	0.000
	Train2	0.954**	0.910	-0.019	0.000
	Train3	0.917**	0.842	0.035	0.001
Average		**0.937**	**0.881**	**-0.003**	**0.002**

* $p < .05$; ** $p < .01$ (2-tailed tests)

Appendix 11. Common method bias analysis for model 2

Construct	Indicator	Substantive Factor Loading (R1)	$R1^2$	Method Factor Loading (R2)	$R2^2$
Advantage	Adva1	0.912**	0.832	0.051	0.003
	Adva2	0.953**	0.908	-0.001	0.000
	Adva3	1.015**	1.030	-0.053	0.003
Bulk	Bulk1	0.974**	0.949	-0.035	0.001
	Bulk2	0.914**	0.836	0.065	0.004
	Bulk3	0.982**	0.965	-0.040	0.002
CFTeam	CFTe1	0.998**	0.996	-0.063	0.004
	CFTe2	1.013**	1.027	-0.066	0.004
	CFTe3	0.830**	0.689	0.096	0.009
	CFTe4	0.927**	0.860	0.022	0.000
Colocation	Colo1	0.781**	0.611	-0.023	0.001
	Colo2	0.937**	0.879	0.000	0.000
	Colo3	0.969**	0.939	0.017	0.000
Goal	Goal1	0.956**	0.914	-0.013	0.000
	Goal2	0.945**	0.893	-0.007	0.000
	Goal3	0.963**	0.928	-0.018	0.000
	Goal4	0.893**	0.797	0.027	0.001
ICT	ICT1	0.965**	0.932	0.005	0.000
	ICT2	0.973**	0.947	-0.019	0.000
	ICT3	0.968**	0.937	0.014	0.000
Informal	Info1	0.889**	0.790	0.023	0.001
	Info2	0.926**	0.857	-0.099	0.010
	Info3	0.829**	0.688	0.088	0.008
	Info4	0.927**	0.860	-0.082	0.007
Inno	Inno1	0.961**	0.923	0.009	0.000
	Inno2	0.949**	0.900	0.003	0.000
	Inno3	0.974**	0.949	-0.012	0.000
Lead	Lead1	0.894**	0.800	0.077	0.006
	Lead2	0.915**	0.836	0.008	0.000
	Lead3	1.004**	1.008	-0.094**	0.009
PriceKnow	Price1	0.885**	0.782	0.045	0.002
	Price2	0.951**	0.904	0.008	0.000
	Price3	1.006**	1.011	-0.053*	0.003
ProdKnow	Prod1	0.953**	0.909	0.011	0.000
	Prod2	0.960**	0.921	0.002	0.000
	Prod3	0.994**	0.987	-0.014	0.000
Reward	Rewa1	0.967**	0.935	0.022	0.000
	Rewa2	0.975**	0.951	-0.047*	0.002
	Rewa3	0.956**	0.915	0.023	0.001

Construct	Indicator	Substantive Factor Loading (R1)	$R1^2$	Method Factor Loading (R2)	$R2^2$
Rotation	Rota1	0.864**	0.746	-0.015	0.000
	Rota2	0.955**	0.912	0.039	0.001
	Rota3	0.961**	0.923	-0.038	0.001
Training	Train1	0.898**	0.807	-0.022	0.000
	Train2	0.954**	0.911	-0.020	0.000
	Train3	0.917**	0.841	0.037	0.001
Average		**0.941**	**0.887**	**-0.003**	**0.002**

* $p < .05$; ** $p < .01$ (2-tailed tests)

Appendix 12. Common method bias analysis for model 3

Construct	Indicator	Substantive Factor Loading (R1)	$R1^2$	Method Factor Loading (R2)	$R2^2$
Bulk	Bulk1	0.974**	0.949	-0.034	0.001
	Bulk2	0.915**	0.838	0.062	0.004
	Bulk3	0.981**	0.963	-0.037	0.001
CFTeam	CFTe1	0.998**	0.995	-0.064	0.004
	CFTe2	1.013**	1.027	-0.067	0.004
	CFTe3	0.833**	0.695	0.094	0.009
	CFTe4	0.925**	0.855	0.026	0.001
Colocation	Colo1	0.781**	0.610	-0.018	0.000
	Colo2	0.938**	0.879	-0.002	0.000
	Colo3	0.969**	0.939	0.016	0.000
Goal	Goal1	0.958**	0.917	-0.015	0.000
	Goal2	0.950**	0.902	-0.013	0.000
	Goal3	0.961**	0.923	-0.014	0.000
	Goal4	0.891**	0.793	0.031	0.001
ICT	ICT1	0.966**	0.934	0.003	0.000
	ICT2	0.973**	0.946	-0.019	0.000
	ICT3	0.967**	0.936	0.015	0.000
Informal	Info1	0.888**	0.789	0.024	0.001
	Info2	0.924**	0.853	-0.096	0.009
	Info3	0.834**	0.695	0.080	0.006
	Info4	0.923**	0.852	-0.074	0.005
Inno	Inno1	0.960**	0.922	0.009	0.000
	Inno2	0.949**	0.901	0.002	0.000
	Inno3	0.974**	0.949	-0.012	0.000
Lead	Lead1	0.893**	0.798	0.077	0.006
	Lead2	0.914**	0.836	0.008	0.000
	Lead3	1.005**	1.011	-0.095**	0.009
PriceKnow	Price1	0.889**	0.790	0.039	0.002
	Price2	0.947**	0.898	0.013	0.000
	Price3	1.006**	1.012	-0.054*	0.003
ProdKnow	Prod1	0.950**	0.903	0.015	0.000
	Prod2	0.965**	0.931	-0.004	0.000
	Prod3	0.992**	0.984	-0.011	0.000
Reward	Rewa1	0.967**	0.934	0.022	0.000
	Rewa2	0.976**	0.953	-0.047*	0.002
	Rewa3	0.956**	0.914	0.022	0.001
Rotation	Rota1	0.864**	0.747	-0.015	0.000
	Rota2	0.954**	0.911	0.038	0.001
	Rota3	0.962**	0.925	-0.038	0.001

Construct	Indicator	Substantive Factor Loading (R1)	$R1^2$	Method Factor Loading (R2)	$R2^2$
Success	Succ1	0.948**	0.899	-0.086	0.007
	Succ2	0.909**	0.826	0.070*	0.005
	Succ3	0.852**	0.727	0.024	0.001
	Succ4	0.972**	0.944	-0.024	0.001
Training	Train1	0.899**	0.808	-0.023	0.001
	Train2	0.954**	0.910	-0.018	0.000
	Train3	0.917**	0.841	0.035	0.001
Average		**0.938**	**0.882**	**-0.003**	**0.002**

* $p < .05$; ** $p < .01$ (2-tailed tests)

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