

# Governance choices for external sourcing in innovation

Towards a portfolio of strategic alliances and mergers & acquisitions



Anna Sabidussi

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This research was conducted under the auspices of  
the Mansholt Graduate School of Social Sciences

# **Governance choices for external sourcing in innovation**

## **Towards a portfolio of strategic alliances and mergers & acquisitions**

**Anna Sabidussi**

Thesis

Submitted in partial fulfilment of the requirements for the degree of doctor  
at Wageningen University

by the authority of the Rector Magnificus

Prof. dr. M.J. Kropff,

in the presence of the

Thesis Committee appointed by the Doctorate Board

to be defended in public

on Tuesday 8 December 2009

at 4 PM in the Aula

Governance choices for external sourcing in innovation  
Towards a portfolio of strategic alliances and mergers & acquisitions

A. Sabidussi

Thesis, Wageningen University, Wageningen, the Netherlands (2009)  
With summaries in Dutch and English

ISBN 978-90-8585-532-3





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## Acknowledgments

The pleasure of the PhD is not only in the personal and intellectual challenge that it offers but also in the opportunity to share the journey. I hereby would like to thank all who have supported the achievement of this PhD thesis and contributed to my professional development.

I would like to thank the thesis supervisors: Onno Omta, for the space to perform this research and his experienced business perspective; Hans Schenk, for stimulating the discussion about the economic significance of the research results; Harry Bremmers, for constantly offering his help in any phase of the PhD process.

I am grateful to Geert Duysters: all the inspiring discussions and continuous encouragement have been of great support for progressing in this research.

I am indebted to Elena Cefis: I have appreciated the opportunity of cooperating in the NWO project and her rigorous methodology in scientific research.

I thank Victor Gilsing for his thoughtful and constructive comments on the draft that constitutes the material for Chapter 4 of the present thesis. I also thank Alison Burrell for the instructive and pleasant discussions about econometrics and music.

I have benefited from the comments and observations from participants and instructors of the summer school of advanced econometrics and in particular from William Greene. I am grateful to scholars who offered their advice and criticism during the conferences I had the opportunity to participate. I have appreciated the challenging discussions with Dovev Lavie that still presents an encouragement to improve.

I thank Michaela Ghita: I have enjoyed not only working together, but as well all the little moments, conversations shared around the coffee mug. I am grateful for the support offered in many different ways by Paul Arts, Miranda Meuwissen, Rannia Nijhoff, Anjo Steen and Victor Lascano.

My deep gratitude goes to the companies that accepted to participate to the interviews: their willingness to share their experience and strategic reflections has been essential for completing this thesis. The quantitative part of the empirical research has been performed at the CBS: I thank all the personnel for the assistance provided during the working sessions.

I am grateful to the members of the commission for evaluating this thesis and offering their comments for improvement.

The research described in this thesis was partially supported by the Netherlands Organization of Scientific Research (NWO, program 472-04-008). The NWO financial support is gratefully acknowledged.

I also would like to thank all the members of the Management Studies Group for the enjoyable moments we shared in the last four years.

Thanks to Jean-Pierre, Joanna, for being so close even if so far away. Maaïke and Johan, thanks for always caring so much. I express gratitude also to Stellario Barbera for permitting the use of the picture serving for the cover of this thesis.

Finally, without my family this PhD could have not been achieved. For their continuous confidence in me and encouragement I would like to thank my family in Venezuela and in Italy. I own all my gratitude to my parents for their endless support to my personal development and growth; to Isabel, my sunshine, for shedding light on my way; to Alex, for sharing every single step of the journey and for the strength and joy that being together gives me.

# I. Introduction

Innovation is one of the most studied fields in economic and management literature, due to its relevance for the success of companies as well as for national economies. Innovation essentially refers to ‘*change*’ with different degrees of novelty, from incremental to radical (Tidd *et al.*, 2005: 10). The change can be in the products/services the company offers, in the context in which those products/services are introduced, in the process with which they are generated or in the models driving organisations’ actions (Tidd *et al.*, 2005). For nations, innovation is the driver of economic progress that provides job opportunities and better wages for employees, high-quality products for consumers, higher standards of living, greater prosperity and societal well-being (DTI Innovation Report, 2003). For companies, innovation is regarded as playing a vital role in their growth, competitive success and long-term survival (Miller and Morris, 1999; Cefis and Marsili, 2006; Roberts, 1999). Innovation indeed is one of the key parameters discriminating between higher and lower market performers (Andrew *et al.*, 2007).

By evolving at a continuously higher rate and speed, technological progress challenges companies to innovate in increasingly complex contexts (Bettis and Hitt, 1995). To face this challenge, firms have complemented their internal R&D efforts with technological knowledge acquisition from external sources (Tsai and Wang, 2007). In a progressively complicated world, companies are not able to develop all the necessary technologies in-house, and the R&D activities alone are no longer sufficient to generate innovation. Firms are limited in the number of technologies they can pursue (Ahuja, 2000) and new technological knowledge often lies outside their traditional areas of expertise (Gay and Dousset, 2005). Moreover, the dispersal of knowledge among companies of different sizes and in different geographical locations makes it difficult to ensure that the firm has all the skilled employees it needs. In the words of Chesbrough (2003), ‘*not all the smart people work for you*’.

One of the consequences of the above is the diffusion of an approach defined as ‘*open innovation*’ by Chesbrough (2003). The ‘*open innovation*’ model is opposed to a ‘*closed innovation*’ model where research projects are generated exclusively by the firm’s science base, and evolve and end in the market in the form of new products or services (Chesbrough, 2003; Chesbrough *et al.*, 2006). In an ‘*open innovation*’ framework, internal and external sources of technology can coexist and interact at any stage of the process (Chesbrough, 2003; Chesbrough *et al.*, 2006). Open innovation is intrinsically associated with the relationships into which a firm enters with other business entities (Chesbrough *et al.*, 2006). Therefore, external sourcing through inter-organisational relationships has become increasingly relevant for innovation success (Ritter and Gemunden, 2003). The ‘*various types of technology sourcing arrangements*’ in which the inter-firms relationships are organised are referred to as governance modes (Nicholls-Nixon, 1995: 12).

The choice of governance modes for sourcing technology externally is the focus of the present study. We first aim at fostering our understanding of the effects of different governance modes

on innovation. Next, we aim at supporting the process of choosing the governance mode. In the following sections, we define the context and the structure of our research. We first illustrate why external sourcing is relevant for innovation and the implications of the above for the governance decision. The governance modes that are available to decision-makers are introduced in Section 1.3. An overview of the theoretical perspective on the governance mode decision is presented in Section 1.4. Next, we illustrate how the study is organised by addressing the research questions on the consequences for innovation of choosing different governance modes (Section 1.5). To answer the above questions, we will use the Community Innovation Survey (CIS) that was collected in the Netherlands from 1994 until 2006 and that provides information about the innovative behaviour of companies. Finally, we will focus on the governance decision process as it occurs in management practice (Section 1.6) and we will use for the empirical analyses interviews with high-level decision-makers from six sectors of activity and two geographical areas (EU and USA).

### ***1.1 The relevance of external technology sourcing for innovation***

As Chesbrough (2003) points out, the ‘*closed innovation*’ paradigm is based on some implicit underlying considerations:

- Companies have to hire the most brilliant people so as to have at their disposal the highest possible level of competences.
- Internal development is a priority and R&D is a strategic tool.
- Doing R&D internally ensures having a competitive advantage by being first to the market.
- Investing heavily in in-house R&D will produce results, by transforming ideas into new products, and it will finally contribute to achieving market success.
- Complete control over the internally generated knowledge prevents competitors taking advantage of the company’s original ideas.

According to Chesbrough (2003: xxii), an ‘*open innovation*’ approach is based on a rationale that can be summarised by the following principles:

- The company may take advantage of working with brilliant people inside and outside the company.
- Internal efforts can be complemented by external R&D contribution.
- Not everything has to be originated internally to create value for the company.
- Being first to the market is not necessarily a guarantee of competitive advantage; the business model is more fundamental.
- The ideas may come from internal and external sources and the capacity to combine them is the key to corporate success.
- Using external knowledge contributes to the company’s corporate success.

The diffusion in managerial practice of ‘*open innovation*’ (Chesbrough, 2003) seems to be confirmed by the fact that fostering innovation is the reason given for an increasing number of relationships in the form of strategic alliances (SAs), mergers and acquisitions (M&As)

(Vasudevan *et al.*, 2001; Chaudhuri, 2004; De Man and Duysters, 2005). Based on Hagedoorn (1993), the rationale for using external relationships for innovation includes (a) stimulating basic and applied research (like knowledge development acquisition, cost saving, risk sharing and time-to-market shortening), or (b) easing the access to market and influencing the market structure. With respect to basic and applied research, companies benefit from generating or acquiring technological knowledge: the value which is expected from partnerships derives from this knowledge exchange (Canter and Meder, 2007). Depending on whether the companies aim at an expansion of existing knowledge or expansion of the use of the same knowledge for different applications, two broad technological scopes of inter-firm agreements can be identified, based on the dichotomy proposed by March (1991): *technology exploration* and *technology exploitation* (Granstrand *et al.*, 1992; Faems *et al.*, 2005; Koza and Lewin, 1998). Explorative partnering aims at '*discovering new opportunities*' while exploitative inter-firm relationships are focussed on maximising the benefits deriving from '*existing knowledge*' (Faems *et al.*, 2005). Using partnerships allows companies to share the costs of developing new technologies (Manders and Brenner, 1995; Sakakibara, 1997) or the uncertainty of the unknown technological evolution and markets conditions (Folta, 1998; Van de Vrande *et al.*, 2006). Compared to the results of exploration activities, the outcome of exploitation is less insecure, temporally more close to the actions taken and more influenced by the experiences gained by the company (March, 1991). The above considerations need, however, to be interpreted in a sector-specific context as exceptions may occur due to industry characteristics. For example, as highlighted by Omta and De Leeuw (1997), in the pharmaceutical sector explorative activities are comparatively low cost and relatively easy to reverse. Higher levels of uncertainty are associated with the high-cost development phase of new drugs when potential side effects are clinically tested. Companies use external partnerships to increase the speed with which innovations are developed (Hagedoorn, 1993) as delays can have costly consequences (Hendricks and Singhal, 1997). In technologically intensive sectors, an increasingly relevant form of competition is based on shortening the time-to-market (Cohen *et al.*, 1996; Kessler and Chakrabarti, 1996). Companies that have poor expertise in a technology that is expected to have a high competitive impact in the future may need to use external relationships to catch up (Fortuin, 2006). With respect to the market, Hynes and Mollenkopf (2008) have pointed out that the partnerships can be used for '*managing the industry structure*'. Not only M&As, by increasing industry concentration, affect the competitive landscape. The competitive terrain is also shaped by the '*inter-firm clusters*' or networks of cooperation in which companies are involved (Gugler, 1992).

From the above discussion, it emerges that the first fundamental strategic decision in managerial practice refers to the choice between internal development and external sourcing (Jones *et al.*, 2001). Understanding what drives companies to source externally is a topic still not completely addressed by the literature (Veugelers and Cassiman, 1999). Once a company has recognised the opportunity of external sourcing and even identified a suitable partner, the governance mode, i.e. the way this inter-firm relationship is going to be organised, still has to be defined. Despite the managerial relevance of the governance choice decision, the criteria



by which different governance modes are chosen, is a topic not often addressed by academic research (Vanhaverbeke *et al.*, 2002).

This book aims at increasing the understanding of the impact of governance modes, like M&As and SAs, on innovation and to define, from the insights gained, a framework for the external sourcing and governance choice decision. In line with Huff and Reger (1987) and Khanna *et al.*, (2000), we consider that the findings on the effects of different governance modes can be beneficial for supporting the decision process. The reasoning is based on the consideration that fostering innovation performance through external relationships represents the final objective that the governance decision process serves. For decision-makers, the awareness of the key success factors that allow external relationships to enhance innovation performance can provide '*empirically validated guidelines*' (De Man and Duysters, 2005) for more effective choosing of different governance modes. If, for example, SAs, M&As (or both) do not contribute to corporate innovation then the decision-makers should take this element into consideration when choosing a particular governance mode. In particular, if the above occurs for specific categories of companies (e.g. small firms or large firms) then the decision process will have to be adjusted accordingly, depending on the size of the firm among other things.

The rationale that we follow is in line with decision analysis. Decision analysis is based on formalising in an ordered sequence the considerations that should be accounted for when addressing a decision problem '*to help decision makers to take better decisions*' (Keeney, 1982: 821). The process starts with understanding the '*consequences of the alternatives*' (Keeney, 1982). In the context of our research, decision-makers should therefore be aware, first and foremost, of the effects on innovation of choosing governance modes like M&As and SAs.

In focussing our attention on the implications for the organisational governance decision process of the external governance mode, we achieve the objective of this book which is *to define a decision framework for the governance decision process*.

### **1.2 The continuum of governance choices on external technology sourcing**

Although external technology sourcing modes can come in a variety of forms, the literature has focused mainly on two broad categories of governance modes that can be chosen by companies: SAs and M&As (Garette and Dussage, 2000; Vanhaverbeke *et al.*, 2002; Roberts and Liu, 2003; Wang and Zajac, 2007). SAs refer to '*cooperative efforts in which two or more separate organizations, while maintaining their own corporate identities, join forces to share reciprocal inputs*' (Vanhaverbeke *et al.*, 2002). According to Dussage and Garette (1999), an alliance can be qualified as strategic '*when it contributes significantly to the strategies pursued by the partner companies*'. The term '*strategic alliance*' indicates many different partnering modalities, including equity as well as non-equity linkages (Osborn and Hagedoorn, 1997). M&As

denote a situation in which one company acquires the control over another corporate entity. An acquisition indicates the purchase of target company resources while merger indicates the acquisition of the whole target (Smart *et al.*, 2007). Depending on the integration modalities, several merger forms are possible. In a statutory merger, the target company ceases to exist. In a consolidation both companies involved in the transaction disappear and a new entity is generated, while in a subsidiary merger the acquired company continues to exist (Smart *et al.*, 2007). Mergers are relatively rare and many transactions called mergers are in fact acquisitions (Van de Vrande, 2006). SAs and M&As can be conceived as organisational alternatives resting on a continuum, depicting various degrees of organisational integration (Chiesa and Manzini, 1998). If we approximate the level of integration by the degree of equity participation, the spectrum ranges from relatively simple contractual transactions to full equity integration in the form of M&As. The characteristics of SAs and M&As vary along the continuum, as does their contribution to innovation (Figure 1.1).

Governance modes on the left hand side of the above scale, like SAs, present the characteristic to be flexible (Chan *et al.*, 1997; Chiesa and Manzini, 1998) (see Figure 1.1). Due to their flexibility in changing conditions, SAs seem to favour the achievement of technological exploration (Dittrich and Duysters, 2007), whereas exploitation is favoured by M&As (Puranam and Srikanth, 2007). The downside of this flexibility is that especially when the scope of the alliance is broad, the possibility to control the partners is limited and the risk of opportunistic behaviour is relatively high (Gulati and Singh, 1998). The above implies that costs need to be sustained to control the opportunistic behaviour of partners or to measure

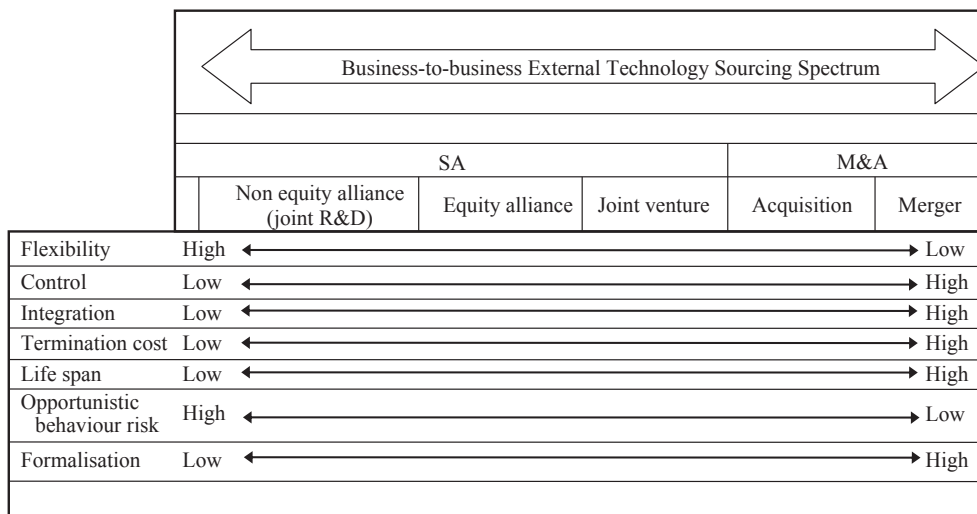


Figure 1.1. Spectrum of technology sourcing choices and associated characteristics. Adapted from Cools and Roos (2005) and Chiesa and Manzini (1998).

whether the goals of the relationship are met (Calantone and Stanko, 2007) (see Figure 1.1). Hierarchical and formal forms of governance, like M&As, provide high levels of control and present reduced levels of opportunism threat (Oxley, 1997). Increasing the degree of integration, however, may also increase the termination costs of the partnership (Fontenot and Wilson, 1997). Moving along the continuum, higher forms of integration are associated with a longer life span – M&As may even have an indefinite life (Chan *et al.*, 1997) (see Figure 1.1). In M&As, the acquirer obtains immediate access and control over the required resources (Chiesa and Manzini, 1998) while, for example, in SAs, partners are committed to develop new technological knowledge through joint activities (Chan *et al.*, 1997). Highly integrated forms, like M&As, however, typically need a longer time span to affect innovation (around five years) while lower degrees of integration like alliances display their effects sooner (around three years or less) (De Man and Duysters, 2005).

### **1.3 Theoretical perspectives on the governance choice**

Governance decisions have been discussed principally within the conceptual frameworks of the Resource Based View (RBV), Transaction Costs Economics (TCE), Network Theory (NT) and Real Option Reasoning (ROR). The RBV states that the internal specific capacities of a firm (core competencies) constitute the fundamental factors that define the competitive advantage (Prahalad and Hamel, 1990). Knowledge is one of the most important resources that companies constantly try to develop (Conner and Prahalad, 1996). Technological capabilities are the constituents of core competencies and two types of activities generate them: internal R&D and technology external linkages (Coombs, 1996). From a RBV perspective, the type and nature of the resources combinations involved in the relationship provide the criteria to identify the most suitable form of governance. RBV is linked to Transaction Cost Economics (TCE) because '*combination of resources is influenced by transaction cost economizing*' (Mahoney and Pandian, 1992). TCE (mainly framed by Coase, 1937; Williamson, 1975, 1985) predicts that managers should prefer the governance mode that carries the lowest costs for coordination and control. TCE is more likely to determine the governance mode once uncertainty is low, large investments are undertaken and the need for control emerges. When uncertainty is high, flexible governance modes are preferred and a Real Option Reasoning is predominant (Garette and Dussauge, 2000; Hoffman and Schaper-Rinkel, 2001; Van de Vrande *et al.*, 2006). In Real Options Reasoning, the main criterion for the governance choice is the level of uncertainty. Uncertainty can be exogenous (related to the phase of the technological development) or endogenous (related to the reliability of the partner in the relationship) (Folta, 1998). Both have an impact on the governance mode choice. A more recent body of literature has adopted the Network Theory approach (Granovetter, 1985; Burt, 1992; Coleman, 1988). Two qualifications of networks have been addressed by the literature (Scholten, 2006; Granovetter, 1985): structural and relational. Relational aspects refer to the nature of the ties in the relationship. Companies can be linked by direct ties when they interact directly or by indirect ties when there is no direct contact and the relationship exists only through a third entity (Ahuja, 2000). Structural aspects refer to the redundancy in the network. Networks

can be closed or dense if all the individual firms are interconnected with each other (Coleman, 1988) or with structural holes or empty spaces if there are no full interconnections among the network members (Burt, 1992). In an NT approach, the governance choice is influenced by the position of the company in its web (network) of relationships and by the nature of these links. Table 1.1 provides a summary of the main criteria for the governance choice from the above theories. Their application poses a number of challenges that we will address in Section 1.6 and that will motivate the adoption of Portfolio Theory as conceptual framework.

#### ***1.4 The impact of governance choices on innovation: towards a portfolio approach***

In the next sections we will present the research questions that drive the empirical part of our study. For this part of the analysis, we have used the Community Innovation Survey (CIS). The CIS data are used to test whether external sources of technology, organised in M&As or SAs, contribute to innovation performance. The Community Innovation Survey (CIS) is a survey organised every four years by Eurostat and the European Commission in order to monitor the innovative activities in the member states. In the Netherlands, the survey has been carried out biannually. For the purposes of our analysis in the present book, we have focused on the first five CIS-waves that were performed between 1994 and 2004. In each wave, the survey collected information on around ten thousand companies. The questionnaire is based on guidelines which were proposed by the Oslo Manual (OECD, 1997). It is harmonised in order to allow the comparability of the innovative characteristics among different European companies. The presence of specific information on the innovative behaviour and on the external relationships of the firm makes the CIS database especially suitable for the scope of the present work. In particular, it is useful for analysing the impact of external sourcing of a single governance mode (either M&A or SA) on innovation and for the assessment of the joint effect on innovation of both M&As and SAs. CIS has been used mainly in Chapters 2 and 3 and 4. For the empirical analysis in all the above chapters, we rely on statistical significance as criteria for the hypotheses testing.

The book starts by investigating the effect of external sourcing on innovation. In framing the research questions, we distinguish the distinct governance modes available to the choice of companies: strategic alliances and mergers & acquisitions. First, we examine the consequences of individual governance modes independently of each other and under different conditions. The aim is to investigate whether SAs and M&As provide a positive contribution to innovation performance. If this is not the case, then their further inclusion as potential governance modes options has to be reconsidered.

The first research question (RQ) that this study aims to answer is therefore the following:

*RQ1: What is the effect on innovation of using SAs as the governance mode for external technology sourcing by SMEs and large firms?*

Table I.1. Summary of theoretical perspectives on governance choices.

	Resource based view	Transaction cost economics
<b>Basic context</b>	In an RBV perspective, the type and nature of the resources combinations involved in the relationship provide the criteria to identify the most suitable form of governance.	TCE predicts that managers should prefer the governance mode that carries the lowest costs for coordination and control.
<b>Criteria</b>	<p><b>Acquisitions</b></p> <p>If resources are core for the company. Synergies come from hard resources (like manufacturing plants).</p> <p>If high levels of integration are required among the partners' activities (i.e. in case reciprocal synergies are needed, when resources need to be generated by integrated activities of the two companies).</p> <p>If technologies are initial phases of the life cycle (fluid or transitional).</p> <p>If the content of the collaboration is very familiar to the company or if content of the collaboration can be clearly defined.</p> <p><b>Alliances</b></p> <p>If resources refer to mature technologies. Synergies come from soft resources (as human resources).</p> <p>If low level of integration in partners' activities is required (i.e. in the case of modular synergies where resources are independently managed and then combined).</p> <p>If content of the collaboration cannot be clearly defined or if the content of the collaboration is not familiar to the company.</p>	<p><b>Acquisitions</b></p> <p>If time pressure great.</p> <p>If low degree of cultural distance between partners.</p> <p>If high level of relative power/size of one partner over the other.</p> <p>If low appropriability regimes.</p> <p>If high levels of specificity of assets.</p> <p>In sectors with high need for control (low-tech).</p> <p><b>Alliances</b></p> <p>If time pressure not significant.</p> <p>If high degree of cultural distance between partners.</p> <p>If low level of relative power/size of one partner over the other.</p> <p>If high appropriability regimes.</p> <p>If low levels of specificity of assets.</p> <p>If high costs of integration with the target firm.</p> <p>In sectors with low need for control (high-tech).</p>
<b>Focus</b>	The company	The transaction

References used: Barney and Lee (1998); Chiesa and Manzini (1998); Dyer *et al.* (2004); Folta and Leiblein (1994); Garette and Dussage (2000); Hagedoorn and Duysters (2002); Hennard and Reddyn (1997);

**Real options approach**

In ROR, the main criterion for the governance choice is the level of uncertainty. High levels of uncertainty suggest the use of flexible governance modes.

**Acquisitions**

If low level of endogenous uncertainty.

If exogenous uncertainty is low/medium (mature technologies).

If learning about the value of the uncertain investment is endogenous (obtained within the governance).

**Alliances**

If high need for flexibility -If high level of endogenous uncertainty.

If high level of exogenous uncertainty (in the early phases of the technological development).

If learning about the value of the uncertain investment is exogenous (depend on factors external to the governance).

If longer project duration (higher uncertainty about the potential developments).

**Network approach**

In a NT approach, the governance choice is influenced by the position of the company in its web (network) of relationships and by the nature of these links.

**Acquisitions**

If prior direct ties exist.

If companies were previously positioned at the centre of a network.

If the relationship is intra-industry.

**Alliances**

If prior indirect ties exist -If relationship is inter-industry.

If networks are vertical (relationships with suppliers and/or customers).

The transaction

The network

Hoffman and Schaper-Rinkel (2001); Leiblein (2003); Roberts and Liu (2001, 2003); Vanhaverbeke *et al.* (2002); Van de Vrande *et al.* (2006); Vilallonga and McGahan (2005); Yoshikawa (2003).

Research question 1 will be answered in Chapter 2. When addressing the above questions, we focus in particular on situations that have been only partially explored by previous studies.

With respect to alliances, which will be addressed in Chapter 2, the literature has mainly paid attention to their effects in large firms, while it has been demonstrated by Standing *et al.*, (2008) that SAs constitute a decisive instrument to innovate especially for small and medium-sized enterprises (SMEs). SMEs, typically, face greater difficulties in innovation compared to large firms, due to less abundant resources (O'Regan *et al.*, 2006; Narula, 2004). Alliances, involving lower levels of resource commitment, are likely to be chosen as a governance modality. We conclude, therefore, that it is especially interesting to study SAs in the context of SMEs.

Next, we focus on the effect of M&As on innovation. As pointed out by Schenk (2006), there are only a few studies (e.g. Hitt *et al.*, 1991, 1996) that addressed the above topic. Their findings indicate a negative impact of M&As on innovation. M&As are complex and financially demanding transactions (Brealey *et al.*, 2006) that have the potential to alter the market structure by reducing the number of competitors (Brito and Catalao-Lopes, 2006). Innovating through M&As may, therefore, be especially critical for potentially dominant firms. The literature has not addressed the impact of M&As on innovation in the context of potentially dominant firms. The main reason for our choice is that EU legislation prohibits M&As if they are conducive to market dominance unless the transaction is beneficial for innovation (European Commission, 2004). Therefore, if M&As do not foster innovation, potentially dominant firms have to exclude M&As from the choice of governance mode in their decision process. We, therefore, formulate the following:

*RQ2: What is the effect on innovation of using M&As as the governance mode for external sourcing by potentially dominant firms?*

Research question 2 is answered in Chapter 3. Answering the first two research questions helps us to understand the effects of M&As and SAs on innovation under different conditions.

A step forward is necessary to gain a deeper understanding. After examining separately the effects of using SAs and M&As, the research proceeds by studying the effects of external governance modes on innovation from a comparative perspective. To be able to make a meaningful comparison, we need to investigate the effect of SAs and M&As in the same conditions. In particular, we focus on confronting strategies that rely on the use of only SAs or only M&As with strategies that combine SAs and M&As. This step is necessary in order to provide comprehensive guidelines to decision-makers. Although M&As and SAs can both have a positive effect on innovation, one form may be preferable as it provides greater benefits. Similarly, the maximum level of innovation could be achieved by exploiting M&As and SAs simultaneously. The arguments that support the above considerations are elaborated on below.



The previous empirical literature on the impact of M&As and SAs on innovation has only rarely adopted a comparative approach. This has three main consequences. First, overlooking the fact that companies rely on multiple governance modes for their external sourcing activities, leads to an incomplete explanation of the innovation performance (Van de Vrande, 2007). Second, the simultaneous presence of various relationships may have influenced the results that have been obtained by previous works on the impact of a single governance modality (Keil *et al.*, 2008). Finally, without comparing the effects of different governance modes on innovation, it is difficult to know if one is superior to the other (De Man and Duysters, 2005). The few studies (for example, Keil *et al.*, 2008; Rothaermel and Hess, 2007) that have followed a comparative perspective help shed new light on the relationship between external sourcing and innovation. In particular, including different governance modes simultaneously in the same model may lead to different results compared to studying a single governance mode. Rothaermel and Hess (2007) confirm the above by proving empirically that, in contrast to previous literature, acquisitions contribute positively to innovation while alliances are a less effective means of fostering innovation. Keil *et al.* (2008) have found that all the governance modes (including alliances, joint ventures, M&As and corporate venture capital) can enhance innovation but greater benefits are to be had from relationships with partners in related industries. The study of the effects on innovation of preferring SAs over M&As as a governance mode or vice versa has been addressed only recently and by only a few studies. The point is, however, especially relevant as companies may benefit from devoting their efforts to increasing experience and learning benefits by specialising on one single governance mode (Levinthal and March, 1993). Investigating whether ‘*strategic purity pays*’ is a central research question in the strategy literature (Thornhill and White, 2007). For the purpose of our analysis, focusing on ‘*pure*’ governance strategies that choose SAs only or M&As only allows us to differentiate and compare their effect on innovation performance. Therefore, the next research question that needs to be answered is the following:

RQ3a: *What is the effect on innovation of using M&As compared to SAs as a governance mode?*

In order to have a more complete understanding of the effects of different governance modes on innovation, an integrated perspective is needed. Although companies face the complexity of technological developments with multiple external links, like M&As and SAs, the interdependencies between different governance modes have attracted surprisingly little attention from scholars (Belderbos *et al.*, 2006). Belderbos *et al.* (2006) have confirmed empirically that complementarities may exist among strategic alliances with different partners. Van de Vrande *et al.* (2007) have extended the reasoning to consider the complementarities among corporate venture capital (CVC) investments with other governance modes like SAs and M&As. Although the results confirm that the effects of CVC on innovation are, indeed, influenced by interactions with diverse governance modes, the simultaneous combination of alliances and mergers has not been considered yet. Previous research has focused primarily on the interaction among multiple alliances. It fails to consider the interactions between alliances and other governance modes like M&As. The above may be explained by the consideration



that previous authors, focusing on their differences, have regarded mergers and alliances as alternative and mutually exclusive strategic options for achieving innovation (e.g. Villalonga and McGahan, 2005; Dyer *et al.*, 2004). However, if interactions in a portfolio of SAs and M&As positively affect innovation, those benefits should be considered and exploited. A degree of diversity in the external relationships, like partners' heterogeneity, stimulates innovation (Faems *et al.*, 2005). Companies have recently started to recognise that considering inter-firm links as 'one-offs' – '*independent relationships pursued separately*' – is perilous (Powell *et al.*, 1996). A report by McKinsey (Bamford and Ernst, 2002) motivates the need for a more integrated approach by arguing that otherwise, over the years, companies collect a '*random mix*' of linkages whose contribution to corporate strategy is unclear. A recent body of literature has recognised the superiority of approaching external sourcing of innovation from an integrated perspective by considering the entire corporate portfolio where portfolio refers to the ensemble of relationships in which the firm is involved (George *et al.*, 2001; Faems *et al.*, 2005; Lavie, 2007; Duysters and Lokshin, 2007). The main reason is that companies need to achieve a better understanding of the interrelationships and the complementarities that exist between governance modes (Parise and Casher, 2003; Belderos *et al.*, 2006) to face the complexity of multiple contemporaneous relationships (Hoffmann, 2005; Mahnke and Overby, 2005). Despite limited attention in previous research, the interactions between multiple relationships are essential to an understanding of innovation results (Belderbos *et al.*, 2006). Interaction effects need, therefore, to be considered when we assess the impact of governance modes on innovation. From a governance choice perspective, companies have to be able to use both SAs and M&As to exploit the interaction effects. This research proceeds by asking the following research question:

RQ3b: *What is the effect on innovation of using a portfolio of SAs and M&As compared to using only M&As or SAs?*

The research questions RQ3a and RQ3b will be answered in Chapter 4.

### **1.5 The actual decision process of external technology sourcing**

For this part of the study we have used data that has been collected from interviews with top managers from 35 large and small firms from six industries. Fourteen of the interviewees are from world leading companies (among the top ten in their market) and eight are best-in-class (among the top-three of their market) in their respective industries. The decision to address companies of different sizes and industries reinforces the external validity of the study. Information taken from the interviews has been used to deepen our understanding of the priorities that are accounted for when dealing with strategic sourcing decisions. In particular, the objective is to gain insight into how the sourcing decision process is conducted at the firm level. The research proceeds by approaching the decision process itself. As indicated in Section 1.2, the decision process is articulated in two main steps. The first deals with the choice to use external sourcing and the second focuses on choosing the governance modality

of the external relationship. There is not a unanimous consensus on how the boundaries of the firm are chosen with respect to internal vs. external sourcing decisions (Veugelers and Cassiman, 1999; Parmigiani, 2007; Schilling and Steensma, 2002). Veugelers and Cassiman (1999) have pointed out that differences in sourcing decisions exist between large firms and SMEs. Dachs *et al.*, (2004) confirm that one of the fundamental aspects to be considered when investigating sourcing choices is the size of the company in which the decision process takes place. Therefore, the research question that the present research addresses is the following:

RQ4: *What drives the decision to source innovation externally in management practice?*

Each organisational mode leverages different mechanisms to enhance innovation (Keil *et al.*, 2008). Studying the individual effects of alliances and M&As on innovation, however, would provide only limited guidance for the governance decision process. Companies are involved in a web of a growing number of relationships (De Man, 2004). A firm's success is no longer determined by the achievements which are obtained from an individual external sourcing of technology but by leveraging the entire portfolio of multiple links (Parise and Casher, 2003). An increasing body of literature confirms that a portfolio perspective is appropriate to explain the effects of external relationships on innovation (George *et al.*, 2001; Wuyts *et al.*, 2004; Faems *et al.*, 2005; Duysters and Lokshin, 2007). Although, a portfolio approach has mainly been adopted by the literature in the context of alliances, previous chapters show that it can be extended to include M&As as well. A recent research line, indeed, calls for a portfolio perspective. It considers that distinct governance modes jointly can better explain innovation performance (Keil *et al.*, 2008). If value is generated by the portfolio, it is critical to identify which mechanisms can be exploited by the governance decision process. We identify two key main mechanisms: interactions and time dynamic effects. A portfolio approach allows us to face the complexity of multiple and contemporaneous relationships (Hoffmann, 2005; Mahnke and Overby 2005) by providing a better understanding of the interdependencies and complementarities among different corporate links (Parise and Casher, 2003; Belderbos *et al.*, 2006). The interactions among the links shape the competitive dynamics and determine the companies' value creation potential (De Man, 2004). The benefits of one relationship can enhance the achievements of another link (Parise and Casher, 2003). The framework in which the companies operate is fluid and dynamic since it is constantly evolving, affected by the changes in the markets, technology shifts, by the development of the company's profile, the competitive position and by its web of relationships. A rich body of literature from different disciplines confirms that technologies (Anderson and Tushman, 1990), innovation patterns (Utterback and Abernathy, 1975; Mansfield, 1961; Abernathy and Utterback, 1978), markets and competitive situation (Schumpeter, 1942; Porter, 1981), and networks (Hite and Hesterly, 2001) change and progress over time. Efficient boundaries of the firm need to be dynamic to adjust to those continuous evolutions (Afuah, 2001). Adapting to changing environments is essential to sustain competitive advantage and corporate performance in the long run. For the above purpose, companies need to develop and exploit dynamic capabilities that include strategic alliances and M&As (Eisenhardt and Martin, 2000; Barney *et al.*, 2001).

A governance decision process, in order to sustain a firm's achievements over time, should comfortably deal with the dynamic nature of external relationships. The results of Chapter 2 and Chapter 3 confirm that external sourcing modes like M&As and SAs display their effects on innovation over the years. The portfolio represents an intrinsically non-static tool that adjusts to new conditions by balancing its composition over time and by monitoring the effects of those changes (Parise and Casher, 2003; Cooper *et al.*, 1999). Hence, the need for a dynamic perspective emerges.

We need a single conceptual framework, comprehensive enough to deal simultaneously and consistently with the different facets of the governance choice. Although the contribution from previous literature has been extensive, the application of the above-mentioned criteria poses a number of challenges that encourages the quest for a new approach. First, even though previous literature focuses on features which are relevant in the governance decision, there are situations where suggestions from different theories diverge and it is not clear which theory, or which aspect within the same theory, should be predominant. Note (see Table 1.1), for example, that when dealing with mature technologies, RBV advises the use of alliances while ROR suggests acquisitions (Chiesa and Manzini, 1998; Roberts and Liu, 2001). Problems of coordination among suggestions from diverse contributions may arise. First, when different theories suggest opposite governance modes, there is no obvious reason to prefer one approach over the other. Second, existing models tend to isolate the governance choice decision. As Table 1 shows, the interactions between different governance modes are not central in the previous contributions. This may be due to the unit of analysis adopted by the precedent literature. From a micro to a macro perspective, the governance choice decision can be alternatively analyzed at the transaction level focusing on the specific nature of the relationship (as in TCE and ROR), at the company level (as in RBV), or at the network level of external relationships (as in NT) (Villalonga and McGahan, 2005). In order to account for interactions among governance modes, a more suitable unit of analysis has to be identified. Third, the governance choice criteria proposed by previous studies appear to give only marginal consideration to the time perspective and its effects on the governance decision process.

Enhancing the innovation performance and the success of external partnership activities encourages the quest for a theoretical approach that considers the above propositions. We propose to use Financial Portfolio Theory (PT) as a conceptual tool. This brings us to the final research question 5 (RQ5):

*RQ5: What would a decision model for the governance choice look like from a Portfolio Theory perspective?*

This research question will be answered in Chapter 5. Finally, in Chapter 6, a synopsis of the key findings and their theoretical implications is given. The chapter then draws conclusions about the theoretical, managerial and policy contributions of the study and the possibilities for further research.

## 2. The effect of strategic alliances on innovation

### 2.1 Introduction

Chapter 2<sup>1</sup> approaches the relationship between individual governance choices and innovation focusing on strategic alliances. It answers Research question 1:

RQ1: *What is the effect on innovation of using SAs as the governance mode for external sourcing by SMEs and large firms?*

The relationship between SAs and innovation has attracted the attention of many scholars. The effect of SAs have been assessed on innovation inputs (Sakakibara, 1997; Irwin and Klenow, 1996), on innovation outputs in terms of new products (Nicholls-Nixon and Woo, 2003), in terms of patents (Keil *et al.*, 2008; Ahuja 2000) and in terms of economic performance (Jones *et al.*, 2001). A review of the results obtained by previous studies suggests that, in the majority of the cases, strategic alliances are beneficial for innovation (De Man and Duysters, 2005). In the present chapter, we focus on the benefits of external sourcing in the form of SAs that have not been completely addressed by previous studies. The use of external relationships aims at supporting and fostering innovation. In an extreme case situation, companies that are not innovative may, therefore, aim at becoming innovators by profiting from the gains of SAs. Not only becoming but also remaining innovators over time represents a necessary condition for sustained competitive advantage. In a dynamic process, innovation comes from firms' competences and stimulates the developments of new ones in order to sustain competitive advantage over time (Danneels, 2002). As we mentioned in Chapter 1, we complement previous studies by investigating the achievement of the above benefits for a particular class of companies: SMEs.

According to several studies (Geroski *et al.*, 1997; Cefis, 2003), a threshold level exists for innovation activities. Distinguishing two categories, non-innovative and innovative firms, Cefis (2003) found that companies experience the highest barrier in patenting when they try to become innovators. In her study on patent applications, she has shown that the probability of obtaining the first patent is uniformly much lower than the probability of having  $n + 1$  patent (where  $n \geq 1$ ). The increased speed and complexity of technological advancements (European Commission, 1995) and the multi-technological nature of products require prohibitive levels of resources' deployment (Narula, 2004). The threshold effect can be particularly hampering for small and medium-sized enterprises (SMEs) that are typically constrained by limited resources and that can, therefore, experience high barriers to innovate (Narula, 2004). SAs can be used by SMEs to access those resources, especially knowledge, or to

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<sup>1</sup> This chapter is based on NWO report, project number 472-04-08 and published as (in alphabetical order): Cefis, E., Ghita, M. and Sabidussi, A., (2009). Partnerships and innovative patterns in small and medium enterprises. *International Journal of Entrepreneurship and Small Business* 7(4), 431-445.

ease their development (Hagedoorn, 1993; Duysters and De Man, 2003; Narula, 2004). The main objective of the present chapter is to determine whether SAs have an impact on firms in order to become innovators and/or to persist as innovators. The question is especially relevant from the perspective of SMEs that are mainly concerned with filling their '*resource gaps*' for innovation (Teng, 2007). The question, therefore, will be approached by distinguishing the effects of strategic alliances in different firm size classes.

Chapter 2 is structured as follows. Section 2.2 provides an overview of the theoretical foundation explaining the use of relationships to innovate and develops the main hypothesis to be tested. Section 2.3 presents the data and the methods. Section 2.4 reports the obtained results. The conclusive remarks and the recommendations for further research are addressed in Section 2.5.

### **2.2 Theoretical background and hypotheses**

The concept that companies foster innovation and sustain, over time, competitive advantage by SAs finds a conceptual foundation in the Resource Based View (RBV) (Nooteboom *et al.*, 2007) and in the Dynamic Capabilities literature (Teece *et al.*, 1997).

The RBV approach stems, amongst others, from the work of Penrose (1959), Wernerfelt (1984) and Barney (1991). At the core of the RBV there is the concept that a company's competitive advantage is determined by the key resources the firms possess (Wernerfelt, 1984). To guarantee a competitive advantage, these resources have to be rare, valuable, not substitutable and hard to imitate (Barney, 1991). Difficult to replicate by competitors, these resources support the firm's competitive advantage (Lockett and Thomson, 2001).

From an RBV stand point, resources can be classified as tangibles like land, buildings, machinery or intangibles (Galbreath, 2005), such as assets or skills (Hall, 1992). Assets refer to what a firm owns (like patents, trademarks, etc.) while skills refer to the firm's know-how and culture. Knowledge has been identified as the most strategically important intangible skill (Grant, 1996). The role of knowledge is so relevant that the knowledge management perspective has been defined as '*the essence of RBV*' (Conner and Prahalad, 1996). The process of knowledge creation has to be continuously renewed in order to sustain innovation, and competitive advantage over time (Popadiuk and Choo, 2006; Wernerfelt, 1984). Continuous innovation is central for knowledge-creating companies that repetitively transform new knowledge into new products (Nonaka, 1991). Innovating sporadically, therefore, does not sustain competitive advantage and firms need to renew their knowledge base in order to remain innovators over time. To account for this dynamic perspective, RBV theory has been expanded to include '*dynamic capabilities*' that refer to the '*firms' ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments*' (Teece *et al.*, 1997). In the above definition, two aspects are especially worth noting as they disclose

by which mechanisms SAs can help firms to become innovators and to maintain the above capability over time.

First, resources used to innovate can be both internally developed or externally sourced. The rationale, from an RBV perspective, to enter partnership activities is therefore that '*organizations enter alliances with each other to access critical resources*' (Gulati and Gargiulo, 1999) and to generate new knowledge (Tsai, 2001). Partnership activities are especially relevant if firms do not possess all the necessary resources themselves (Powell *et al.*, 1996). SAs are used mainly when a company is in a weak strategic position, struggling in highly competitive markets, or when it is pioneering unknown technologies (Eisenhardt and Schoonhoven, 1996; Powell *et al.*, 1996). Using partners to access resources reduces the time and the cost of in-house development (Hagedoorn, 1993). Alliances, conveying resources from the outside world to the company, represent a '*dynamic capability*' (Eisenhart and Martin, 2000).

Second, from a resource/knowledge perspective, novelty can be achieved through integration, reconfiguration or '*recombination*' of resources. SAs foster innovation by permitting the integration of complementary knowledge (De Man and Duysters, 2005). SAs can be used to combine existing resources and reach the critical mass which is needed to innovate (Bidault and Cummings, 1994). Recombination can be obtained by means of two mechanisms: synthesis of existing resources (where new links among different knowledge bases are generated) or reconfiguration of resources (where existing links among knowledge bases are changed or altered), (Galunic and Rodan, 1998). Das and Teng (2000) have categorised SAs by distinguishing the level of similarity (degree of resemblance among the resources) and the level of utilisation (relevance of the contribution) which is involved in the relationship. When similar resources are combined, they can typically generate economies of scale and scope in R&D. When dissimilar (and compatible) resources are combined with high levels of utilisation, they unveil their potential generating synergistic and complementary effects (Das and Teng, 2000). In case of similarity, the exchange of technological knowledge among partners is facilitated (Mowery *et al.*, 1998). When dissimilar resources have to be combined, partners need internal know-how to develop '*absorptive capacity*', i.e. the '*ability to recognize the value of new, external knowledge, assimilate it and apply it to commercial ends*' (Cohen and Levinthal, 1990: 128; Mowery *et al.*, 1998).

All the above arguments are significant for all companies but they have a special relevance for SMEs. According to the European Commission (1995), '*SMEs are the key sector for generating ... creativity and innovation through the Union*'. SMEs exploit external relationships to sustain their competitive advantage (Narula, 2004). The study of Liao *et al.*, (2003) proves that SAs are effective mechanisms for supporting SMEs' responsiveness in the face of external changes. SAs, by facilitating the knowledge-acquisition process, affect positively firms' performance in term of sales, profits and product variety (Van Gils and Swart, 2004). A similar conclusion is reached by Lee (2007) who confirms that SMEs' new ventures, in terms of sales and profits from new products, new product success in achieving sales/profits objectives and positioning



with respect to competitors, are supported by SAs. Although Freel (2003) notes that external relationships are not a '*necessary, nor less a sufficient condition*' for innovating, his results confirm the positive role of SAs in fostering new product introduction for SMEs. Despite all of the above, the literature reports reasons why partnerships may fail. In particular, the results of the partnership can be hampered by the distance between the knowledge bases of the companies involved in the relationship (Lane and Lubatkin, 1998). Additionally, some companies can decide to enter into an alliance not to share and develop knowledge, but to take possession of the partner's technological expertise (Hagedoorn, 1993). This happens more often when cooperation is established among competing firms (De Man and Duysters, 2005). In this case, companies sustain costs to protect themselves from partners' opportunistic behaviour (Chan *et al.*, 1997). The above relational costs need to be considered as expenses associated with managing the external relationship. They can offset the initial benefits of sharing with partners the costs of developing jointly new technologies or finding new technological applications (Afuah, 2001). Therefore, managing alliances requires a certain level of resources; the associated costs can be unaffordable for SMEs (Narula, 2004). When this is the case, the benefits of entering into alliances may be more easily appropriated by larger firms than by SMEs. We, therefore, formulate the following hypotheses:

H1: *SAs have a positive effect on the likelihood of companies becoming (H1a) and/or remaining (H1b) innovators.*

H2: *SMEs benefit less from SAs than large companies with respect to becoming (H2a) and/or remaining (H2b) innovators.*

### 2.3 Data and methods

The analysis has been performed by linking two Dutch databases: the Community Innovation Survey (CIS) and the Business Register (ABR)<sup>2</sup>. The resulting dataset that was obtained by combining CIS waves and ABR provides distinctive information on the characteristics and the innovative activities of more than 2,500 companies.

The Business Register (ABR) is a database that includes all firms which are listed in the Netherlands for fiscal reasons. ABR reports detailed information about the sector of a company at the 6-digit standard industrial classification (SIC), the number of employees and the date of entry and exit from the register. The Community Innovation Survey (CIS) is an international comparative firm-level database that is produced as a result of a joint action of the Commission's services Enterprise DG and Eurostat with the intention of obtaining a comparable data on the innovative behaviour of European firms. It includes the European Union and EFTA member states, and it is conducted on a four-year basis, including the three-

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<sup>2</sup> The empirical analyses were performed at the Centre for Economic Micro data (Cerem) at Statistics Netherlands (CBS).

years period prior to the year of the survey. The Netherlands are an exception to the above typical schedule as the CIS has been carried out every two years. This offers, therefore, the opportunity to study the innovation patterns in Dutch firms along 6 survey waves from 1994 until 2006: CIS 2 (from 1994 to 1996), CIS 2.5 (from 1996 to 1998), CIS 3 (from 1998-2000), CIS 3.5 (from 2000 to 2002) CIS 4 (from 2002 to 2004) and CIS 4.5 (from 2004 to 2006). CIS 1 was excluded because it was a pilot survey carried out in the Netherlands by SEO Economic Research Amsterdam. The CIS represents an important source of information because of: (1) its multi-dimensional coverage of a range of input, output and organisational indicators of innovative activities; (2) its longitudinal design in which information is gathered to study changes over time at the micro level; (3) its standardised procedures since surveys are carried out using a common methodology and are further processed by Eurostat to increase cross-country comparability. Additionally, *'within each country the sample is designed to be representative of all regions, all industrial sectors and all enterprise sizes'* (Lucking, 2004). In our analysis, we use the two most recent non-overlapping data sets from CIS 3 and CIS 4 to capture the effects of SAs on innovation. The time lag between two non-overlapping CIS waves is necessary in order to allow the cooperation agreements to exert their effects on firm innovation proxies and to avoid endogeneity problems.

The main focus of our analysis is directed at investigating the differences in firms' innovative behaviour among different size classes. The choices firms make with respect to investing (or not) in innovation after cooperation agreements are analysed using Probit regression models.

First, we estimate the probability of firm  $i$  moving from a status of active innovator ( $I_{it-1}$ ) or non-innovator ( $N-I_{it-1}$ ) in period  $t-1$  to an innovative-active status ( $I_{it}$ ) in period  $t$ . The above probabilities to move from one state to the other are summarised in a matrix called Transition Probability Matrix. A schematic overview of the variables which are used to depict firms' innovative patterns across waves is given in Table 2.1. It also includes a description of the control proxies that are employed in the parametric models.

Each probability ( $p_{it}$ ) of change from one innovative state to another within a time frame  $[(t-1) - t]$  can be regarded as a pattern of firm level innovative behaviour. We analyze whether or not firms are more likely to change from non-innovators to active innovators, namely by making higher investments in R&D, in licensing, training of personnel, or in innovative machineries after entering into cooperation agreements. Two innovative patterns will be the main focus of the analysis: firms changing from being non-innovators to active innovators, as well as firms' persistence in innovative activities. We assume that a firm  $i$  will experience a change in its innovative behaviour in period  $t$  following a cooperation agreement undertaken at time  $t-1$ . The expected change in innovative patterns depends (1) on previous involvement in innovation-driven cooperation ( $X_{t-1}\beta$ ), (2) on observable control variables, as technological regime, firm size and age ( $Z_{t-1}Y$ ) and (3) on unobservable firm-specific attributes, captured by  $\mu_i$ . The effect of the unobservable time-varying factors is captured by the idiosyncratic error ( $\varepsilon_{it}$ ).



Table 2.1. Variables used to develop firms' innovative patterns.

New-entrant innovators	Transition from non-innovator at time t-1 to innovator at time t
Persistent innovators	Transition from innovator at time 1 to innovator at time t
Involvement in SAs (at time t-1)	Firm has reported being involved in cooperation agreements in the previous CIS wave
R&D intensity (at time t-1)	R&D expenses divided by the number of employees in the previous CIS wave
Pavitt's taxonomy	Firms' taxonomy, 4 categories: science-based, specialised suppliers, scale-intensive, supplier-dominated
Firm size	Number of employees, size classes: small(10-49), medium-sized(50-249) and large (>250)
Firm age	Expressed in months (since the date of entry in the Business Register)

Using a Probit framework, the model can be estimated by the following:

$$P(\varphi_{is}) = \text{probit}(\beta_0 Co_{it-1} + \beta_1 R\&D_{it-1} + \beta_2 SB_i + \beta_3 SS_i + \beta_4 SI_i + \beta_5 Age_{it-1} + \beta_6 Age_{it-1}^2 + \beta_7 Size_{it-1} + \beta_8 Size_{it-1}^2 + \beta_9 Age_{it-1} \times Size_{it-1} + \mu_i + \varepsilon_{it})$$

where  $\varphi_{is}$  denotes firms' transitions in different innovative states with  $s=1, 2$ . More precisely:

$$Pr(Y_{it}=1|Y_{it-1}=0) = \varphi_{i1}$$

$$Pr(Y_{it}=1|Y_{it-1}=1) = \varphi_{i2}$$

where  $Y_{t,t-1}$  is the firm's innovative status (0=non-innovator/1=innovator). In particular,  $\varphi_{i1}$  represents the probability of a non-innovator firm in period ( $t-1$ ) becoming an innovator in period ( $t$ ). Conversely,  $\varphi_{i2}$ , represents the probability of an innovator firm in period ( $t-1$ ), remaining an innovator in period ( $t$ ). The former probability tells us the chance that a firm has of overcoming the innovative threshold, while the latter probability tells us how many chances a firm has to be a persistent innovator.

Using Probit, we model such probabilities on different types of regressors.  $Co_{it-1}$  represents our main variable of interest: the engagement in cooperation agreements undertaken for innovation-related purposes in the previous period. Since our aim is to model firms innovative patterns, we have included among the regressors the R&D intensity,  $R\&D_{it-1}$ , (R&D expenses at time  $t-1$  divided by the number of employees) because of its role in determining the firm's capability to innovate. The others are mainly control variables:  $SB$ ,  $SS$  and  $SI$  represent

technological regimes in accordance with Pavitt's taxonomy (science-based, specialised suppliers and scale-intensive; Pavitt, 1984). As summarised by Vossen (1998), in the Pavitt classification, 'science-based' includes industries like chemical and electric goods; 'specialised-supplier' includes industries like machinery, instruments and optical goods; 'scale-intensive' includes food, beverage, tobacco, oil, rubber and plastics, metals, metal products, building material, glass, earthenware, and means of transport. The control group is represented by the 'supplier-dominated' category that includes textiles, clothing, leather, paper, wood and furniture, printing and fibers.

*Age* and *Size* are a firm's demographic characteristics. The squared terms of *Age* and *Size* are also included, as we expect a non-linear relationship of age and size with innovation. We also add an interaction term age-size to our model to test possible heterogeneity in the effect of size as firms mature.

For the firm level changes in innovative status we focus on the changes from the state of non-innovators to the state of innovators and innovation persistency. The time interval of transition is 2-6 years, given the cadence of the non-overlapping CIS waves. This time gap allows for a sufficiently long period in which the collaboration agreements can become effective and start yielding results. Splitting the analysis by size classes (small, medium-sized and large) allows for an analysis of the level of heterogeneity which is induced by firms' size in deriving patterns of entry or persistence in innovativeness, and to verify differences for SMEs in becoming or remaining innovators.

### 2.4 Results

The descriptive statistics reveal that firms which are involved in cooperation agreements are on average larger than those that have not partaken in such activities: the average number of employees in firms previously involved in cooperation activities is more than double compared to firms not engaged in cooperation (a mean of 376 employees vs. 147 for the latter). It also appears from the statistics that those firms (probably due to being large firms) invest more in R&D and innovation activities in general. Indeed, the R&D intensity for firms involved in cooperation agreements is almost four times larger (a mean of 8.2 vs. 2.9 for non-collaborating firms). The same pattern can be observed with respect to innovation intensity: firms involved in collaborations invest almost double that of non-collaborators (the ratio is 11.9 vs. 6.3 for the latter group of firms). In terms of sales from innovative products, firms that are active in external relationships seem to be more successful than firms that do not use cooperative activities. Indeed, in firms with SAs the mean is 2.34 (for sales of products new to the market), 2.89 (for sales of improved products new to the firm) or 5.22 (for sales of products new to the market) times higher than the average in firms without SAs. Table 2.2 also reports the between (based on the difference between individual mean and the mean of the entire sample) and within (based on the difference between the individual observation and the individual mean) standard deviation.

Table 2.2. Descriptive statistics of R&D and innovation behaviour panel of manufacturing firms 1998-2004.

Variable		Firms involved in cooperation agreements		Firms not involved in cooperation agreements		t-test
		Mean	Std. dev.	Mean	Std. dev.	
Firm size (number of employees)	Overall	375.7	1,164.8	147.1	416.1	-9.2***
	Between		1,201.4		471.1	
	Within		168.4		82.9	
R&D intensity (R&D expenditures/ number of employees)	Overall	8.22	41.42	2.87	10.7	-6.4***
	Between		39.7		10.7	
	Within		19.6		3.6	
Innovation intensity (Innovation cost/number of employees)	Overall	11.9	44.09	6.3	27.2	-5.06***
	Between		41.06		31.1	
	Within		21.5		5.7	
Total sales due to new and improved products for the firm	Overall	1,755.02	20,458.03	606.3	2,796.5	-2.88***
	Between		8,450.3		2,141.6	
	Within		16,673.02		1,851.7	
Total sales due to new products for the firm	Overall	1,234.2	14,115.2	236.3	884.7	-2.8***
	Between		7,571.9		801.7	
	Within		9,947.7		382.02	
Total sales due to new products for the market	Overall	38.5	268.03	16.4	53.6	-3.64***
	Between		228.4		51.6	
	Within		145.7		18.7	

Note: statistically significant at: \*\*\* 1% level; \*\* 5% level; \* 10% level.

The multivariate analysis considers the innovative transition and the innovative persistence. Distinctions are made across size classes, covering first our complete sample, and then lowering the level of analysis to reflect the different innovative patterns across small, medium-sizes and large firms.

Table 2.3 shows that for the whole sample, engaging in cooperative agreement for innovative activities in  $t-1$  will increase the probability of becoming an innovator in  $t$  by about 11%. R&D-intensity is a significant and positive determinant for explaining the transition. This

Table 2.3. New-entrants innovators (from time  $t-1$  to time  $t$ ): Probit models reporting marginal effects.

Dependent variable	Innovative transitions (non-innovators to innovators)							
	All firms		Small firms		Medium firms		Large firms	
	dF/dx	z	dF/dx	z	dF/dx	z	dF/dx	z
Cooperation agreements at time $t-1$	0.11*** (0.02)	4.17	0.2*** (0.06)	3.33	0.07** (0.03)	2	0.12** (0.05)	2.2
R&D intensity at time $t-1$	0.03*** (0.004)	6.36	0.04*** (0.01)	3.2	0.03*** (0.006)	5.24	0.007 (0.007)	0.92
Science based	0.122*** (0.04)	3.4	0.08 (0.06)	1.4	0.09** (0.05)	2.03	0.26*** (0.06)	3.5
Specialised suppliers	0.04 (0.03)	1.3	-0.056 (0.04)	-1.2	0.04 (0.04)	1.07	0.29*** (0.054)	5.04
Scale intensive	0.07* (0.04)	1.6	0.08 (0.07)	1.2	0.02 (0.06)	0.34	0.23*** (0.07)	2.7
Firm size	0.2*** (0.04)	4.75	0.13 (0.14)	0.95	0.05 (0.7)	0.06	0.41 (0.34)	1.22
Firm age	-0.03 (0.13)	-0.24	0.07 (0.24)	0.3	-0.01 (0.17)	-0.07	-0.26* (0.19)	-1.37
Square of size	-0.008** (0.004)	-1.7	-0.01 (0.03)	-0.4	0.009 (0.08)	0.11	-0.03 (0.02)	-1.2
Square of age	0.006 (0.01)	0.49	-0.007 (0.02)	-0.3	0.005 (0.01)	0.33	0.03* (0.02)	1.54
Age $\times$ size	-0.03*** (0.001)	-24.2	-0.027*** (0.004)	-6.8	-0.03*** (0.001)	-19.08	-0.03*** (0.002)	-14.3
LR chi2	893.2***		100.7***		474.07***		381.5***	
Rsquared	24.60%		11.42%		22.80%		42.40%	
Number of observations	2,624		690		1,501		661	

Note: (1) dF/dx is for discrete change of dummy variable from 0 to 1, for continuous variables it is calculated at the mean value.

(2) z correspond to the test of the underlying coefficient being 0.

(3) Standard errors of the marginal effects in parantheses; statistically significant at: \*\*\* 1% level; \*\* 5% level; \* 10% level.

result indicates that cooperation is not used as a substitute for but as a complement to R&D activities. The findings confirm that SAs need to be coupled with a certain level of internal R&D investment in order to build the capacity to absorb the external resources and knowledge and to exploit the results of the collaboration.

If we consider the distinction between small, medium-sized and large companies, we note that SAs are especially beneficial for small firms. Indeed, entering into an external relationship increases the probability of becoming an innovator by almost 20% in the case of small firms while for medium-sized and large size firms this percentage is clearly lower (around 6% for medium-sized firms and almost 12% for large firms). For small and medium-sized companies the intensity of the R&D activities is also a significant factor for explaining the transition from a non-innovator to an innovator status, while this seems not to matter for large firms.

Size matters when explaining the transition from non-innovator to innovator confirming that small companies encounter more difficulties crossing the threshold. The effect of size is significant, and non-linear, only for the overall sample. There is a different innovative behaviour among small, medium-sized and large firms. However, when we consider homogeneous size classes, within each group, the effect of firm size disappears.

Age affects the probability of becoming an innovator in a significant, negative and non-linear way for large firms. However, the interaction between age and size negatively affects the transition in the overall sample as well as for each size class, suggesting that too large and/or too old companies may encounter difficulties in becoming innovators. It seems that if large companies do not innovate in the early stages of their existence, they have less probability of doing so in later stages. This result comes as a surprise considering that older companies had the opportunity to accumulate more resources over time. A possible explanation is that non-renewed stock of resources can become a source of rigidity for companies and impede innovation (Leonard-Barton, 1992). This can be especially restrictive for larger firms that have typically the disadvantage of being less flexible than smaller firms (Narula, 2004).

The organisational and technological characteristics of sector regimes, captured by Pavitt's taxonomy, appear to be important in explaining the probability of crossing the innovative threshold especially in capital and knowledge-intensive sectors. Table 2.4 shows which factors affect the persistence in innovative activities. SAs positively and significantly affect the probability of remaining in the innovators class. For the overall sample, the results show that, given that a firm was already an innovator at time  $t-1$ , a partnership agreement increases the probability of remaining an innovator over the period by 1%. This process is supported by the effects of R&D intensity. The probability of being a persistent innovator increases if firms invest in R&D and perform a partnership agreement. So just as in the case of becoming an innovator, cooperation needs to be coupled with the firm's efforts to build and maintain internal knowledge-absorbing capabilities.

Table 2.4. Persistent innovators (from time  $t-1$  to time  $t$ ): Probit models reporting marginal effects.

Dependent variable	Innovative persistence at time $t+1$ (innovators to innovators)							
	All firms		Small firms		Medium firms		Large firms	
	dF/dx	z	dF/dx	z	dF/dx	z	dF/dx	z
Cooperation agreements at time $t$	0.01*** (0.004)	4.3	0.0005 (0.001)	0.9	0.013*** (0.007)	3.55	0.008** (0.008)	2.3
R&D intensity at time $t$	0.003*** (0.001)	8.8	0.0003*** (0.0004)	4.08	0.003*** (0.001)	6.6	0.002*** (0.002)	3.9
Science based	0.006* (0.04)	1.7	0.0007 (0.001)	1.04	0.0032 (0.005)	0.7	0.02 (0.02)	2.01
Specialised suppliers	0.0008 (0.002)	0.4	-0.0004* (0.0007)	-1	0.00003 (0.003)	0.01	0.007 (0.007)	1.6
Scale intensive	0.0003 (0.003)	0.01	-0.0004 (0.0007)	-1.7	0.001 (0.005)	0.2	0.02 (0.03)	1.5
Firm size	0.007* (0.004)	1.6	0.003 (0.005)	1.08	-0.13** (0.08)	-1.9	-0.04 (0.04)	-1.6
Firm age	-0.0003 (0.13)	-0.03	0.0015 (0.003)	0.73	0.018 (0.02)	0.9	-0.008 (0.01)	-0.9
Square of size	-0.001*** (0.005)	-2.6	-0.0005 (0.0008)	-1.2	0.014** (0.008)	1.9	0.002 (0.002)	1.45
Square of age	-0.0008 (0.01)	-0.86	-0.0002 (0.0003)	-1.05	-0.003 (0.002)	-1.5	-0.0003 (0.0009)	-0.3
Age $\times$ Size	0.002*** (0.0006)	14.6	0.0001*** (0.0002)	5.2	0.002*** (0.0009)	11.8	0.002 (0.001)	7.3
LR chi2	1,259.7***		156***		746.3***		422.8***	
Rsquared	0.61%		0.6		0.59		0.67	
Number of observations	2,624		690		1,501		661	

Note: (1) dF/dx is for discrete change of dummy variable from 0 to 1, for continuous variables it is calculated at the mean value.

(2) z correspond to the test of the underlying coefficient being 0.

(3) Standard errors of the marginal effects in parantheses; statistically significant at: \*\*\* 1% level; \*\* 5% level; \* 10% level.

If we focus on the distinction between small, medium-sized and large companies we notice that, for medium-sized and large companies, entering into SAs increases the chances of remaining an innovator by about one percent. Remarkably for small firms the engagement in SAs is not significant to explain the persistence of the innovator status. This result seems to confirm previous findings that continuous innovation is rare and most small companies innovate only occasionally (Geroski *et al.*, 1997; Cefis, 2003). For small companies, the effect of SAs seems to fade over time. This is confirmed by the fact that the intensity of the internal efforts is significant for all the size classes. Thus, in the long run, persistent innovative behaviour cannot be sustained by external sources of knowledge alone: internal sources are a crucial and strategic factor.

Within medium-sized and large size classes, size has a significant, negative and non-linear effect on the probability of remaining in the innovative status but is not, in itself, a sufficient condition for continuous innovation. An explanation for this could be that smaller firms, relative to their class (not in absolute terms), are more able to adapt to changing environments (Narula, 2004). The non-linearity of the effect suggests that the above is true as long as the limitations associated with smaller firm size do not offset the benefits.

Contrary to what happened for the probability of crossing the innovative threshold, the interaction between size and age positively affects the probability of being a persistent innovator. Thus, once the threshold is crossed, larger and more experienced companies have a higher probability of persisting in their innovative behaviour.

Surprisingly for persistence in innovative activities the Pavitt taxonomy coefficients are significant only for science-based sectors. Therefore, this result only partially supports previous findings (Cefis and Orsenigo, 2001) that technological and organisational characteristics matter when explaining the probability of remaining an innovator.

A summary of the results suggest that cooperation activities increase the probability of all firms becoming and remaining innovators. The findings support the hypotheses H1a and H1b that firms may rely on external resources to innovate. The findings show that the benefits of alliances are greater for small firms than for large companies for becoming innovators but not for sustaining the above condition over time. We, therefore, cannot accept H2a and accept H2b.

## 2.5 Discussion and conclusions

The results of our analysis answer to RQ2 and show that adopting cooperative strategies is beneficial for companies that want to become and/or remain innovators. Distinguishing among size classes, this benefit in crossing the threshold seems to be accentuated for SMEs. The findings of the present analysis are in line with the theoretical framework which was proposed. Interpreting the Resource Based View approach from an '*open innovation*'

perspective (Chesbrough, 2003), we support the view that companies can become or remain innovators by using external relationships to access critical resources and knowledge. SAs, however, seem not to be a substitute for the internal effort aimed at innovation, but rather a complement. SAs are a vital governance mode to engage in a learning process where partners benefit from sharing and combining their knowledge-bases (Khanna *et al.*, 1998). Consistent with the theoretical approach presented, firms are, moreover, not exempted from investing in building their own resources to develop '*absorptive capacity*' (Cohen and Levinthal, 1990) and be able to profit from cooperation. Indeed, the intensity of R&D-expenses has been shown to be a significant factor to explain both the transition to an innovator condition and the persistence as innovator.

In particular, the strategic use of alliances seems to be favourable for SMEs. Our results indicate that, joining forces with other companies, SMEs can surmount their boundaries and become innovative. Despite the risk of opportunistic behaviour of partners, SAs are beneficial. According to Weaver and Dickson (1998), SMEs tend to control opportunistic threats by using informal, social mechanisms based on trust. For SMEs, the situation is different if we focus on being a continuous innovator. In this case, persistence in the innovative state does not seem to be sustained by SAs. Our results suggest that, to remain innovators, SMEs should pursue the strategy of augmenting the intensity of their R&D efforts.





## 3. The effect of mergers and acquisitions on innovation

### 3.1 Introduction

Chapter 3<sup>3</sup> investigates the effect of individual governance choices on innovation by focusing on M&As. It is aimed at answering the research question 2.

RQ2: *What is the effect on innovation of using M&As as the governance mode for external sourcing by potentially dominant firms?*

Despite the relevance of M&As for the national global economy (between 1995 and 2000 around 12,000 billion dollars were spent on M&As according to Schenk, 2006), and despite the fact that innovation has become one of the most cited reasons for mergers and acquisition activities, there are surprisingly few studies on the relationship between the two (De Man and Duysters, 2005). Moreover, existing studies have found little empirical evidence of any positive effect (De Man and Duysters, 2005), leaving little clarity on the benefits that M&As bring to innovation. M&As, by entailing costly processes (Porrini, 2004), involve the deployment of a considerable amount of resources that are affordable mainly for large firms. The firms that are relatively large in their sector are those that have the potential to become dominant in their market. The above class of companies is the most exposed to the economic and legislative (antitrust) consequences of choosing M&As as a governance form for their external sourcing. The effects of M&As that are of particular relevance for potentially dominant firms are the following. First, M&As increase the size of the acquirer through external growth and second, they potentially alter the market structure and the competitive dynamics (Cefis *et al.*, 2009; Brito and Catalao-Lopes, 2006). As mentioned in Chapter 1, the literature has mainly overlooked the effects of M&As on innovation in the above situation. The present work intends, therefore, to contribute to the literature by testing empirically the effect of M&As on innovation in the specific context of potential market dominance.

Chapter 3 presents a detailed analysis of the innovation dimensions that M&As may affect. As highlighted by Chesbrough *et al.* (2006), in a '*closed innovation model*', new products that reach the market are generated by a linear process that starts with the inputs provided by the firm's internal knowledge base. Contrary to the above paradigm, in an '*open innovation*' perspective (Chesbrough, 2003), external sourcing may contribute to the innovation process at different stages of the process. In the present chapter, we consider the impact of M&As on

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<sup>3</sup>This chapter is based on NWO report, project number 472-04-08 and published as (in alphabetical order): Cefis, E., Sabidussi, A. and Schenk H., 2007. Do mergers of potentially dominant firms foster innovation? An empirical analysis of the manufacturing sector. Working Paper series 07-20 2007. T.C. Koopmans Institute, Utrecht School of Economics, Utrecht University, the Netherlands.

the diverse stages of the innovation process that include the inputs for innovation, the outputs and the efficiency with which inputs are transformed into outputs.

Chapter 3 is organised as follows. It starts with a presentation of the theoretical background in Section 3.2. We first review the literature on the relationships between market power, size and innovation. Next, we review the effect of M&As on innovation, distinguishing innovation inputs, innovation outputs and innovation efficiencies. From the above literature, the hypotheses are derived and tested on a panel dataset, linking Dutch Community Innovation Survey (CIS) and the Dutch Business Register from 1992 to 2002 and including around 1000 manufacturing firms. The data and methods are presented in Section 3.4. The results are illustrated in Section 3.5. Conclusive remarks are included in section 3.6.

### **3.2 Theoretical background and hypotheses**

In the present Chapter, we analyze M&As in the specific context of market dominance. Market dominance is often associated with large size and, therefore, we start by briefly mentioning the main considerations which can be found in literature on the relationship between market structure, size and innovation.

The Industrial Organisation debate dates back to Schumpeter (1934, 1942). Industries develop innovations according to two main patterns which were first discerned by Schumpeter (1934, 1942). These two basic regimes that describe the link between size and innovation are defined as Schumpeterian Mark I (SM-I) and Schumpeterian Mark II (SM-II).

Under SM-I, a pattern of '*creative destruction*' or '*widening*' is characterised by the entry into the market of new innovators, by the persistent 'erosion of the competitive and technological advantage of the established firms' (Malerba and Orsenigo, 1996) and by less favourable appropriability conditions (Breschi *et al.*, 2000). Under this regime innovation derives from the relevant knowledge base which is available to everybody. Technical change is driven continuously by entrepreneurs and new small firms that enter the market. As a result, the market displays low levels of concentration (Malerba and Orsenigo, 1996).

In contrast, in SM-II a higher level of innovation is reached when large firms operate in a concentrated market. Under SM-II, the prevailing mechanism is defined as '*creative accumulation*'. In this framework (also referred to as the '*deepening*' regime), innovation results from the firm-specific, tacit, and cumulative nature of the knowledge base that over time builds high barriers to entry. A few large firms eventually come to dominate this concentrated and stable market (Malerba and Orsenigo, 1995, 1996).

Both company size and market power are relevant in the context of our research, as an M&A has an effect on size, fusing two firms into a single one or enlarging an existing firm, as well as on market structure, inducing higher levels of concentration and potential market dominance.

Several arguments, other than Schumpeter's ones, have been used to assert that innovation benefits from highly concentrated markets (market concentration being typically used as a proxy for market power) and large companies (Syrneonidis, 1996).

There are at least two reasons to expect a positive effect of market power on innovation (Syrneonidis, 1996). First, firms that have higher levels of market power can better finance their R&D activities using their own profits. This argument is in line with the assumption that innovative companies with higher market power have higher levels of cash flow and therefore dispose of more internal funds to invest in R&D activities. Second, firms with higher market power can better appropriate the benefits of innovation by protecting them with patents (which are costly) or other mechanisms like secrecy, control of distribution channels, and investments in marketing and customer services. Therefore, their incentive to innovate is higher.

The effect of the market structure on innovation is approached in terms of incentives to innovate by Arrow (1962) who argued that, contrary to Schumpeter's Mark II point of view, firms that operate in markets with low levels of competition have little incentive to innovate. Companies will engage in innovative activities if returns from innovation are higher than the existing returns and the costs associated with the innovation development. Therefore, companies that are already close to a monopolistic situation will have little stimulus to actively pursue higher levels of innovation. Firms in a competitive environment will try to use innovation to 'escape competition' (Aghion *et al.*, 2001, 2002).

Empirical studies have, along the years, found mixed and inconclusive results supporting both Schumpeter's Mark II and Arrow's point of view (Kamien and Schwartz, 1975; Damanpour, 1996). Some studies have found that the effect of market concentration on innovation is different when the analysis focuses on small or on large companies respectively. In particular, it seems that large companies innovate more in concentrated, capital intensive markets, while the contrary is true for small companies (Koeller, 1995; Acs and Audresch, 1987). In the specific framework of the manufacturing sector, Blundell *et al.* (1999) explore the relationship between innovation, market share and stock market value. Their empirical findings show that manufacturing firms with a higher market share are more innovative and benefit more from those innovations in terms of stock market value. This result suggests that potentially dominant companies have greater incentives to innovate in order to maintain their dominant position. Moreover, firms with higher market share appear to have greater capabilities to appropriate the results of their innovative activity. This leads to higher market values (Acs and Audresh, 1987; Blundell *et al.*, 1999). However, scientific results that support a positive effect of market share and firm size on innovation should be interpreted with caution as other factors, like sector characteristics, also appear to have a great impact on the level of innovation (Crepon *et al.*, 1995).

A conciliation of Schumpeter's and Arrow's perspectives is proposed by the empirical work of Aghion *et al.* (2002) who found evidence that competition and innovation are linked in an

inverted U-shaped curve. Recently, Tang (2006) pointed out that previous empirical tests on the relationship between competition and innovation may be biased by inappropriate measures of market competition. Market power cannot be assessed directly and, therefore, it is necessary to rely on proxies like seller concentration or market share. Tang (2006) proposed using a new measure to evaluate the view that companies have of their competitive environment. The results confirm that a high level of competition stimulates innovation and that large firms are more likely to engage in innovative activities than small ones. Christensen and Raynor (2003), however, noted that the dominance of large, leading firms may be threatened by new market entrants (even small firms) which compete by using disruptive innovation models. In the above context, the competitive battle takes place in an initially non-important market for the leading firm. The incumbent, however, can erode the position of the leading firm by opening a competitive arena with new customers.

The variety of the findings and often the difficulty of reconciling the results from both theoretical and empirical studies suggest that there is not a clear *a priori* expectation about the relationship between market power/concentration and innovativeness. The present work adds to the debate on the link between competition and innovation by focusing on the effects of M&As on innovation in the context of market dominance.

The effect of M&As on firms' innovative activities has been tackled by surprisingly few studies, as already mentioned. According to De Man and Duysters (2005), the existing literature can be divided in two main groups: those that have studied the conditions for M&As to have an effect on innovation and those that have considered the impact of M&As on R&D activities. In the first group the studies mention three main conditions for M&As to affect innovation. The first one is the relatedness of the companies. Companies that *ex ante* have similar technological knowledge seem to display ex-post higher levels of R&D-efficiency. In the opposite situation, where companies have ex-ante dissimilar technologies, they seem to drastically reduce levels of R&D after the M&A process (Cassiman *et al.*, 2005). The second factor that is able to alter the impact of M&As on innovation is the post-merger integration process. The knowledge bases of the companies that are engaged in an M&A will have to be integrated. This process, although unavoidable, can be extremely complex and risky. The way this is conducted, for example in terms of communication and team building (Epstein, 2004), can have a dramatic negative impact on ex-post innovation performance (Ahuja and Katila, 2001; Cloudt *et al.*, 2006). The third factor is the size of the merging companies. There is no clear agreement on the optimal size of the companies that are involved in M&As in order to favour ex-post innovation. Some studies have found that similar size of the acquirer and the acquired firm are associated with higher levels of innovation performance (Chakrabarti *et al.*, 1994; Hagedoorn and Duysters, 2002), while other empirical tests found evidence to the contrary (Ahuja and Katila, 2001).

The present work is in line with the second research line, which is proposed by De Man and Duysters (2005). This line focuses on the effects of M&As on innovation. Innovation is a

complex phenomenon that is, by its very nature, difficult to capture. In order to account for the multidimensional nature of innovation, we have simplified the innovation process in three dimensions: innovation input, innovation output and innovation efficiency.

In the next section, we derive our hypotheses from the literature that distinguishes the above three dimensions of innovation.

In order to be able to compare the effects of M&As between companies on innovation in a meaningful way, a distinction is made between 3 different dimensions of innovation: inputs, outputs and efficiencies. Moreover, for each activity in the innovation generation process, it is suitable to use several measurements. Patel and Pavitt (1995) argue that firms can display very diverse patterns of innovation activities. Differences may depend on their sector of activity, the specific nature of the technologies developed and/or their size. As a matter of example, R&D is appropriate for science-based sectors like chemicals, but it is a poor proxy of innovation inputs for production-based technological classes of activity (like mechanical) because innovations are generated by Design Offices, Production Engineering as well as by R&D departments (Patel and Pavitt, 1995). Moreover, in the same technological class, smaller companies tend not to have a formal R&D department and therefore it is more suitable to consider other innovation inputs as well, for example the total cost of innovation. The same reasoning is applicable for innovation output and for innovation efficiencies which establish the relationship between inputs and outputs.

### 3.2.1 M&A and innovation inputs

In previous research, R&D expenses have been the typical proxy for innovation inputs. According to the economic theory, two main mechanisms affect the impact of M&As on R&D: economies of scale and economies of scope (Cassiman *et al.*, 2005; Henderson and Cockburn, 1996). Economies of scale refer to the possibility to reduce the average costs by increasing the amount of output and economies of scope refer to the cost reduction which is achieved when producing two goods jointly is cheaper than producing them separately. Companies are likely to be keen to increase R&D expenditure if they can profit from economies of scale and to expand the number of R&D projects to profit from economies of scope. In order to minimise costs, companies will wish to maximise efficiencies. Companies that have merged are likely to avoid unnecessary duplication by closing redundant laboratories or by redeploying research personnel to other departments/tasks, as well as by rethinking or suspending existing R&D projects (Cassiman *et al.*, 2005; Capron, 1999).

With the exception of Ikeda and Doi (1983) empirical studies have mainly reported negative effects of M&As on R&D inputs (De Man and Duysters, 2005; Hitt *et al.*, 1991). Hitt *et al.* (1989) reported an increase in R&D expenditure in absolute terms but this was due to a general increase in research expenditure at the industry level. In relative terms merging companies reduced their R&D efforts. A potential reason for the negative findings is that managers may

have already used a considerable amount of funds in the merger process and this means that long-term investment in R&D is therefore less likely (Hitt *et al.*, 1996). Another explanation could be that acquisition of technology through M&As is considered to be a substitute for internal R&D. The same kind of argument can be advocated not only for the specific R&D activities, but also for the widespread category of innovation expenses (see Hitt *et al.*, 1996). In the present study, we considered as proxies for innovation inputs R&D expenses and, in broader terms, the costs of innovation, including intramural (performed within the boundaries of the firm) and extramural (performed with external entities) R&D expenditure, industrial design costs, investments in the acquisition of external knowledge like trademarks or software, marketing for innovations and training of personnel for innovation purposes.

We formulate the following hypothesis:

*H1: In potentially dominant firms M&As have a negative effect on innovation inputs.*

### **3.2.2 M&A and innovation outputs**

In their efforts to increase innovative output, companies are increasingly relying on M&As. This seems to be especially true for dynamic sectors where technological developments occur continuously (Hagedoorn and Duyster, 2002; Bannert and Tschirky, 2004). A possible reason for expecting M&As to have a positive effect on innovation output is that technological knowledge often has a strong tacit component and tacit knowledge can be absorbed better through the acquisition of a whole company (De Man and Duysters, 2005; Bresman *et al.*, 1999). Furthermore, two merging companies might own different knowledge bases that need to be combined in order to be able to generate an innovation that would otherwise not be achievable (De Man and Duysters, 2005; Gerpott, 1995). M&As may also allow the acquiring company to introduce more innovations in the market by shortening the time required to develop new products or to launch these products to the market (Chaudhuri, 2004). However, empirical tests have generally failed to prove the positive effects of M&As on innovation output (Hitt *et al.*, 1991; Schenk, 1996; Ernst and Vitt, 2000; De Man and Duysters, 2005) despite the reasons to expect so. In fact, innovation output might be mitigated by the post-merger integration process that absorbs energy and resources which could be devoted to new activities (De Man and Duysters, 2005). An exception to this research stream is presented by the results of Ahuja and Katila (2001). They argue that technology-driven M&As could increase innovation output, especially when the absolute size of the acquired knowledge base is large. Because we focus on M&As of potentially dominant firms, we can expect that the acquired knowledge base is large. We, therefore, formulate the second hypothesis as follows:

*H2: In potentially dominant firms, M&As have a positive effect on innovation outputs.*



### 3.2.3 M&A and innovation efficiency

Economic literature recognises that M&As can stimulate different types of efficiencies: (a) allocative, (b) productive, (c) transactional, and (d) dynamic (Kolaski and Dick, 2003). Allocative efficiencies refer to the use of resources at the highest valued level among all possible alternatives. Productive efficiencies are the capability to obtain the same output by using less input; transactional efficiencies result from reducing the transaction costs based on opportunistic behaviour or information asymmetry. Dynamic efficiencies are the efficiencies of interest in the present study and refer to the processes aimed at generating more innovations. M&As can stimulate dynamic efficiencies by providing the resources which are needed to innovate or by providing them at a lower cost. Being large, however, does not seem to provide an advantage in terms of obtaining greater levels of efficiency (Grupp, 1997).

In a dynamic efficiency context, the same observed output of new/improved products is obtained with lower levels of R&D inputs. According to Gugler *et al.*, (2003) this can even take place in a small number of cases. This phenomenon could be due to the post merger capability to manage innovation better at a corporate level. It has been shown that companies that use R&D resources more efficiently are also likely to be more innovative (Boone, 2000). Bughin and Jacques (1994) have argued that *'failure to innovate ... is also linked to the inability of firms to obey to some key managerial principles ... like R&D efficiency'*. Hence, we formulate the following hypothesis:

H3: *In potentially dominant firms, M&As have a positive effect on innovation efficiencies.*

## 3.3 Data and methods

The descriptive and explanatory analyses that will be used in this study are based on data from the Business Register (ABR) and five waves of the Community Innovation Survey (CIS) in the Netherlands<sup>4</sup>.

In the Netherlands, each wave includes information on more than 10,000 companies. The threshold to be included in the sample is 10 employees (Eurostat, 2001). In the Netherlands, however, CIS 2.5 and 3 have been sponsored by the Ministry of Economic Affairs and they have also included companies with fewer than 10 employees. CIS are surveys conducted on samples which are stratified by firm size. Therefore large and very large firms are over represented.

In order to exploit the time dimension of the Community Innovation Survey, a panel data set has been constructed on the basis of the 5 CIS waves. Despite the fact that Eurostat has composed a common guideline for the Community Innovation Survey, the national statistical

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<sup>4</sup> The empirical analyses were performed at the Centre for Economic Micro data (Cerem) at Statistics Netherlands (CBS).



institutes were allowed to adapt or slightly modify it. This resulted in waves that differ slightly from one another. Once the variables of interest across waves have been homogenised, the preliminary panel dataset has been integrated with the Dutch Business Register database (ABR). In doing so, we have not only at our disposal the details of companies' innovative behaviour, but also relevant information on firm-specific characteristics.

In order to focus on firms that have the potential to become dominant in their market, we select the firms above the 85<sup>th</sup> percentile of the size distribution calculated for each 3-digit sector.

The next section introduces the variables.

### 3.3.1 Dependent variables

Innovation is a complex and multidimensional phenomenon that is, by its own nature, difficult to capture. Hagedoorn and Cloudt (2003) noticed that using multiple indicators to measure innovation has the advantage that it is not necessary to rely on the goodness of fit of a single variable and that a more comprehensive assessment of innovation performance is possible. The present work distinguishes between three main proxies for innovation: innovation inputs, outputs and efficiency.

#### *Innovation input proxies*

As innovation inputs we consider two types of indicators: (1) expenses devoted to R&D, and (2) total cost of innovation.

The R&D department has been traditionally considered the location where new (especially technological) knowledge is generated and embedded in innovative output. Following the literature, we use the logarithm of the total R&D expenses as our first innovation input proxy (see for example, Hitt *et al.*, 1996; Hall *et al.*, 1990; Mairesse and Mohnen, 2005; Frenz and Ietto-Gillies, 2007) to capture the levels of knowledge which are generated within the boundaries of the firm.

R&D is, however, just one input of the innovation process and a company can engage in other type of investments that generate innovation. CIS reports a variable, namely the total cost of innovation. This represents the sum of firm expenses for intramural and extramural R&D, the acquisition of hardware or machinery, the acquisition of external knowledge like licenses or the rights to use patents. It also includes the costs of personnel training which are directly aimed at innovation, the cost of marketing activities in order to launch a new product and the cost of procedures to realise innovations. Roughly, the total costs of innovation refer to all investments and expenses that are made for innovation purposes. The total cost of innovation is our second proxy for innovation input.

Both variables have been scaled by the number of employees and taken as a logarithm.

### *Innovation output proxies*

In line with previous research that has used CIS data (among others Evangelista *et al.*, 1998, Mairesse and Mohnen, 2005; Frenz and Ietto-Gillies, 2007), we choose a firm's sales due to new or improved products introduced into the market as a proxy of innovation output. Compared to other innovation output measures (like patents), sales resulting from new products has the advantage that it also indicates the success of the innovation (Kleinknecht *et al.*, 2002). In the CIS questionnaire, this proxy is the percentage of firm's total sales that can be attributed to innovative products. We transformed the variable multiplying the percentage by a firm's total sales in order to have a continuous variable not bounded between 0 and 1. The variables have been scaled by the number of employees and taken in the logarithm form.

For product innovations, two levels of newness are considered. The products/services can be new to the company, or new to the whole market. Products new to the firm indicate that the firm has been able to imitate innovations already introduced to the market thus improving its competitiveness. New products for the market signals that the firm is an innovator in a strict sense, i.e. it is able to generate complete new products and successfully launch them into the market.

### *Innovation efficiency proxies*

We are interested in understanding how much innovative input is needed to generate an observed innovative output. As a proxy for efficiency we have constructed two new variables. The first variable is innovation cost efficiency. It is obtained by dividing the total sales due to new products in the current period ( $t$ ) by the total expenditures devoted to innovation in the previous period ( $t-1$ ). The second variable, R&D efficiency, is constructed by dividing total sales due to the new products in the current period ( $t$ ) by R&D expenses in the previous period ( $t-1$ ).

These efficiency indicators, namely the total cost of innovation efficiency and of R&D efficiency account for the time lag for investments in innovation to generate returns. According to the two levels of newness (products new to the firm or new to the markets), we constructed 4 variables as efficiency proxies: R&D efficiency in terms of new products for the firm, R&D efficiency in terms of new products for the market, innovation cost efficiency in terms of new products for the firm and innovation cost efficiency in terms of new products for the market.

### 3.3.2 Independent variables

Our main independent variable of interest is the occurrence of an M&A. We are interested in identifying whether M&A activities, previously performed, affect our dependent variables.

For this purpose, we have constructed a dummy variable that indicates whether the firm had acquired another firm in the previous CIS wave. The lagged M&A-proxy allows accounting for the time span necessary for the M&A to display its effects on innovation. With the use of a lagged M&A variable we allow for a time span that ranges from a minimum of 3 to a maximum of 5 years. This interval is consistent with the period that was reported in literature for an M&A to potentially show its effects on innovation (De Man and Duysters, 2005).

### 3.3.3 Control variables

We control for the specific characteristics of the technological regimes in which firms operate on the basis of Pavitt's (1984) taxonomy. We construct 4 dummy variables, classifying our sample according to the technological regimes which were proposed by Pavitt (1984): science-based firms (the variable is named 'science-based' in the model), specialised suppliers (named 'specialised-sup' in the model), scale-intensive ('scale-int.' in the model) and supplier-dominated firms. The last category (supplier-dominated) acts as a reference category in our estimates.

In addition, in order to control for firm specificities other than technology we introduce firm's age and firm's size as variables. The age proxy has been constructed using the difference in months between the year of entry of the company in the Business Register and the year in which the Community Innovation Survey took place. Firms' date of entry in the Business Register has been used as it very closely approximates firms' actual date of entry into the market (Cefis and Marsili, 2006).

Concerning size, we had at our disposal two proxies: firm's total sales and the number of employees. Due to quite a high non-response level for both of these proxies in CIS surveys, we use as proxy for firm's size the number of employees as reported in the ABR files in each of the years under analysis. In order to account for non-linear relationships in firm's age and size and the innovation proxies, we also include the squared terms of both age and size in all regression models. We add to our analysis an interaction term 'age-size' to account for a possible interaction between the two variables.

Finally, we recognise that some other important control variables, like the product life cycle, should have been taken into account to properly consider the specific context of innovation. However, the nature of the available data did not enable direct controlling for the above (but only indirectly by including the sector characteristics variables in the model).

We have estimated a model for each innovation proxy that is described in the above part. Each model considers the specific innovation proxy as a function of a lagged M&A variable (M&A<sub>it-1</sub>) and firm specific characteristics such as age and size.

Accordingly, the model can be written as:

$$\ln(\text{innovation})_{it} = \alpha + \beta_1(M\&A)_{it-1} + \beta_2\ln(\text{size})_{it} + \beta_3\ln(\text{age})_{it} + \beta_4\ln(\text{size}^2)_{it} + \beta_5\ln(\text{age}^2)_{it} \\ + \beta_6\ln(\text{age}_{it} \times \text{size}_{it}) + \beta_7\text{science-based} + \beta_8\text{specialised-sup.} + \beta_9\text{scale-int.} \\ + u_{it}$$

where the error term is:

$$u_{it} = \mu_i + v_{it}$$

with  $\mu_i$  representing unmeasured individual factors which affect innovative proxies – or the so-called unobserved random effect and  $v_{it}$  as the remaining error component.

The M&A coefficient captures the causal effect of mergers on one of the three dimensions of innovativeness at firm level.

The choice of the estimation technique was based on the context of the data, next to other factors. Specifically, panel data may create analytical problems in the form of error terms containing heteroskedasticity, autocorrelation, or cross-sectional correlation. (Wooldridge, 2003). We performed statistical tests to check for heteroscedasticity (Breusch-Pagan test), the significance of random effects (the standard Lagrange multiplier test) and for autocorrelation of the residuals. It has to be noted that the presence of autocorrelation makes the Hausman (1978) test for choosing between fixed-effect models (FEM) and random-effects models (REM) inappropriate (Baltagi, 1995; Matyas and Sevestre, 1996). The use of REM is supported by the structure of our panel dataset with a short time series and a large number of observations. Furthermore, the choice of random effects is due to the fact that most of the variability in our dependent and independent variables is across firms and not within firms over time (see Table 3.2), (Hsiao, 1986; Vernon, 2003). Since we found autocorrelation of the first order, models allowing for first-order autocorrelation (AR1) are estimated. Finally, for censored dependent variables, the application of Tobit models is appropriate.

### 3.4 Results

#### 3.4.1 Descriptive statistics

Table 3.1 shows the characteristics of our entire sample, the potentially dominant firms (PD) and the manufacturing potentially dominant firms (MPD). The entire sample has a number of observations ranging from 10,664 firms (CIS2) to 13,465 firms (CIS2.5) across waves while the PD firms sample has obviously fewer observations varying from 1,658 firms (CIS3) to 2,526 (CIS 2.5). When we focus on the manufacturing sector the number of observations decreases substantially, from 482 (CIS 3.5) to 726 (CIS2.5).

Table 3.1 shows that in all the waves the means and the median are significantly larger in PD firms than in the entire sample. The mean is always larger in all dominant firms in all CIS

Table 3.1. Firms' number of employees across CIS waves.

<b>Variable: number of employees in the last year of CIS</b>	<b>Entire sample</b>	<b>Potentially Dominant Firms (PD)</b>	<b>Manufacturing PD Firms (MPD)</b>
CIS 2 (1994-1996)	N=10,664	N=2,267	N=574
Mean	183	557	551
Median	60	160	217
5 <sup>th</sup> percentile	12	16	53
95 <sup>th</sup> percentile	525	1,600	1,691
Variance	1,859,732	8,482,945	4,126,467
Skewness	41.28	19.55	14.8
Kurtosis	2184.6	484.1	267.1
CIS 2.5 (1996-1998)	N=13,465	N=2526	N=726
Mean	162	586	574
Median	39	150	180
5 <sup>th</sup> percentile	2	3	3
95 <sup>th</sup> percentile	400	1,707	1,360
Variance	1,327,678	6,604,133	6,056,728
Skewness	25.4	11.6	10.97
Kurtosis	787.6	161.5	139.3
CIS 3 (1998-2000)	N=1,0750	N=1,658	N=542
Mean	158	630	457
Median	45	200	200
5 <sup>th</sup> percentile	2	47	55
95 <sup>th</sup> percentile	445	1,810	1,400
Variance	1,286,035	6,843,590	885,592.5
Skewness	33.5	14.9	6.68
Kurtosis	1,363.1	268.5	59.004
CIS 3.5 (2000-2002)	N=10,596	N=1,677	N=482
Mean	147	501	390
Median	58	178	201
5 <sup>th</sup> percentile	10	41	51
95 <sup>th</sup> percentile	440	1,435	1,295
Variance	733,894	4,273,106	476,858
Skewness	37.5	16.29	6.8
Kurtosis	1,813.2	326.7	70.4

Table 3.1. Continued.

<b>Variable: number of employees in the last year of CIS</b>	<b>Entire sample</b>	<b>Potentially Dominant Firms (PD)</b>	<b>Manufacturing PD Firms (MPD)</b>
CIS 4 (2002-2004)	N=10,853	N=1,720	N=491
Mean	171	681	642
Median	45	242	235
5 <sup>th</sup> percentile	9	41	50
95 <sup>th</sup> percentile	500	2,277	2,157
Variance	899,690	4,708,631	3,585,829
Skewness	24.4	11.002	8.001
Kurtosis	796.5	159.6	76.8

waves than in the potentially dominant firms in the manufacturing sector only (PDM). On the contrary, the median behaves the other way around: it is higher for PDM than for all the potentially dominant (PD) firms (with the exception of CIS 4). This suggests that the largest firms in the population that raise the mean are not manufacturing firms. In every wave the median is lower than the mean suggesting that the firm size distribution is skewed towards the smaller firms. The skewness and the kurtosis in PDM are much smaller than in the entire sample and in the PD sample, implying that firms' size distribution is less skewed and contains fewer firms in the tails, so there are fewer very small or very big firms.

Table 3.2 shows the statistics of the dependent variables, distinguishing between firms involved in M&A activities and those that are not involved. The last columns report the results of a *t-test* and the Kolmogorov-Smirnov test on the means of the two firms groups.

The results which are reported in the table highlight the striking differences between these two groups of firms. The results of both the *t-test* and the Kolmogorov-Smirnov test confirm that the means do indeed differ significantly for all the variables (with the only exception of the *t-test* result for R&D efficiency in terms of new products for the firm). Our findings suggest that MPD firms involved in M&As are strong investors in R&D. This is confirmed by the fact that R&D intensity is much higher for M&A active firms than for M&A non-active firms. Remarkably, M&A non-active firms display higher levels of innovation intensity compared to M&A-active firms. M&A active companies are more efficient in the use of R&D and innovation investments. Indeed, M&A active firms display higher levels of R&D and innovation cost efficiencies for products new to the firm compared to M&A non-active firms. When we consider products new to the market, the result is similar and M&A active companies are more efficient with respect to both R&D and innovation investments compared to M&A non-active firms.

Table 3.2. Descriptive statistics of PDM.

Variable		M&A active firms		M&A non-active firms		t-test	Kolmogorov-Smirnov test
		Mean	Std.dev.	Mean	Std.dev.		
R&D intensity (R&D expenditures/number of employees)	Overall	9.1	19.9	6.8	32.3	-3.74***	0.17***
	Between		19.09		37.3		
	Within		6.9		5.1		
Innovation intensity (innovation cost/number of employees)	Overall	13.88	23.4	15.88	119.9	-2.6***	0.15***
	Between		22.4		129.6		
	Within		1.23		40.09		
Total sales due to new and improved products for the firm	Overall	177.06	411.07	145.7	973.05	-3.09***	0.22***
	Between		430.3		1,163.01		
	Within		31.3		89.8		
Total sales due to new products for the firm	Overall	45.7	202.3	27.3	137.7	-1.5**	0.11***
	Between		212.2		157.3		
	Within	18.2		35.4			
Total sales due to New products for the market	Overall	32.2	66.01	26.9	172.9	-3.4***	0.15***
	Between		65.6		198.1		
	Within		14.2		42.2		
R&D Efficiency in terms of new products for the firm (expressed as log)	Overall	1.82	4.3	1.5	10.7	0.65	0.23***
	Between		4.4		5.9		
	Within		1.01		7.9		
Innovation cost efficiency in terms of new products for the firm (expressed as log)	Overall	0.67	2.4	0.54	4.7	1.79**	0.24***
	Between		2.3		2.5		
	Within		0.8		3.5		
R&D Efficiency in terms of new products for the market (expressed as log)	Overall	8.56	30.8	3.4	29.3	-1.56**	0.24***
	Between		23.2		15.7		
	Within		17.9		22.1		
Innovation cost efficiency in terms of new products for the market (expressed as log)	Overall	1.88	8.7	1.41	20.1	-1.23*	0.25***
	Between		9.2		11.8		
	Within		0.52		14.5		

Note: statistically significant at: \*\*\* 1% level; \*\* 5% level; \* 10% level.

Innovation output also seems to be higher for M&A-active firms than for M&A non-active firms. Companies involved in M&As show higher levels of sales from products new to the market and to the firm. The mean for the M&A-active firms is higher than the mean of the M&A non-active firms (for a percentage ranging from a minimum of the 19% to a maximum of the 60%).

It is worth noting that the between variance for all the dependent variables is significantly higher than the within variance for the M&A active firms (for the non-M&A-active firms, the same is true with the sole exception of the efficiency variables). The between variance is on average at least 29 percent higher than the within variance and in certain cases (innovation intensity) it is 18 times the within variance. The above suggests the use of Random Effect (RE) models.

### 3.4.2 Multivariate analysis

Tables 3.3, 3.4 and 3.5 show the effects of M&As on the proxies of innovation input, innovation output and innovation efficiencies respectively. Table 3.3 focuses on the innovation inputs. The first two columns show that M&A-activities performed in the previous 3-5 years have a positive and significant (10% level) effect on R&D and innovation intensity. We consequently reject our hypothesis H1 stating that M&A activities have a negative effect on innovation inputs. Not surprisingly, the technological characteristics significantly affect the inputs of innovation. This suggests that science-based, specialised suppliers and scale-intensive firms have higher levels of investment in R&D and innovation than supplier dominated firms. Our findings also suggest that the size of the company positively influences the innovation intensity, but not the intensity of the R&D investments. Large companies have higher levels of costs associated with innovation other than R&D-related expenses. There is no evidence that companies, which are present in the market for a longer time, have higher levels of innovation inputs. So age does not significantly affect the level of innovation intensity. We observe that when size and age are associated their interaction has a positive impact on innovation intensity. With respect to R&D intensity, the results suggest that younger companies display higher levels of R&D inputs. An increase in the age of the company has a positive and non-linear effect on the level of the dependent variable. The non-linearity suggests that the increase in the R&D investments is affected in a more than proportional way for each unit of increase in the control variable.

The Tobit random effect models estimation on innovation output proxies are reported in Table 3.4. For each dependent variable, two models are estimated using alternatively or R&D intensity in time  $t-1$  or innovation intensity in  $t-1$ . The results show that M&As activities can enhance the innovativeness of a corporation by increasing their level of sales from products new to the firm and new to the market. At the company level, this increase in innovation output appears to take place only if we account for the effect of innovation intensity of the previous period. High levels of R&D and innovation investments performed in the previous



Table 3.3. The effects of M&amp;As on firms R&amp;D and innovation input proxies.

Dependent variable	Tobit model estimates			
	R&D intensity		Innovation intensity	
	Coef.	(std. error)	Coef.	(std. error)
Merged in t-1	0.119*	(0.08)	0.149*	(0.09)
R&D intensity t-1	0.29***	(0.03)	-	-
Innovation intensity t-1	-	-	-0.01	(0.03)
Science-based firms	0.56***	(0.06)	0.95***	(0.09)
Specialised suppliers	0.19***	(0.05)	0.301***	(0.07)
Scale-intensive firms	0.65***	(0.07)	0.98***	(0.11)
Size	0.04	(0.101)	0.209*	(0.14)
Size_sq	1.15	(0.9)	-1.3	(1.4)
Age	-0.0002*	(0.0001)	-0.0001	(0.0002)
Age_sq	1.16**	(0.65)	-0.58	(0.95)
Age × size	-0.004	(0.007)	0.017*	(0.01)
Constant	-0.4	(0.3)	-0.03	(0.404)
rho	0.26		0.55	
Wald chi2	360.02***		198.6***	
Number of observations	1,650		1,650	

Note: Standard error in parantheses; statistically significant at: \*\*\* 1% level; \*\* 5% level; \* 10% level.

Lagrange multiplier test for zero random effects has been employed, as well Breusch-Pagan heteroskedasticity test and the ARI test discussed in Wooldridge (2002).

period do not appear to have, in themselves, a positive effect on the percentage of sales due to products new to the firm. When we concentrate on the degree of firm's innovativeness, considering the sales from products new to the market, M&A activity appears to have a positive and significant effect on the dependent variable of interest. M&As seem to improve the acquiring firms' capabilities to produce and sell completely new products in the market. It is essential for the company to have invested intensively, in the previous period, in R&D activities. It is worth noting that the proxy used (percentage of sales from new products for the market) also indirectly measures the commercial success of an innovation. It is possible that M&As also affect factors (like marketing activities) that are important to support the commercial success of completely new products.

Table 3.4. The effects of M&As on firms R&D and innovation output proxies.

Dependent variable	Random effect model estimates			
	%of total sales due to new products for the firm		%of total sales due to new products for the market	
	Model 1 Coef. (std. error)	Model 2 Coef. (std. error)	Model 1 Coef. (std. error)	Model 2 Coef. (std. error)
Merged in t-1	0.167 (0.17)	0.26* (0.17)	0.49*** (0.1)	0.49*** (0.16)
R&D intensity t-1	-0.2*** (0.05)	- -	0.12** (0.05)	- -
Innovation intensity t-1	- -	-0.32*** (0.04)		-0.05 (0.04)
Science-based firms	1.04*** (0.12)	1.09*** (0.13)	0.9*** (0.12)	0.96*** (0.12)
Specialised suppliers	0.44*** (0.1)	0.44*** (0.108)	0.6*** (0.1)	0.49*** (0.102)
Scale-intensive firms	0.92*** (0.15)	0.96*** (0.15)	1.04*** (0.1)	1.015*** (0.14)
Size	0.24 (0.22)	0.24 (0.22)	0.03 (0.21)	0.037 (0.21)
Size_sq	-0.37 (2.07)	-0.18 (2.09)	-0.7 (2.01)	-0.93 (2.009)
Age	-0.0004 (0.0003)	-0.0002 (0.0003)	0.0002 (0.0003)	0.0002 (0.0003)
Age_sq	0.7 (1.44)	1.14 (1.4)	-3.04** (1.3)	-3.14** (1.4)
Age × size	-0.003 (0.2)	-0.003 (0.02)	0.04*** (0.01)	0.043*** (0.016)
Constant	-0.48 (0.63)	-0.51 (0.63)	0.3 (0.6)	0.34 (0.6)
Rho	0.07	0.13	0.08	0.07
Wald chi2	110.12***	153.04***	131.4***	124.25***
Number of observations	1,650	1,650	1,650	1,650

Note: Standard error in parantheses; statistically significant at: \*\*\* 1% level; \*\* 5% level; \* 10% level. Lagrange multiplier test for zero random effects has been employed, as well Breusch-Pagan heteroskedasticity test and the ARI test discussed in Wooldridge (2002).

Table 3.5. The effects of M&As on efficiencies.

Dependent variable:	R&D efficiency in terms of new products		Innovation cost efficiency in terms of new products	
	for the firm Coef. (std. error)	for the market Coef. (std. error)	for the firm Coef. (std. error)	for the market Coef. (std. error)
Merged in t-1	0.195*** (0.074)	0.38*** (0.114)	0.045 (0.05)	0.208*** (0.06)
Science-based firms	-0.01 (0.043)	0.086* (0.055)	-0.03 (0.027)	0.036 (0.05)
Specialised suppliers	-0.013 (0.03)	0.049 (0.045)	0.002 (0.024)	0.04 (0.04)
Scale-intensive firms	0.013 (0.06)	-0.004 (0.06)	-0.022 (0.04)	-0.005 (0.06)
Size	0.195*** (0.08)	0.13 (0.12)	0.08*** (0.04)	0.136* (0.08)
Size_sq	-0.7 (0.75)	-0.98 (1.07)	-0.18 (0.4)	-0.88 (0.8)
Age	-0.0005*** (0.0001)	-0.0003*** (0.0001)	-0.0002*** (0.0007)	-0.0002* (0.0001)
Age_sq	2.64*** (0.58)	1.1** (0.55)	1.28*** (0.37)	1.06** (0.55)
Age × size	-0.01* 0.007	0.001 (0.006)	-0.006 (0.005)	-0.004 (0.006)
Constant	-0.74*** (0.23)	-0.4 (0.32)	-0.36*** (0.101)	-0.48** (0.24)
R-squared	0.07	0.03	0.04	0.03
Wald chi2	111.14***	39.6***	68.55***	30.2***
Number of observations	1,650	1,650	1,650	1,650

Note: Standard error in parantheses; statistically significant at: \*\*\* 1% level; \*\* 5% level; \* 10% level. Lagrange multiplier test for zero random effects has been employed, as well Breusch-Pagan heteroskedasticity test and the ARI test discussed in Wooldridge (2002).

Our results show that size is not important to explain higher levels of innovation outputs (both at the company and at the market level). When size is considered in combination with

the age of the company, the results indicate that older and larger companies are more likely to display higher levels of sales from products new to the market. Positive and highly significant are, again, the Pavitt variables for all the innovation output proxies considered.

Summarising, the above findings lead us to accept hypothesis H2. With this we affirm that M&As have a positive effect on innovation output measured by total sales due to new products to the firm and total sales of products new to the market.

Table 3.5 shows the results of the regression analysis for the efficiency variables. We distinguish two cases. The first one considers the R&D efficiencies for products new to the firm and new to the market. The second case considers innovation cost efficiencies for products new to the firm and new to the market. M&As are a significant factor in explaining the levels of both types of R&D efficiencies. With respect to innovation cost efficiencies, M&As seem to have an effect only in terms of new products to the market. The findings suggest that companies are not helped by M&As to improve the effectiveness of their innovation investments for products only new to the company. M&As have a positive, but insignificant, effect on innovation cost efficiencies for products new to the company. The findings highlight that companies can use M&As to optimise internal investments and expenses with respect to all their R&D activities and, in general, to make a more efficient use of innovation investments when they are focussed on introducing new products in the market. Large companies seem to have an advantage over smaller companies in using their innovation investments and R&D expenses to generate products new to the company more efficiently. Size is not significant when considering R&D efficiency for products new to the market. Remarkably, the technological characteristics are not significantly correlated with the efficiency variables, with the sole exception of the R&D efficiency for products new to the market in the science-based companies. Surprisingly, younger companies appear to make a more efficient use of their R&D and innovation investments for both products new to the company and new to the market compared to older firms. The effect of age is, however, not linear. This implicates that the dependent variable is affected in a more than proportional way by increasing age.

In conclusion, we can accept H3 that M&As have a positive and significant effect on all R&D efficiencies variables and on innovation efficiency exclusively in terms of products new to the market (but not in terms of new products to the firm).

### **3.5 Discussion and conclusions**

The present Chapter answers RQ2. In the present study we have empirically tested a series of hypotheses on the impact of M&A activities on innovation performance in the specific context of market dominance. In order to account for the multidimensional nature of innovation, we have considered three aspects of the innovative activity: innovation inputs, innovation outputs and innovation efficiencies. We have exploited the panel nature of our dataset to account for the time gap necessary for the M&As to have an effect on the corporate innovation performance.

Our analyses show that, with minor exceptions, M&As have a positive and significant effect on the innovation dimensions that were investigated. The findings of our analysis contribute to a better understanding of the effects of M&A in the context of potential market dominance for managerial practice and also for policy makers.

From a managerial perspective our research confirms that – contrary to conclusions from previous empirical researches – M&As are an appropriate tool for stimulating innovation. M&As appear to be an appropriate tool for sustaining the process of internal renewal of the company's product base and have the potential to provide direct support to develop products new to the market. M&As enhance R&D efficiencies and innovation efficiencies in terms of products new to the market. The achievement of higher levels of efficiencies is often advocated as a motivation for M&A activities following the reasoning that, combining their resources, two companies can benefit from synergistic effects (Gupta and Gerchak, 2002). Our results confirm the above effect. It is worth noting that the variables which were used to control for specific technological characteristics (i.e. Pavitt's taxonomy), have been confirmed to be highly significant in explaining innovation patterns. This supports previous findings that '*innovative activities in an industry can be explained as the outcome of different technological (learning) regimes*' (Breschi *et al.*, 2000). Only with respect to the levels of efficiency, the Pavitt taxonomy appears not to be relevant. This suggests that the efficient use of resources is not influenced by sector characteristics.

Our study is also relevant for the authorities' perspective. The European Commission has stressed on several occasions that to improve employment, competitiveness and the growth of the economy as a whole, it is essential to strengthen innovation (European Commission, 1995), as innovation can promote societal welfare by providing new products of better quality. Policy-makers try to stimulate the economy and increase the competitiveness of nations to preserve overall wealth. Under the basic assumption that society benefits from a situation of competition and, therefore, low concentration, M&As alter the structure of the market by generating dominant firms. They can affect the competition of an economy, and as a consequence, they can impede the long run societal well being (George and Jacquemin, 1992; Lopez, 2001). It is not, therefore, surprising that authorities closely monitor the potential impact of M&As as they can reduce competition through the abuse of market power. However, scholars often suggest that the downside in terms of increase of market power should be weighted against the potential positive effects, e.g. concerning innovation, in a case-by-case assessment (Williamson, 1968; George and Jacquemin, 1992). In the context of the new EC Merger Regulation (European Commission, 2004), M&As favouring market dominance that would have been prohibited based on a traditional analysis of market structure (static efficiency), might obtain an approval if the proposed transaction will foster innovation. The above exception is defined as a dynamic efficiency defence. From this perspective, the positive effects on innovation (dynamic efficiencies) balance the negative effects due to increased market concentration. If M&As generate market power but foster innovation, policy makers are challenged by the need to identify the effects of M&As on innovation in the context of

potential market dominance. In the context of market dominance it is, therefore, even more relevant for decision makers to have a clear assessment of the potential benefits that can be expected from choosing an M&A as governance mode. Our empirical evidence supports the fact that M&A activities can actually enhance innovation. By confirming the above positive link, we argue that authorities are therefore confronted with weighing M&As' potential anticompetitive effects on market structure against their capability to stimulate competition through innovation. For this positive effect to be visible a considerable time lag (3-5 years) is necessary. Long-term societal well-being can be harmed if the merger evaluation does not take into careful consideration the full range of potential effects of the M&A activity, including those on innovation.



## 4. The effect of a portfolio of strategic alliances and mergers & acquisitions on innovation

### 4.1 Introduction

The purpose of Chapter 4<sup>5</sup> is twofold. First, we intend to verify whether being ambidextrous in using M&As and SAs and combining diverse governance modes in a portfolio is advantageous for innovation. Second, we aim to compare the effects of a portfolio-based strategy with the effects of specialising in the use of a single governance mode, namely SAs and M&As. The purpose of the present chapter is, therefore, to answer the third research question (RQ3a and RQ3b).

RQ3a: *What is the effect on innovation of M&As compared to SAs as governance modality?*

RQ3b: *What is the effect on innovation of using a portfolio of SAs and M&As compared to using only M&As or SAs?*

In doing so, we intend to deepen our current understanding of the strategic use of sourcing decisions by ranking the success of different governance modes with respect to innovation performance. Previous literature has mainly assessed the effect of a single governance mode, alliances (e.g. Baum *et al.*, 2000) or, alternatively, M&As (e.g. Ahuja and Katila, 2001) on innovation. The lack of comparative studies leaves managerial practice with limited guidance for strategic governance decisions (De Man and Duysters, 2005). Only a few studies (e.g. Keil *et al.*, 2008; Schildt *et al.*, 2005; Rothaermel and Hess, 2007) have compared the impact on innovation of distinct governance modes for technological sourcing. An emerging research stream has, however, recognised that entering into multiple, diverse and simultaneous relationships may enhance the value-generating potential of external sources of technology as a result of synergistic effects (Mahnke and Overby, 2005). Considering M&As and alliances jointly, the success of external relationships does not depend on the management of a single relationship but on the strategic use of a portfolio containing multiple and diverse corporate links (Parise and Casher, 2003; Gulati, 1998; Hoffman, 2005; Hoffman, 2007). The portfolio is, therefore, the locus of the value creation potential for external relationships (George *et al.*, 2001).

The contribution of the present chapter is twofold. The work, testing the ambidexterity hypotheses in the context of governance modes, expands previous empirical works that have mainly focused on ambidexterity in exploration/exploitation (e.g. He and Wong, 2004),

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<sup>5</sup> This chapter is based on: Sabidussi, A., Duysters, G., Bremmers, H. and Omta, O., 2008. Governance strategies for technological innovation: a portfolio perspective. Presentation at ISC08, 2<sup>nd</sup> Israel Strategy Conference, December 2008, Tel Aviv, Israel.



external/internal technology sourcing (e.g. Rothaermel and Alexandre, 2009), and strong/bridging ties in alliances (Tiwana, 2008). The study contributes to the research stream that takes a comparative perspective on the external technological sourcing modalities. In doing so, we enrich the above literature by making a comparative study both of the isolated and the joint effects of alliances and M&As. Furthermore, the present study contributes to the existing literature by adding to previous works (e.g. Faems *et al.*, 2005; Laursen and Salter, 2006) on the performance of portfolios, in a new conceptualisation of the 'portfolio' dimension that embraces alliances as well as M&As.

The remainder of this chapter is organised as follows. In Section 4.2 we use the Resource Based View (RBV) as a theoretical framework to deploy the hypotheses and to predict the effects of governance strategies on innovation. In Section 4.3 we present the methods of our research model. The results of the Tobit estimates are reported in Section 4.4. Section 4.5 includes the discussion and the conclusions, together with the recommendations for further research.

### **4.2 Theoretical background and hypotheses**

In the present chapter we approach the governance of external sourcing of technology from two strategic perspectives: the first is based on specialisation and the other is centred around ambidexterity.

#### **4.2.1 Specialisation strategies**

The argument that specialising in a governance modality contributes to innovation is found in a Resource Based View approach (RBV). At the essence of the RBV there is the concept that a company's competitive advantage is determined by the valuable, rare, non-imitable and sustainable set of core resources and capabilities that a firm possesses (Wernerfelt, 1984; Barney, 1991; Teece *et al.*, 1997). From an RBV perspective, technological capabilities that are provided by external sources, are essential for firms as they nourish the innovation process (Lee *et al.*, 2001; Galende, 2006). From an RBV perspective, specialisation may be beneficial for two reasons. First, specialisation in a specific governance modality, representing a '*capabilities-deepening*' strategy, reinforces the existing core capabilities of a firm (Argyres, 1996: 398). Second, specialisation is beneficial for strengthening dynamic capabilities by supporting and leveraging learning effects from experience (Levinthal and March, 1993). The rationale is that the core capabilities define the strategic profile of a company but they need to be continuously renewed, in order to maintain a sustainable competitive advantage over time (Leonard-Barton, 1992; Teece *et al.*, 1997). Dynamic capabilities are stimulated by learning and continuous acquisition of new knowledge (Teece *et al.*, 1997). Specialising, therefore, increases the gains from experience and optimises the learning effects. In the following sections, we introduce the effect of M&A and SAs on innovation and we elaborate on the potential reasons for specialising. We argue that specialising leverages the specific capabilities that are associated with each governance modality success. In particular, with respect to M&As, specialising may

support the knowledge integration process that is crucial in innovation-driven acquisitions. With respect to alliances, specialising may increase the experience in dealing with opportunistic behaviours from partners and this experience is critical for the SAs achievements.

### *Specialisation strategy in M&As*

From a Resource Based View perspective, M&As may foster innovation because resources have been obtained that would not otherwise have been available (Wernerfelt, 1984; Capron, 1999). One of the most important benefits of entering into M&A activities is to acquire technological knowledge and stimulate corporate innovative capabilities (Grimpe, 2007; Schilling and Steensma, 2002). The distinction of Polanyi (1966) suggests two types of knowledge which can be identified on the basis of their level of transmissibility (Teece, 1977): tacit and codified. The first cannot be easily communicated (Nonaka, 1991). It is juxtaposed to codified knowledge that is explicit and easily communicated in a formal way (Edmondson *et al.*, 2003). Technological knowledge is generally considered to be tacit in nature. Acquiring an entire company may, therefore, be the only way to incorporate technological knowledge from external sources (McEvily and Chakravarthy, 2002; De Man and Duysters, 2005). Empirical findings, however, seem to deny the, theoretically driven, expectation of positive effects of M&A on innovation. The empirical literature on the effects of mergers and acquisitions on innovation is surprisingly scarce (De Man and Duysters, 2005). In their review, De Man and Duysters (2005) conclude that there is no evidence of positive effects of M&As on innovation performance. Using the number of patents as a proxy for innovation performance, Hitt *et al.*, (1991) even found a decline in innovation after a merger. Negative effects of M&As on innovation have been found, especially when the acquirer and the acquired were competitors before the acquisition (Cassiman *et al.*, 2005), when the merger was not technology-driven (Ahuja and Katila, 2001), or when the post-acquisition tasks absorb time and efforts which could have been otherwise dedicated to innovative activities (Hitt *et al.*, 1990). The acquisition process entails numerous tasks, ranging from the partner selection to the post-merger integration (Very and Schweiger, 2001). Looking at the above restrictive circumstances, it seems that inappropriate management of one or more phases of the acquisition process may be considered as the main determinant for M&A failure (Very and Schweiger, 2001; Epstein, 2004). From a dynamic capabilities perspective, however, an acquisition can be regarded as a 'learning process aimed at improving the acquisition process itself' (Very and Schweiger, 2001: 11). Although the conditions which facilitate learning are still debated (see Barkema and Schijven, 2008 for a review), the experience which is accumulated by the firm supports the development of M&As capabilities (Barkema and Schijven, 2008; Halebian and Finkelstein, 1999). The more experienced the acquirer is, the easier it is for the firm to discriminate, in a new acquisition context, the aspects of previous experiences which may be successfully applied (Halebian and Finkelstein, 1999). A specialisation strategy in M&As, which increases the company's experience in the acquisition process is therefore expected to foster the positive effects of M&As on innovation.

### *Specialisation strategy in alliances*

From an RBV perspective, alliances allow companies to obtain the necessary resources for a sustained competitive advantage that would otherwise be outside their reach (Eisenhardt and Schoonhoven, 1996; Das and Teng, 2000). In contrast to M&As, alliances allow ‘*cherry picking*’ of the needed resources (De Man and Duysters, 2005: 1379). Alliances may also be used to protect existing firm’s resources when companies enter into partnerships that are aimed at achieving a more efficient use of otherwise unexploited resources (Das and Teng, 2000). Alliances serve to enhance the firm’s overall competencies and stimulate learning processes, which are essential for innovation (Powell *et al.*, 1996). Empirical studies seem to confirm the positive effects of alliances on innovation. Using the intensity and the relevance of firms’ patenting results as a proxy of innovation performance, partnerships appear to be beneficial for the firms (Weck and Blomquist, 2008; Stuart, 2000). The same applies when the success of alliances is measured in terms of economic value creation (Chan *et al.*, 1997; Anand and Khanna, 2000) or in terms of sales from new products (Faems *et al.*, 2005). In their review, De Man and Duysters (2005) pointed out that the average failure rate of alliances remains around 40-50%, despite the fact that most of the empirical literature reports negative effects only rarely (e.g. Duysters and Hagedoorn, 2000; Vanhaverbeke *et al.*, 2002). Alliance success can be threatened by factors like the opportunistic behaviour of the partners involved in the relationship and by the uncertain appropriability mechanisms of the SAs results (Oxley, 1997; Gulati and Singh, 1998). The negative effects of these contingencies may be softened by the positive learning effect which has been gained in previous similar experiences (Anand and Khanna, 2000). Experience represents, therefore, a prerequisite for building the specific capabilities that are needed for the achievement of successful external relationships (Chang *et al.*, 2008).

If specialisation strategies in alliances only and in M&As only are expected to be beneficial for innovation performance, differences may still exist in the size of the effects as well as in the mechanisms that improve innovation. In particular, we distinguish between innovation that is obtained from the ‘*exploitation of old certainties*’ and innovation generated by ‘*the exploration of new possibilities*’ (March, 1991: 71). Exploration may be associated with the discovery of a new technology while exploitation refers to the improvement of an existing one (March, 1991). The benefits that derive from exploration are more uncertain and more distant in time than those that arise from exploitation (March, 1991). Alliances, requiring lower levels of investment and being more easy to reverse, are more flexible instruments than M&As and, therefore, more suitable in situations of high technological uncertainty (Van de Vrande *et al.*, 2006). Alliances may be beneficial in monitoring and examining the suitability of different competing technologies without sustaining the costs of full development (Duysters and De Man, 2003). Finally, alliance-specialised strategies, compared to M&A-based ones, allow the

firms to target more precisely the resources needed and to avoid problems of ‘indigestibility’ of non-desired resources that affect M&A performance (Hennart, 1988; Hennart and Reddy, 1997: 6). For the purpose of technological innovation in the context of rapid scientific evolutions, the characteristics that are associated with alliances are especially suitable for explorative innovation (Dittrich and Duysters, 2007).

M&As, which are characterised by a high degree of integration present an advantage over alliances in that they provide complete control over the resources that are accessed (Chiesa and Manzini, 1998). High degrees of integration favour the exploitation of existing knowledge (Puranam and Srikanth, 2007). Therefore, we formulate our next hypotheses as follows:

H1a: *A governance strategy focusing only on alliances will show a more positive effect on explorative innovation than a governance strategy specialised in M&As.*

H1b: *A governance strategy focusing only on alliances has a less positive effect on exploitative innovation than a governance strategy specialised in M&As.*

### 4.2 Strategy based on governance ambidexterity

For achieving and sustaining competitive advantage, managers are challenged in the short run to exploit existing knowledge with incremental innovations and in the long run to explore new knowledge for generating radical innovations (Tushman and O'Reilly, 1996). The ability to do both simultaneously represents a dynamic capability that is qualified as ambidexterity (O'Reilly and Tushman, 2008; Tushman and O'Reilly, 1996). The concept of ambidexterity indicates ‘the firm’s ability to simultaneously balance different activities in a trade-off situation’ (Rothaermel and Alexandre, 2009: 759). Im and Rai (2008) have extended the concept of ambidexterity to explorative and exploitative learning in the context of inter-firm relationships. According to Schildt *et al.*, (2005), alliances are associated with explorative learning and acquisitions with exploitative learning. In a technological sourcing context, we therefore interpret ambidexterity as the capability to use both alliances and M&As. O'Reilly and Tushman (2008: 192) observe that firms pursuing ambidexterity may end up being ‘mediocre at both exploration and exploitation’ compared to firms that focus and specialise in a single dimension. In a trade-off situation where the companies have to choose between two diverse strategies, the tendency is to prefer one of the extremes (Ghemawat and Ricart I Costa, 1993). Intermediary positions that combine simultaneously different strategies expose the companies to the risk of being, in the words of Porter (1980: 17), ‘stuck in the middle’ (Ghemawat and Ricart I Costa, 1993: 64; O'Reilly and Tushman, 2008: 192). Ambidexterity represents a complex managerial task that requires the conciliation of conflicting tensions (He and Wong, 2004; O'Reilly and Tushman, 2008). The ‘complexity costs’ that are associated with integrating different strategies are higher than those associated with adopting a single, focused strategy (Ghemawat and Ricart I Costa, 1993: 64). Ambidexterity is, therefore, costly. In their study of more than 300 small firms, Ebben and Johnson (2005) found empirical evidence

that pursuing either efficiency or flexibility strategies leads to higher levels of performance compared to trying to pursue both. In a governance choice context, we, therefore, formulate the following hypotheses:

H2a: *An ambidextrous governance strategy will show a less positive effect on explorative innovation than a strategy specialised in strategic alliances only.*

H2b: *An ambidextrous governance strategy will show a less positive effect on exploitative innovation than a strategy specialised in M&As only.*

Even if potential difficulties may be associated with ambidexterity, ‘both exploration and exploitation are essential for corporations’ (March, 1991: 71). A firm’s long-term success depends on being simultaneously efficient in the use of existing resources and on profiting from new opportunities (O’Reilly and Tushman, 2008). In doing so, companies avoid both the ‘*failure trap*’, where the continuous shift to different alternatives inhibits efficiency, as well as the ‘*competency trap*’ of just focusing on what a company is good at (O’Reilly and Tushman, 2008: 190). It may also be argued that until a ‘*certain inflection point*’ where the ‘*marginal costs of managing complexity are higher than the expected benefits from this increased complexity*’, ambidexterity can be beneficial to performance (Duysters and Lokshin, 2008: 13). Empirical verification of ambidexterity hypotheses is still limited (Raisch and Birkinshaw, 2008). Existing studies, however, seem to suggest that ambidexterity is positively associated with performance. In particular, He and Wong (2004) found empirical evidence that ambidexterity in exploration and exploitation has a positive effect on the sales growth rate. Lubatkin *et al.* (2006) tested the effect of ambidexterity on performance among SMEs. By measuring performance in terms of the CEOs’ perceived achievements with respect to sales growth, market share growth, return on equity and return on assets, the results confirmed that ambidexterity is favourable for the firm’s success (Lubatkin *et al.*, 2006). Ambidexterity in internal and external sourcing of technology has been also proven to have a positive impact on both financial (return on equity) and innovation (number of patents) performance (Rothaermel and Alexandre, 2009). In the context of external technology sourcing, ambidexterity may enhance innovation performance by leveraging the contributions from both alliances (in terms of exploration potential and flexibility benefits) and M&As (in terms of exploitation potential and control advantages). We, therefore, state:

H2c: *An ambidextrous governance strategy will show a more positive effect on both exploration and exploitation (total innovation performance) than specialised strategies.*

### 4.3 Data and methods

#### 4.3.1 Data

In this chapter, we make use of the Community Innovation Survey (CIS)<sup>6</sup>. For the purpose of our analysis, we have used the third questionnaire (CIS III). CIS III was collected in 2000 and refers to the innovative activities that took place in the years from 1998 until 2000. Although in the Netherlands the participation in the survey was not mandatory, the response rate (with a percentage of around 54%) is the 5<sup>th</sup> highest after the four countries where the questionnaire was compulsory, namely Norway, Spain, France and Italy (Lucking, 2004). The unit of analysis of the survey is the individual firm. In the Netherlands the percentage of firms with innovative activities is around 45%, 5% higher than the European average (Lucking, 2004). Among Dutch innovative firms, the percentages of both product and process innovators are higher than the EU average and the incidence of product innovation is higher than the occurrence of process innovation (Lucking, 2004). The third CIS contains data on 10750 firms. In the present work we are interested in technological innovation that requires 'objective improvement in the performance of a product' (OECD, 1997: 28). For the purpose of our analysis, we have, therefore, focused on the companies operating in the manufacturing sector which includes a sample of 3,430 companies.

#### 4.3.2 Variables

##### *Dependent variable*

The dependent variable of interest in the present study is innovation performance. Because innovation is a complex phenomenon, which is still not completely understood (Gopalakrishnan and Damanpour 1997; Coombs *et al.*, 1996), the measurement of innovation performance represents a challenge (Van der Panne, 2007; Hagedoorn and Cloudt, 2003). According to Hagedoorn and Cloudt (2003), innovation performance may be conceived from a broad or from a narrow perspective. From a broad perspective, the entire process for generating innovation is taken into account. The measures used are related to R&D inputs, the patenting rate and the announcement of new products which are introduced to the market. In a narrow sense, the focus is only on the output of innovation when the market introduction takes place. From this perspective, measures for the assessment of innovation performance are mainly counts of new product announcements. In the present part of the study, we limit our attention to the outcome effects of strategic governance decisions. We adopt a narrow view of innovation. The Community Innovation Survey has refined and expanded the existing measures by introducing new indicators of innovation performance (Kleinknecht *et al.*, 2002). For instance, at the output level the CIS questionnaire asked the companies to quantify the

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<sup>6</sup> The empirical analyses were performed at the Centre for Economic Micro data (Cerem) at Statistics Netherlands (CBS).



percentage of their total sales from products new to the market and the percentage from products new to the firm. The two measures do not, however, have a unique interpretation in the literature. In the Dutch CIS, the qualification 'new for the market' has been considered vague as the geographical extension of the reference market is not clearly defined (Brouwer and Kleinknecht, 1996). Companies operating on a global scale may tend to underestimate the novelty of their innovation as they use the world market as a reference while local companies, considering the national market, run the risk of overestimating the relevance and the originality of their innovations (Brouwer *et al.*, 2008). We recognise that the variables may reflect the self-perception of the firm and may contain a subjective element in this respect. Despite this limitation the two measures are interesting, especially as they capture the cash flows which are generated by innovations that are successfully introduced to the market (Kleinknecht *et al.*, 2002). In this perspective, we consider that the two variables quantify the success of innovation at the firm level and that they are suitable for the purposes of our analysis. In empirical studies the sales from products new to the market may be considered to capture the level of the 'true' innovation while the sales from products new to the firm refer to more 'imitative' innovation (Kleinknecht *et al.*, 2002: 114). The sales from products new to the market, due to their level of novelty, have also been associated with radical innovations and the sales from products new to the firm with incremental innovations (e.g. Laursen and Salter, 2006). In line with Orihata and Wanatabe (2000) radical innovations are the result of exploration activities while incremental innovations derive from the exploitation of existing knowledge. In line with the above, we distinguish three conceptions of innovation performance: (a) explorative innovation, (b) exploitative innovation, and (c) total innovation. We have calculated the value of the 'explorative innovation' variable as follows. First, we multiplied the percentage of sales in 2000 of products new to the market with the total sales to obtain a continuous variable. In order to limit the potential distortions caused by the effect of size, then we scaled the variable by the number of employees. Finally, we calculated the natural logarithm of the result + 1. The same procedure was adopted for assessing the value of the next two variables. For the second dependent variable ('exploitative innovation') we used the sales in 2000 from products new to the firm. In line with Faems *et al.* (2005), the third variable ('total innovation') indicates the total sales from new products, considering jointly the proportion of sales from products new to the market and from those new to the firm. The above variable represents an indicator of the overall innovation performance of the firm.

### *Independent variables*

The independent variables aim at identifying and distinguishing the three governance strategies which are presented in the theoretical framework: a strategy based on M&As, a strategy specialised in alliances, and an ambidextrous governance strategy. The CIS III provides two basic variables to identify whether companies entered into alliances in order to innovate and if they engaged in M&A activities in the previous 3 years. It is worth noting that the questionnaire asked whether the company had performed an acquisition that increased its turnover by ten percent or more. We have constructed a dichotomous variable

(called 'specialisation strategy M&As') that takes the value of 1 (else 0) to indicate whether the company had adopted a strategy based only on M&As. Similarly, we have generated a variable ('specialisation strategy alliances') that takes the value of 1 (and 0 otherwise) if the company had preferred a strategy based on alliances only. Finally, the dichotomous variable called 'strategy ambidexterity' identifies (value 1, otherwise 0) the strategic governance approach that combines the simultaneous use of both M&As and alliances. We have obtained it by multiplying the dichotomous variable indicating the company choice to use alliances by the dichotomous variables indicating the company choice to engage in acquisitions. The procedure that we followed for the generation of the above variables allows us to make a distinction between three groups of companies that are identified by the governance strategy adopted over the previous three years.

### Control variables

In the present analysis, we have introduced variables to control for the effect of the internal level of innovative efforts (R&D intensity), the firm's size and the sector of activity (referred to as Pavitt variables). R&D activities are associated with higher levels of innovative output (Mairesse and Mohnen, 2005). The rationale is that internal R&D efforts generate the technological knowledge base that represents the essential grounding for the innovation process (Tsai and Wang, 2007). R&D also has another important function whose relevance becomes crucial when a company uses external sources of technology. Internal R&D activities promote the company's absorptive capacity. This is '*the ability to identify, assimilate, and exploit knowledge from the environment*' (Cohen and Levinthal, 1989: 569). The R&D intensity variable ('R&D intensity') has been calculated by scaling the expenses in 2000 on intramural R&D activities which are reported by the firm by the number of employees and then taking the natural logarithm of the result + 1. Additionally, we have controlled for the size of the company (variable 'size'), expressed as the natural logarithm of the total number of employees in 2000 (e.g. Faems *et al.*, 2005). The reason behind controlling for the size effect is that larger companies have more resources at their disposal to commit to innovation activities (Brouwer *et al.*, 2008). By scaling the variable R&D intensity by the number of employees and including also the variable 'size' in our model, we have separated the effect of the R&D investments from the effects of size. Finally, we have controlled for the specific characteristics of the sector in which the company is active. The motive for this control variable is vested in the consideration that the characteristics of technological regimes are sector-specific (Nelson and Winter, 1982; Winter, 1984; Marsili and Verspagen, 2002). Technological regimes are defined '*in terms of conditions of opportunity, appropriability, cumulativeness and properties of the knowledge base*' (Malerba and Orsenigo, 1996: 451). A large part of the variability in innovation patterns depends on the differences in the nature of the technology (Marsili and Verspagen, 2002; Breschi *et al.*, 2000). Following the Pavitt (1984) taxonomies, we have identified four classes: science-based companies, specialised suppliers, scale-intensive and supplier-dominated companies. The supplier-dominated dummy is used as a base category.



## 4.4 Results

### 4.4.1 Descriptive statistics

The sample which was used for our analysis includes 3,430 manufacturing firms. Table 4.1 and 4.2 report the descriptive statistics of our sample. In Table 4.1, we have categorised the companies by technology sourcing strategies that rely on: (1) M&As only; (2) Alliances only; and (3) both Alliances and M&As. The variables of relevance are presented as originally available in the CIS database and in the non-logarithm, non-scaled form for ease of interpretation. Additionally, we report, for the entire sample, the variables of interest in the elaborated form (after scaling and logarithmic transformation) and their correlations in Table 4.2.

From Table 4.1 we notice that a specialisation strategy based on alliances seems to be the choice of preference followed by the majority (15 percent) of the firms, compared to an M&As-specialisation strategy (5 percent). An ambidextrous approach, combining M&A and alliances, appears to be adopted rarely, only in 1.1 percent of the cases. The above confirms that ambidexterity represents a managerial challenge and that only few companies have the capability and the competencies which are necessary to combine and to deal simultaneously

*Table 4.1. Descriptive statistics per firm's strategy.*

<b>Variables</b>	<b>All firms<sup>a</sup></b>	<b>Firms with strategy ambidexterity<sup>a</sup></b>	<b>Firms with specialization strategy alliances<sup>a</sup></b>	<b>Firms with specialization strategy M&amp;As<sup>a</sup></b>
R&D expenditures	1,918.58 (38.92)	39,030.63 (142,234.70)	28,486.87 (179,475.30)	73.80 (310.82)
Number of employees	150.11 (845.72)	482.220 (1,371.89)	395.0176 (1,073.52)	43.81 (120.10)
Total sales	62,638.85 (578,608.60)	285,833.30 (969,266.20)	266,165.70 (1,446,067.00)	15,372.28 (40,874.10)
Sales from products new to the market	4,175.03 (70,799.67)	116,077.70 (625,875.30)	13,524.95 (58,657.90)	740.85 (3,015.31)
Sales from products new to the firm	14,632.27 (124,349.20)	139,157.30 (623,322.50)	58,689.33 (257,795.90)	2,859.444 (8,823.25)
Total sales from new products	18,026.96 (171,830.20)	258,859.30 (1,225,339.00)	67,110.79 (261,579.80)	3,616.92 (11,580.99)
Total number of firms	3,430	39	512	169

<sup>a</sup> Scaling and logarithm transformation.

Table 4.2. Descriptive statistics and correlation matrix.

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1. Total innovation <sup>a</sup>	2.03	2.36	1										
2. Explorative innovation <sup>a</sup>	0.87	1.56	0.61	1									
3. Exploitative innovation <sup>a</sup>	1.97	2.27	0.99	0.56	1								
4. Strategy Ambidexterity	0.01	0.13	0.08	0.07	0.08	1							
5. Specialisation strategy alliances	0.26	0.43	0.22	0.23	0.21	-0.08	1						
6. Specialisation strategy M&As	0.04	0.21	-0.03	-0.06	-0.03	-0.03	-0.14	1					
7. Size <sup>b</sup>	3.57	1.65	0.18	0.16	0.18	0.06	0.37	-0.20	1				
8. R&D intensity <sup>a</sup>	0.44	0.99	0.41	0.35	0.41	0.03	0.40	-0.15	0.46	1			
9. Science-based sector	0.18	0.39	0.11	0.08	0.12	-0.00	0.12	-0.04	0.05	0.23	1		
10. Specialised-suppliers sector	0.25	0.43	0.01	0.00	0.01	0.01	-0.03	0.06	0.07	-0.07	-0.32	1	
11. Scale-intensive sector	0.19	0.39	0.08	0.09	0.07	-0.03	-0.02	-0.06	0.03	0.16	-0.29	-0.29	1

<sup>a</sup> Scaling and logarithm transformation.

<sup>b</sup> Logarithm transformation.

with diverse governance modes. The majority of the companies apply a strategy based on a single governance mode (either alliance or M&A). The companies that follow an ambidextrous strategy are on average larger (both in terms of number of employees and turnover) compared to the companies which specialise on alliances or M&As. Using the number of employees as a proxy for size, we note that companies that rely on ambidexterity have a higher standard deviation with respect to the firms using specialised technology-sourcing approaches. The above suggests that an ambidextrous strategy is embraced by firms with very diverse sizes and that small firms also adopt this strategy (see Lubatkin *et al.*, 2006). Surprisingly the firms that are active in M&As are smaller than the average of the total sample. This may appear contra-intuitive as acquisitions, requiring significant economic resources, are more likely to be used by large firms. The explanation may reside in the formulation of the question in the CIS-questionnaire. Firms were required to indicate only M&As that have increased the turnover by 10 percent or more. For large companies such relevant transactions are relatively infrequent due (among other things) to antitrust restrictions. The fact that the integration

strategy is employed on average by larger companies suggests that, when relevant deals are undertaken, M&As are not used in isolation but in combination with alliances. In terms of innovative behaviour firms which use a mixed strategy are on average the highest R&D spenders, followed by companies specialised in SAs and finally by those that use M&As. The result seems to support the view that external partnership activities are not considered as a substitute for internal efforts. Looking at the innovative output, we observe a similar pattern across the strategies. Companies that specialise in M&As show the lowest levels of total innovation performance (total of explorative and exploitative innovation). The highest levels of innovative output are displayed by a minority of firms which combine alliances and mergers and acquisitions.

#### **4.4.2 Regression models**

In the present study, the dependent variables are censored and therefore Tobit (Tobin, 1958) models represent the methodology of choice. In the estimation of Tobit models the conditions of homoscedasticity and distribution normality are especially relevant (Wooldridge, 2002, 2006). In line with Laursen and Salter (2006) the log-normal transformation is appropriate to satisfy the conditions required by Tobit models and to deal with departures from normality of the dependent variable (Wooldridge, 2002). Finally, in line with the procedure of Hardin (2005), the analysis is performed by estimating robust standard errors. Table 4.3 reports the results from the Tobit estimates for the three models that have been tested. Model 1 uses exploitative innovation as dependent variable. Model 2 and model 3 use, respectively, explorative innovation and total innovation as dependent variables. The McDonald and Moffitt (1980) decomposition has not been reported as we are interested in the order of magnitude of the effect and not in the exact elasticity.

The results show that a specialisation strategy in M&As has a positive but not significant effect on the overall firm's innovation performance. Using explorative, exploitative and total innovation performance as dependent variables, specialisation strategies in SAs have a positive and significant effect on innovation performance. Companies appear to benefit more from the usage of flexible forms of external relationships to increase their performance levels. As predicted by hypothesis H1a, we confirm that a strategy based on alliances should be preferred over a strategy based on M&As when aiming at benefits from exploration. An M&A-specialised strategy has a negative although not significant effect on exploration performance. With respect to exploitative innovation, M&A-specialised strategies do not perform as expected. We therefore cannot confirm H1b. A strategy based on ambidexterity is, in all models, conducive to the highest levels of performance. The above results go beyond the effect we anticipated: an ambidextrous strategy outperforms specialisation strategies also with respect to both exploration and exploitation success. We therefore do not confirm H2a and H2b and we confirm hypothesis H2c. In order to verify how diverse the effects of the different strategies are, we have tested if their coefficients are significantly different from each other.

Table 4.3. Regression models: Tobit estimates.

<b>Variables</b>	<b>Model 1. Exploitative innovation</b>	<b>Model 2. Explorative innovation</b>	<b>Model 3. Total innovation</b>
Strategy ambidexterity	1.34 ***(0.38)	1.79***(0.63)	1.38***(0.39)
Specialisation strategy alliances	0.52***(0.18)	1.04***(0.29)	0.49***(0.19)
Specialisation strategy M&As	0.37(0.38)	-0.13(0.62)	0.32(0.41)
Size	-0.016(0.06)	-0.01(0.09)	-0.02(0.06)
R&D intensity	0.60*** (0.048)	0.66*** (0.11)	0.65*** (0.08)
Science-based sector	0.50** (0.22)	0.51(0.35)	0.53** (0.23)
Specialised-suppliers sector	0.48** (0.23)	0.60* (0.34)	0.54** (0.24)
Scale-intensive sector	0.55** (0.18)	0.80** (0.36)	0.56** (0.24)
Constant	2.05*** (0.30)	-1.32*** (0.46)	2.11*** (0.32)
Wald chi2	156.28***	137.97***	157.30***
Mc Fadden's R2	0.04	0.04	0.04
LR test	150.86***	113.66***	154.74***
No. of observations	852	826	826

Significance levels: \*<0.10, \*\*<0.05, \*\*\*<0.01.

The results indicate that specialising in M&As, in alliances or in an ambidextrous approach represent three statistically different strategies for innovation.

The impact of the control variables is worth noting. As expected the intensity of the R&D activities is a positive and significant determinant of innovation performance for all the innovative proxies we used. Remarkably the variable 'size' displays a negative sign and it is not significant in any of the models. Although the effect of size on innovation is still debated in the literature, it may be expected that larger firms dispose of more abundant resources and are more likely to innovate. Additionally, external partnerships, also involving high levels of resource commitment, may be more easily handled by large companies. In our sample, the success of external technology sourcing appears to be independent of size considerations. The implication is that companies may achieve higher levels of innovation performance, regardless of their scale, by exploiting ambidextrous strategies. Finally, with the sole exception of the science-based dummy in the model that uses explorative innovation as a dependent variable, the sector variables are in general significant and positive. This confirms that the innovation patterns are sector specific.

**4.5 Discussions and conclusions**

Companies increasingly rely on external technological sourcing to innovate. Despite the importance of the topic there is still no unanimous consensus on the effects of strategic governance decisions. The present paper addresses the above subject by comparing strategies specialised in alliances and M&As as single alternatives or SAs and M&As as constituents of an approach that is centred on governance ambidexterity. The above discerned sourcing strategies are statistically different in all the models. Our results indicate that the highest level of total innovation performance is obtained by the ambidextrous strategy that uses both SAs and M&As. Remarkably, although the effects of M&As are negative or not significant as a stand-alone governance strategy, they enhance the outcome of alliances when simultaneously balanced in an ambidextrous approach. Surprisingly, our results also indicate that an ambidextrous approach is preferable to a specialised focus in order to achieve higher levels of explorative or exploitative success. The positive effects which are generated by the use of different governance modes seem to be greater than those that are generated individually by the application of a single governance mode.

Our findings, in line with Keil *et al.* (2008), confirm that the effect of partnerships on innovation can be better understood from a portfolio perspective where the variety of corporate links is accounted for (Faems *et al.*, 2005; George *et al.*, 2001). The main conclusion of our work is therefore that a portfolio perspective in governance strategies, that balances both alliances and mergers, is conducive to the highest levels of innovation performance.

In comparison with the above approach strategies based on a sole governance modality are less beneficial. Our findings also indicate that strategies based on alliances are more favourable to innovation than those based on M&As. This seems to corroborate the conclusions in the review of De Man and Duysters (2005). Alliances are confirmed to be an effective tool for gathering the resources which are needed for innovation and to serve a 'radar function' when technological opportunities are explored (Duysters and De Man, 2003: 54). Our results indicate that being specialised in alliances also contributes to exploitation. The above can be explained by the fact that the typology of alliances with an equity involvement shares part of the characteristics, especially control, that are typical for a more integrated governance mode. In this respect, equity alliances are suitable for exploitation activities. In line with other studies (e.g. Hitt *et al.*, 1991), and contrary to our hypothesis, we have found that M&As do not contribute positively to the innovative efforts of the firm. In particular, we have not found significant effects on exploitation. The positive effect of learning from experience does not seem sufficient to overcome the problems which are often advocated to explain M&A's failures like the assets indigestibility and difficulties in the post-acquisition phase (De Noble *et al.*, 1988; Hennart and Reddy, 1997).

The contribution of the present study to the literature is twofold. First, it expands the literature on ambidexterity in the context of external technology sourcing. By ranking the effects of

alliances and M&As considered independently of each other or jointly, the present work contributes to the literature that assesses the governance choices in comparative terms (e.g. Keil *et al.*, 2008; Rothaermel and Hess, 2007; Schildt *et al.*, 2005). Second, it enlarges the portfolio boundaries to embrace not only SAs, which have been explored by a considerable stream of studies (e.g. Faems *et al.*, 2005; Belderbos *et al.*, 2006), but the variety of governance modes that are used in external relationships. The findings have practical implications for the governance decision process. If balancing different governance modes within a portfolio of relationships is the source of value, firms should focus on optimising the entire portfolio. The emphasis of the strategic governance decision may, therefore, shift from identifying the governance mode with superior absolute qualities to balancing a portfolio that uses multiple and diverse external technological sources (Sabidussi *et al.*, 2008). The above perspective adds a new viewpoint in the governance choice literature (for example, Chiesa and Manzini, 1998; Hennart and Reddy, 1997), that is mainly oriented at identifying the preference for a single individual organisational strategy.

The contribution of the present work should be considered in the context of its limitations. In fact, the main limits of this work are common to studies on external partnerships activities that rely on the Community Innovation Survey (e.g. Cassiman and Veugelers, 2002; Faems *et al.*, 2005). First, we have used dichotomous variables to identify the specific governance strategy which is adopted by the companies. Although for the purpose of the study this choice is justified, getting hold of information about the number of alliances and the number of M&As would have allowed a more fine-tuned analysis. In particular, the number of links in the portfolio is an important determinant of the portfolio configuration (Hoffman, 2007). In its turn, the composition of the portfolio influences the availability and the accessibility of resources pursued by a company. This variable, therefore, mediates the final impact of the governance strategy on innovation performance (Hoffman, 2007). CIS, however, does not dispose of count variables for the number of external partnerships. Second, the effect of time was not considered in the present study. The CIS database covers a period of three years: from 1998 until 2000. The occurrence of alliances or M&As, however, is not attributed to a specific year or time period. It can be argued that for building a sufficient experience a longer time span is needed. It can be noted that external relationships also need a time span to display their effects on innovation, ranging from a few months to 3 or even 5 years (De Man and Duysters, 2005). The opportunity to investigate the time which is needed for the governance strategies to affect innovation, especially in a portfolio perspective, would have offered an interesting element of analysis. A refinement of the present work should add a time-dynamic dimension and assess the outcome of governance strategies over time. Finally, the data did not allow us to further investigate the reasons for the over-performance of ambidextrous strategies with respect to strategies relying on a single governance modality. Mahnke and Overby (2005) have suggested that value potential in a portfolio of multiple relationships may be fostered by means of two key mechanisms: synergies and risk diversification. Synergies arise when the effectiveness of one relationship is enhanced by another linkage (Duysters and Lokshin, 2007). Risk diversification refers to the reduction of uncertainties in the outcome of one partnership

by means of another relationship (Mahnke and Overby, 2005). A fruitful extension of the present work could be to investigate the existence and the nature of the potential interactions that may arise among different governance modes in the context of ambidexterity. All of the above represents a subject to be developed by further studies.

## 5. The process of governance choice

### 5.1 Introduction

Chapter 5<sup>7</sup> aims at deepening our understanding of the decision-making process with respect to two main aspects: (1) the external sourcing and (2) the governance decision.

It therefore answers the following research questions:

RQ4: *What drives the actual decision to source innovation externally?*

RQ5: *What would a decision model for the governance choice look like from a Portfolio Theory perspective?*

In the first chapters (Chapters 2, 3 and 4) we have focused on what is known as ‘content research’ that investigates ‘what strategic positions of the firm lead to optimal performance’ (Chakravarthy and Doz, 1992) by investigating the effect of governance modes on performance. In particular innovation performance is enhanced when (1) effects are considered over time (Chapters 2 and 3); and (2) the governance modes are conceived not in an isolated fashion but as constituents of a portfolio where interdependencies are emphasised (Chapter 4).

In this chapter our focus shifts from content research to process research that is related to how decisions are taken (‘how to do it’ in the words of Khanna *et al.*, 2000). Following the recommendation of Huff and Reger (1987) and Khanna *et al.* (2000), we consider that bridging process and content research constitutes a fruitful research path.

In order to innovate, companies need to take a series of complex decisions (Veugelers and Cassiman, 1999). The decision to develop innovation internally or to source part of the innovation externally is a central question that the companies need to address. To identify why firms decide to use external partners and which are the prevalent motives is of major importance to an understanding of the competitive success of the firms (Yasuda, 2005). What drives the decision to innovate internally or to source externally? Which criteria motivate decision-makers’ choices and how is the decision taken? Empirical studies on the motivation behind external sourcing are relatively scarce due to the difficulty in gathering detailed and complete information (Dodourova, 2009). It might be expected that criteria and priorities are different for small and large firms. On the one hand, it has been argued that large firms are more likely to be active in cooperation activities (Dachs *et al.*, 2004). On the other hand it has been pointed out that small firms have learned to remove obstacles to innovation by

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<sup>7</sup> Part of this chapter is based on: Sabidussi, A., Bremmers, H., Duysters, G., and Omta O., 2008. Business-to-business External Sourcing of Technology (BEST) and Innovation: A dynamic Portfolio approach. In: Proceedings of the 5th International Conference on Innovation and Management, ICIM 2008, (pp. 807-820) UNU-MERIT, December 2008, Maastricht, the Netherlands.



making proper use of external relationships (Narula, 2004). Veugelers and Cassiman (1999) have observed that small and large firms display different behaviours in the decision process to develop innovation internally or externally. Large firms are more likely to combine internal with complementary external sources, whereas small firms tend to rely on just one of the alternatives. The above considerations stimulate questions about what drives large and small companies in their sourcing decisions and how the decision process is structured. The environmental context in which the sourcing decisions are taken is also relevant (Mittra, 2007). For example, the use of external sourcing is more likely to occur in highly technological intensive industries (Dachs *et al.*, 2004).

The first part of the study aims therefore at investigating differences and similarities in the criteria and in the decision process followed by small and large firms in the innovation sourcing choices. We focus on best-in-class-companies versus large companies so as to highlight successful decision guidelines that are relevant for the literature.

Once we have clarified what drives companies to source innovation externally, we focus on the organisational decision about the governance mode that the relationship is going to assume. The second part of the chapter aims at proposing for the governance decision process what Khanna *et al.*, (2000) call a '*benchmark model*': a decision model that provides a reference framework against which empirical research can test actual behaviour. A portfolio approach grounded on financial Portfolio Theory (PT) (Markowitz, 1952, 1959) is proposed as theoretical framework. The guidelines which are provided by PT are interpreted in the context of the governance decision process and integrated in a decision model. In order to validate its applicability, we have investigated the extent to which it is applicable in decision-making practice.

The present chapter is organised as follows. In the next section, we identify the main motives for sourcing innovation externally as reported by the literature. Next, the conceptual pillars from financial PT are presented and interpreted in a governance decision model. Then, we present the data and methods that we adopted to collect the information. In order to deepen the understanding of the priorities that drive managerial practice, we use semi-structured interviews with high level decision-makers. This methodology allows us to take 'the perspective of the players' (Dodourova, 2009) and it differentiates our study from previous works which are based on quantitative approaches (e.g. Veugelers and Cassiman, 1999; Dachs *et al.*, 2004; Parmigiani, 2007). The procedure that we have followed in the semi-structured interviews was designed to gather insights about both the explicit priorities that executives identify and the implicit considerations that may underlie the decisions (Dienes, 2008; Größler *et al.*, 2008). To the best of our knowledge, the above methodology is original in the studies of decision drivers for external sourcing. Klein (2005) argued that qualitative case studies on one firm or industry may be of limited general relevance. A total of 35 interviews with companies and 2 with experts were performed for the present study. In the final sections, we present the findings and discuss the implications of the study.

## 5.2 Theoretical background

### 5.2.1 The motivation for external sourcing

In this part of the study, we address the fundamental question as to what drives companies to move from developing innovation internally to source it externally. Sourcing strategies can rely on external or internal sources that are distinguished based on the '*ownership aspect of component sourcing (internal vs. external)*' (Murray *et al.*, 2005: 188). In the present study external sourcing refers to the use of links and relationships with external entities. We focus in particular on business-to-business relationships. Using the motive classes of Hagedoorn (1993), the specific objectives that lead to the use of external relationships for innovation may be classified, similarly to Bayona *et al.*, (2001), into two main groups of motives. The first group refers to the research process that includes basic and applied research as well the technology development like knowledge generation, cost savings or risk sharing. The second group refers to the general innovation process, time-to-market, internationalisation and access to new markets.

With respect to the research process, external sourcing may help to generate new knowledge or better exploit existing knowledge (exploration and exploitation in the words of March, 1991). Radically new technologies are connected to exploration efforts while incremental innovations result from exploitation efforts (Orihata and Watanabe, 2000). SMEs are constrained by their limited resources like lack of knowledge, economic burdens, shortage of personnel or of specialised employees (Sawers *et al.*, 2008; Van de Vrande *et al.*, 2009). SMEs can develop only a limited range of technologies internally (Narula, 2004). Having access to new knowledge is therefore more critical for small companies than for large ones. With respect to knowledge the use of external sources can also be motivated by the intention to monitor technological changes and developments (Rohrebeck, 2007). Large firms often have dedicated units that have the task of monitoring the competitors' activities and developments (Chiesa, 2001). External monitoring is more likely to be relevant for large firms that can afford the associated costs. We therefore formulate the following:

*Proposition 1: SMEs are more motivated than large firms to source innovation externally in order to gain access to new knowledge.*

Especially in complex technological environments inter-firm relationships are used to overcome the difficulties of innovating (Bayona *et al.*, 2001). Companies may rely on external partners to limit the exposure to uncertain technological advancements or market developments (Folta, 1998; Van de Vrande *et al.*, 2006) which are typically higher in exploration activities (March, 1991). Sharing risk is one of the motives for sourcing innovation externally (Tethler, 2002). Costs, risk and time-to-market considerations are therefore not independent of each other. The related uncertainty may refer to the unclear outcomes of the innovation efforts or to the fact that the results may be achieved at a higher cost or later than expected (Bayona *et al.*, 2001).

Partnerships may be motivated by the attempt to share the costs of innovation (Manders and Brenner, 1995; Sakakibara, 1997) or to reduce the time-to-market (Hagedoorn, 1993; Hynes and Mollenkopf, 2008). A recent report of Boston Consulting Group (Andrew *et al.*, 2007) indicated that reducing costs through cooperation, instead of in-house, may contribute to an increase in the returns on innovation investments (Andrew *et al.*, 2007). March-Chorda *et al.* (2002) have confirmed that the costs that are associated with innovation constitute a barrier for SMEs since they have less access to financial sources compared to large firms (Serrasqueiro and Maças Nunes, 2008). Large companies typically have more diversified businesses which allow them to spread risk over more business units (Serrasqueiro and Maças Nunes, 2008). Small companies tend to limit their exposure to risky situations (Lensink *et al.*, 2005; Serrasqueiro and Maças Nunes, 2008). We therefore formulate the following proposition:

*Proposition 2: SMEs are more motivated than large firms to source innovation externally in order to share (2a) risks and (2b) costs.*

Being fast to the market is also a way of reducing the uncertainty arising from unstable and rapid changing market preferences (Bayona *et al.*, 2001). With respect to innovation speed, the report of Boston Consulting Group (Andrew *et al.*, 2007) confirmed that the length of the development time is one of the major obstacles that firms need to overcome in order to innovate. Speeding up innovation is increasingly important in the context of the current fast-changing and dynamic environments (Kessler and Chakrabarti, 1996). The study of Ali *et al.* (1995) showed that being fast to the market is also beneficial for SMEs as it enables firms to recover the initial investment earlier. Reducing time-to-market increases sales volumes but this positive effect is moderated by increased development costs (Langerak *et al.*, 2008). Due to their limited resources, small companies are more likely to team up to accelerate the innovation process. With respect to market access, internationalisation and market structure shaping, partnerships can be used to enter into new, unknown markets or to internationalise parts of the corporate activities (Hagedoorn, 1993). In case of government or legislative constraints, the entrance to the market may be facilitated by a link with an external partner (Contractor and Lorange, 2004; Vilkmø and Keil, 2003). Partners may have specific knowledge about the target market or already be active in it (Bayona *et al.*, 2001). Recent studies have demonstrated that market entry motives are the main drivers for small companies in particular to choose external sourcing (Van de Vrande *et al.*, 2009; Bayona *et al.*, 2001). We therefore formulate the following:

*Proposition 3: Small firms are more motivated than large firms to source innovation externally in order (3a) to reduce time to market and (3b) to access new markets.*

### 5.2.2 The governance decision from a Portfolio perspective

As mentioned in Chapter 1, we propose widening the application of PT as a conceptual tool to support external sourcing governance decisions. Changing the boundaries of the main

PT principles from financial assets to partnership activities requires a degree of adaptation and interpretation. The overall model that applies PT to a dynamic process that manages the governance decision process is illustrated in Figure 5.1. Each phase of the decision is associated with the interpretation of the PT conceptual pillars in a governance choice context. In financial markets, managers face the challenge to allocate scarce resources to a limited set of assets. In a portfolio context, the investment process aims at determining in which assets (or class of assets) it is preferable to invest for the specific objectives and at finding an optimal balance among assets by shifting the composition of the portfolio itself over time (Farrell, 1997). Portfolio theory disciplines the investment process. It originates from the seminal work of Markowitz (1952, 1959). The corner stone of PT is that an investor will select the combination of securities based on its *risk-return* profile: preference is given to the ‘efficient’ portfolio that provides the highest expected return at the lowest level of variance (Farrell, 1997). In Financial PT the investors choose the assets which, when added to the portfolio, provide the highest return for a given level of risk and, therefore, optimise the risk-return profile of the overall portfolio. To define which assets maximise the portfolio profile the interactions among assets need to be accounted for. The reason for the above is that the contribution to the overall portfolio from each single security, in terms of risk and returns, is influenced by the inter-relationship with all the other assets. The key contribution from the theory is therefore not that the specific characteristics of the individual asset are considered in isolation but ‘*how*

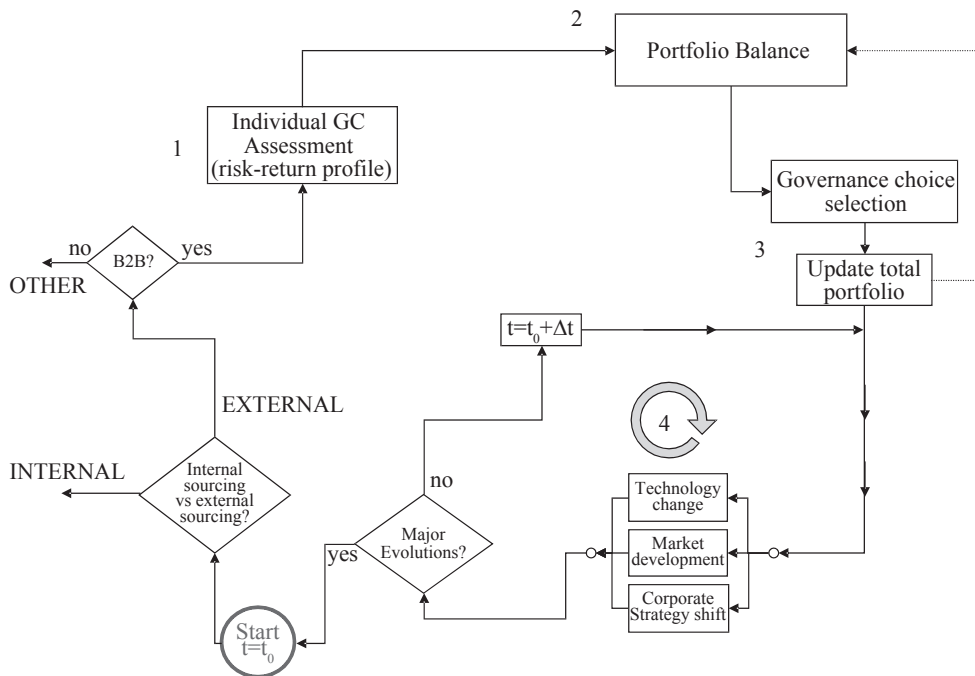


Figure 5.1. Decision process model in a dynamic portfolio theory approach.

*each security co-moves with all the other securities'* (Elton and Gruber, 1997). Optimising the portfolio is not a one-point-in-time activity but a dynamic process that calls for continuous rebalancing (Ahmed and Hegazi, 2006). Summarising, the main PT conceptual pillars are: (1) the risk-return profile of an asset, (2) the interdependencies among the components of the existing portfolio and the asset under consideration, (3) the maximisation of the portfolio as the final scope of the investment choice, and (4) the monitoring and rebalance of the portfolio composition over time. Since the '50s, financial theory has evolved an increasing level of detail and realism in the modelling process. The basic concepts provided by Markowitz remain at the core of the investment selection techniques (Elton and Gruber, 1997). Due to the conceptual similarity of the financial investment process with other fields where the allocation of limited resources and the balance of different objectives is critical, PT principles have been applied to R&D investment selection (e.g. Chiesa, 2001) and extended to the management of technology (e.g. Yu, 2006). In expanding the range of application of PT reasoning it has been argued that the portfolio logic may be applied to the context of the multiple alliances in which firms are involved (George *et al.*, 2001). A motivation for the above extension is that firms enter into several relationships trying to achieve greater returns while minimising risks from their alliances, in a process that is comparable to the rationale followed in a PT framework (George *et al.*, 2001). For the choice of our theoretical framework we follow the same reasoning. When deciding which governance mode should be preferred in order to achieve technological innovation, the company is, conceptually, facing an investment selection decision' and financial Portfolio Theory principles may be applied.

### **Phase I**

In Phase 1, the risk-return profile of a governance decision has to be defined. At this initial stage, the governance alternatives are valued individually by considering their specific nature and characteristics.

In an external technology sourcing perspective expected returns can be considered as the benefits foreseen from engaging in a relationship. As mentioned in Chapter 1 companies can aim at achieving technology exploration and technology exploitation (March, 1991; Granstrand *et al.*, 1992; Faems *et al.*, 2005; Koza and Lewin, 1998). The benefits of the relationships are balanced against the costs to achieve them (Wang and Zajac, 2007). Additionally the time span which is necessary to achieve an innovation is an essential element to consider when assessing the competitive benefits foreseen by a partnership (Cohen *et al.*, 1996; Hagedoorn, 1993). At which cost and within which time framework the exploration/exploitation objectives can be reached depends on the characteristics of the single governance modes (see Table 1.1 in Chapter 1). Non-technological objective of an external partnership refers to the access to new product markets or geographical areas in the case a company may need to use external relationships to introduce an innovation in a foreign market through a local company that provides the required distribution channels (Sakakibara, 1997; Hung and

Tang, 2008). Additionally, partnerships may be used for competitive purposes like blocking a rival in a specific technological or market field (Vanhaverbeke and Noorderhaven, 2001).

The precise quantification of an expected return is not straightforward. Expectations about returns can oscillate as they are affected by a series of factors that influence the expected outcome. How much an expected return can fluctuate depends on the level of the associated risk. From a governance choice point of view, the returns which are expected from external relationships can fluctuate due to two types of uncertainties: endogenous and exogenous (Folta, 1998; Van de Vrande *et al.*, 2006). Endogenous uncertainty refers to the possibility of failure of the relationship. Exogenous uncertainty refers to the unknown evolution of technologies and of market conditions. It increases proportionally to the level of technological newness and the novelty of the potential applications in the market. SAs and M&As are differently exposed to the above sources of risk. SAs are more exposed to opportunistic behaviours than M&As as the levels of control are higher. The risk-return profile of the individual governance modality results from the definition of the benefits that are expected and of the associated level of uncertainty. We therefore state that:

*Proposition 4: The risk return profiles of M&As and SAs are actually considered by decision-makers and affect the preference for the governance mode.*

### Phase 2

In Phase 2, the analysis takes a portfolio balance perspective. By compounding the governance alternatives in the portfolio the interactions that take place between the new potential governance link and the existing relationships are considered. In order to clarify the mechanisms that play a role in the portfolio composition phase we proceed in two steps. First, we discuss the kind of interdependencies that should be accounted for when a new potential governance form of external partnership has to be introduced into the portfolio. Second, we discuss the levels at which interdependencies may generate benefits.

The interactions among governance modes can affect the portfolio by means of two mechanisms: risk reduction through diversification and/or generation of synergies (Mahnke and Overby, 2005). As Wilcox *et al.* (2001) diversification is obtained if a firm enters into diverse and unrelated relationships. Diversification mainly has an effect on spreading exogenous, technological and market risks over different partners (Mahnke and Overby, 2005). Endogenous risk, however, can also be affected by interactions. The uncertainty surrounding an acquisition can be reduced by the existence of previous alliances with the same partner and by reciprocal knowledge. A recent study confirms that previous alliances with a target company increase the performance and the learning effect of the M&A (Porrini, 2004). Synergies are typically generated by links among a firm's activities (Kay and Diamantopoulos, 1987) and by the combination of complementary assets (Colombo *et al.*, 2006). The benefit that is individually expected by the firm from an alliance can be higher because of synergies



and complementarities generated by and with other relationships. Adapting to our context the distinction between private and common benefits (Khanna *et al.*, 1998), we distinguish two levels of the interaction effects. At a first level, individual benefits are defined as the gains from the interactions that increase the return or decrease the risk of the governance alternative directly. At a second level, common benefits refer to the situation where the gains from the interaction favour one or several of the other existing relationships by reducing their risk or enhancing their returns. By explicitly considering interactions among the proposed governance choices and existing web of relationships, current governance decisions are influenced by the unique current corporate profile (technology and market positioning) and by past governance choices (Argyres and Liebeskind, 1999). We, therefore, state that:

*Proposition 5: The interactions with the present portfolio of existing relationships affect the governance mode decision for new M&As and SAs.*

### Phase 3

In a financial portfolio approach, once the interactions of a potential security with other securities are defined, the final choice about which investment to make can be taken. Preference is given to the asset that optimises the risk-return profile of the overall portfolio when the new security is added to the portfolio. Interpreting the above in a governance context, the governance modality that optimises the portfolio is the one that offers the highest levels of private or common benefits after considering the interactions with the other links in the portfolio. It is worth noting that, in the proposed approach, the focus is not on identifying a governance choice with superior absolute qualities, but on selecting the organisational modality that provides the highest contribution to the whole portfolio over time. The governance mode decision is, therefore, not conceived as an independent choice but as an element in the dynamic balance of the portfolio. Once the governance mode decision is taken, the profile of the portfolio is altered by the new added relationship.

### Phase 4

In Phase 4, after the governance decision is taken, the conditions evolve over time simultaneously in terms of technology change, competitive and market conditions, corporate characteristics and strategic orientation. By optimising the entire portfolio, the governance decision process is focussed on the strategic, future-oriented interests of the firm. Strategy indeed deals with making choices for the future and can be defined as 'the scope and direction of an organisation over the long run' (Johnson and Scholes, 2002). The entire corporate portfolio of relationships is not static but 'co-evolves' with the firm's strategy (Koza and Lewin, 1998). Also the individual relationships within the portfolio are evolving: with the passing of time, for example, some of the less integrated governance modes (e.g. like R&D agreements) will come to an end. This will alter the profile of the portfolio and call for a rebalance through new governance decisions. As a consequence of time dynamics the same company facing a new governance decision will

have, as a starting point, a different portfolio which will affect the final choice in a different way. The process starts again, entering into a circular loop that is continuously repeated. In the proposed context, the governance decision process is dynamic as it cannot be considered independently of the previous choices, the past evolution of those choices as well as of the strategic orientation the company embraces. The approach which is presented in Figure 5.1 is dynamic as it considers the effect of different time aspects in the decision process, considering jointly the current characteristics of the company (Phase 1), the past governance decisions that led to the present portfolio composition (Phase 2) and the future-oriented corporate strategic orientation (Phase 3). The proposed approach is also dynamic because it recognises the need for rebalance over time (Phase 4) to account for the above-mentioned evolutions.

*Proposition 6: The governance decision of SAs and M&As is interpreted by decision-makers as part of a dynamic process.*

### 5.3 Data and methods

For the present study, we have adopted semi-structured telephone interviews as a data collection method. Prior to the interview information about the company was collected from public sources (corporate websites or newspapers). The interviews were performed by telephone due to geographical distance but in nine cases face-to-face meetings could be organised. Semi-structured interviews have the advantage of making the comparison possible among the respondents' answers by following a common interview guideline but at the same time leaving the respondents free to express their thoughts in a flexible and open way (Horton *et al.*, 2004). The interview protocol was structured in three main parts. In order to be able to gather the information and to formulate consistent comparisons, a common definition of innovation was provided to all participants.

In the first part of the interviews, the respondents were asked to answer closed-form questions about the company characteristics, e.g. the number of employees and market of reference (if not available from secondary sources). Respondents were asked to grade on a 7-point Likert scale, the degree of relevance of innovation for the corporate competitive success and the strategic orientation of the company (from 'follower' to 'ahead of competition'). Finally, it was asked how much of the corporate innovation was sourced internally and how much externally, to account for the relative importance of the sourcing alternatives. All the above data served to clarify the context of the decision process. The first part of the interview includes the questions from 1 to 10 of the protocol in Appendix A.

The second part of the interview focused on ranking the relative importance of the motives for the decision to source innovation internally or with external partners. The respondents received a table with a list of motives for sourcing innovation externally and for deciding on a specific governance modality. During the conversation, the respondents were also invited to



comment on the logic driving their assessments. The second part of the interview includes the questions from 11 to 14 of the protocol in Appendix A.

The third part of the interview was organised on the basis of a business case inspired by the logic of experiment research approaches (e.g. Nees, 1983). This part (see cases from A to F in Appendix A) aimed at shedding light on how the decision process develops. The respondents were presented with a detailed, hypothetical case. In the basic case, the company had to modify or improve an existing product in a situation of low market and technological uncertainty. The respondents had to decide if sourcing innovation externally or internally would be their preferred choice. In case of external sourcing the respondents were asked for arguments in favour of SAs or M&As. The respondents were asked to 'think aloud', step-by-step, about the considerations that would have occurred in a real decision-making process and to explain the rationale behind the final choice. Next, the basic conditions were altered and the respondents were asked to reconsider their decision in the new situation. Progressively the uncertainty levels and the development costs were increased, and the need to be faster to the market or the access to a new market was introduced. The purpose was to assess if and how the decision was influenced by the new information.

The respondents were asked to allow the interview to be recorded. Except in one case, in which notes had to be taken during a telephone interview, all the respondents agreed to allow the interview to be taped.

### 5.4 Results

For the present research, we have collected data from interviews with 35 companies<sup>8</sup> and 2 industry experts from consultancy firms. Our overall sample includes companies from Biopharma (28%), Food and Chemistry (18%), Energy (9%), Materials (23%), Mechanics (20%) and Electronics (3%).

In general terms, fifty-two percent of the sample are large companies (250 employees or more) and forty-eight percent are SMEs (lower than 250 employees) (Table 5.1). In order to gain insights from the practices of the best-in-class companies, the sample includes 14 world-leading companies (those companies in the top ten for market share in the specific, world-wide sector of reference); 8 of the large companies are best-in-class (top three worldwide).

The companies were selected on the basis of their innovation performance, on the geographical location of their headquarters and the sector of activity. First, companies had to be operating with advanced technologies. Second, companies had to be qualified as innovative by secondary sources of information. Third, the headquarters had to be located in two main geographical areas: Europe or USA. Much effort was put into getting a high response rate by using direct

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<sup>8</sup> Data from four interviews were collected by the MSc student Victor Lascano.

Table 5.1. Base-line description of participating companies.

Baseline of interviewed companies: SMEs companies (n=17)	
Employees	From 2 to less than 150
R&D personnel	From 2 to 35
Countries	Europe/USA
Sectors	Bio-pharma 47%, Materials 35%, Food/chemistry 12%, Electronics 6%
Innovation sourcing (average)	68% Internal, 32% External (SD 22%)
Baseline of interviewed companies: large companies (n=18)	
Employees	From 900 to less than 350,000
R&D personnel	From 70 to less than 5,000
Countries	Europe/USA
Sectors	Mechanics 39%, Food/chemistry 17%, Bio-pharma 11%, Energy 22%, Materials 11%
Innovation sourcing (average)	70% Internal, 30% External (SD 22%)
Baseline of interviewed companies: best-in-class companies (n= 8)	
Employees	From 5,000 to less than 350,000
R&D personnel	From 110 to less than 25,000
Countries	Europe/USA
Sectors	50% Mechanics, 12.5% Food, 12.5% Materials, 12.5% Bio-pharma, 12.5% Energy
Innovation sourcing (average)	79% Internal, 21% External (SD 10%)

contacts or intermediaries. Of all the companies contacted for the purpose of the present study, two potential respondents (one expert and one biotech firm) did not reply to the invitation to participate in an interview. The final selection included both large and small companies with headquarters in nine different countries in Europe and in the USA. The geographical diversity of our sample reinforces the external validity of the gathered data. Additionally, the possibility to generalise our findings is strengthened by the fact that the vast majority (86%) of the companies are active in global markets, compete against global competitors (84%) and are therefore hardly influenced by local geographical concerns.

To avoid tactical constrain-based decisions, the position of the decision-makers that were addressed in this study was as high as possible in the firms' organisations. Beside the experts (5% of the total), the companies' interviewees were divided into five classes: (1) CEOs, managing directors, and board members (54%), (2) CTOs and vice presidents (11%), and (3) directors (14%) and (4) corporate innovation managers (16%). An overview of the positioning of the decision-makers for large companies and SMEs is presented in Table 5.2.

*Table 5.2. Interviewed decision-makers.*

Interviewed decision-makers: SMEs (n=17)	
CEO/board	81%
Vice president	13%
Director	0%
Corporate innovation manager	6%
Interviewed decision-makers: large companies (n=18)	
CEO/board	30%
Vice president	12%
Director	29%
Corporate innovation manager	29%
Interviewed decision-makers: best-in-class companies (n=8)	
CEO/board	12%
Vice president	25%
Director	25%
Corporate innovation manager	38%

All respondents regarded innovation as an essential element contributing to their competitive success: with an average of 6.8 on a 7-point scale (S.D. 0.7). For the interviewed sample, an average of 70% corporate innovation comes from internal development and 30% from internal R&D activities. For SMEs the share of external sourcing is 32% and the share of internal sourcing is 68%. For large companies 30% comes from external sourcing and 70% from internal development. We note that the 79% innovation of the best-in-class companies comes from internal development and 21% from external development. Forty percent of our respondents indicated that their organisation is absolutely ahead of the competition. Large companies reported adopting a strategy of staying ahead of their competitors in innovation but in both the small firms and the large firms only 28% reported being proactive at the maximum level (7 in our scale). Respondents from large firms pointed out that this ambition cannot be achieved in all their markets in which they are active while SMEs emphasise the pursuing of absolute leadership. This is consistent with the view that small firms often operate in a single, specific niche market. The above is confirmed by the fact that SMEs perceive lower levels of competition compared to large firms that typically compete in multiple markets.

With respect to the strategic orientation, operational excellence, customer intimacy and product leadership (Treacy and Wiersema, 1995), SMEs and large firms differ in the strategic orientation they follow. While large firms tend to maintain a high level in all three strategic directions, SMEs tend to favour customer intimacy and disregard operational excellence as a strategic orientation.

### 5.4.1 The external sourcing decision

The results from the second part of the interviews are summarised in Figures 5.2 and 5.3.

The scope of analysis in the present chapter is aimed at obtaining a qualitative feed-back from managerial practice about the topics of relevance for the present study. Although an in-depth statistical analysis is beyond the scope of the present work, the relative ranking of each motivation for large companies and small companies has been tested by using the

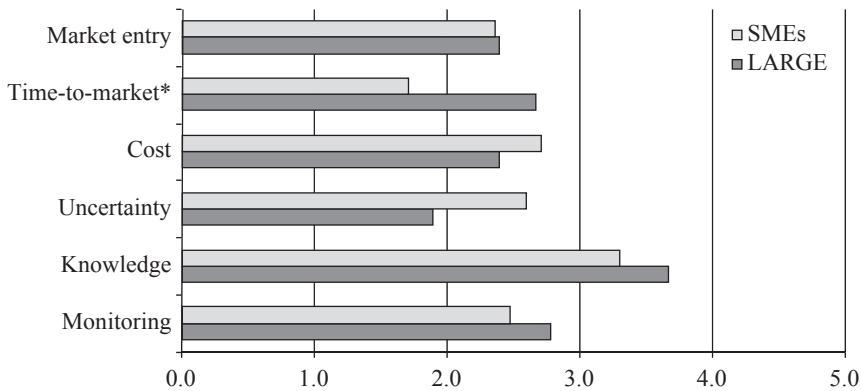


Figure 5.2. Motives for external sourcing. The comparison of the large companies vs. SMEs. (Mann-Whitney test is significant at the: \* 10% level).

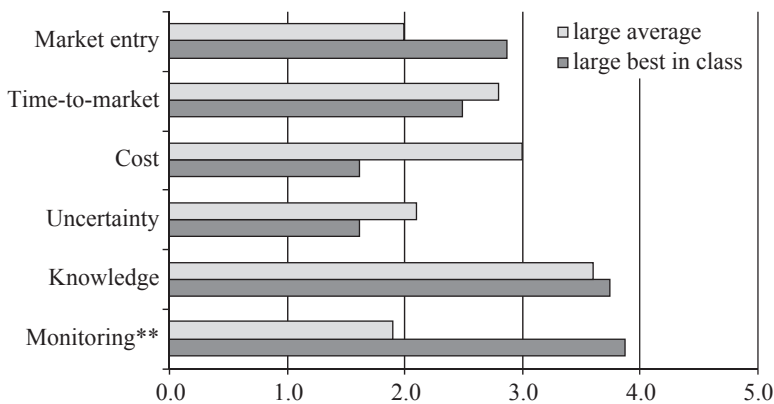


Figure 5.3. Motives for external sourcing. The comparison of the best-in-class vs. average large companies. (Mann-Whitney test is significant at the: \*\* 5% level).

Mann-Whitney U test in order to provide a more solid test of our propositions. The test is appropriate as it calculates the ranking across companies for each specific motivation. For SMEs and large firms the need to have access to new knowledge in an increasingly complex technological context is the most important reason for external sourcing. Contrary to our expectations this objective seems to be more relevant for large firms than for SMEs. The difference is however non-statistically significant. We therefore cannot confirm Proposition 1 that predicts the prevalence of knowledge-driven motives for small firms. According to our expectations, monitoring is more often mentioned as relevant for large companies that are typically active in several technological domains. SMEs often take their innovations from a narrow technology range. Cost and uncertainty reduction are important reasons for small firms to source externally but the difference between large firms and SMEs is not statistically significant. Propositions 2a and 2b, stating that SMEs are especially driven to external sourcing by a willingness to reduce costs and risks are not confirmed by the Mann-Whitney test. The finding is not in line with the literature that mentions risk-sharing as a determinant of external sourcing (e.g. Tethler, 2002). The finding is also consistent with our arguments that the limited resources that small companies have at their disposal lead them to join forces with external partners. However, for large firms, reducing uncertainty is the least important reason to source innovation externally. One of the respondents argued that large firms are competent to deal with uncertainties encountered in technological innovation on their own. Partnering, in itself, is not important for reducing uncertainty, only if the desired technology lies outside the expertise range (as in the case of expansion into a new market) can external sourcing help diminish risks.

Contrary to our prediction, time-to-market is a more important driver for large companies than for SMEs to source externally and the difference is statistically significant. We therefore cannot confirm our Proposition 3a, stating that SMEs use external sourcing to accelerate time-to-market more than large firms. When SMEs need to accelerate the innovation process, they prefer to intensify internal efforts. As reported by one of the respondents, finding a suitable partner and arranging a deal is considered to be a time-consuming process in itself. In the words of one of our respondents of a small company: *'I am sitting on top of it and I can steer it. If I have to find a partner who can do it and settle an agreement then it takes time anyway'*. And another said: *'A new market for us generally is an existing market for a bigger company. So I can never be there first'*.

Entering into new markets is similarly relevant for SMEs and large firms. It is perceived as a costly and time-consuming activity that might be simplified by external relationships. One commented: *'Finding the right market is more problematic than developing a new product'*. And another added: *'In order to transform knowledge into value, you need a market'*. We therefore cannot accept Proposition 3b which states that small firms rely on external sourcing to enter into new markets more than large firms.

If we consider the rationale for external sourcing for the best-in-class companies, one main point is worth noting. Cost and risk-sharing is at the lowest levels of importance to this group of companies. For best-in-class companies, monitoring technological opportunities and developments has the highest priority (see Figure 5.3). Being constantly aware of potential opportunities in their environment is clearly a top priority for excellent companies. As one respondent said: *'We work with people outside our company to know what is going on out there.'* And another commented: *'I want to have access to all kind of new opportunities, and, yes, I may lose some knowledge or I may have to share something with others, but at least I take my part.'* *'We can do everything we want, we have the knowledge and the resources to do that, but we have to be open to opportunities that come from outside.'*

The third part of the interview generally confirmed the above results. The decision process follows the same pattern in both large firms and SMEs. The process starts with the definition of the strategic objectives to be achieved and with the analysis of what is available and feasible internally. In the words of one of our respondents: *'If you do not have the expertise or the capacity in house, then you will work with an external partner.'* *'We try to do everything ourselves ... if we cannot, then we have to decide how to proceed.'*

Both SMEs and large firms have pointed out that, if full control over the new technology is needed, internal development is preferable. Some comments from our respondents explain this: *'Having control over the new technology is the main benefit of internal development.'* *'It is the control over the developed technology that is very important.'*

Especially technologies that are core to the company's business tend to be developed in-house. When a need arises that cannot be fulfilled by internal R&D, companies use external sourcing. A respondent said: *'The reason for sourcing innovation externally is that we do not have the knowledge in-house: what is core to the company is done in-house, what is not core is done externally.'*

From the discussions, it can be concluded that the adoption of 'open innovation' practices (Chesbrough, 2003) are strongly determined by the corporate culture. Corporate culture can be defined as *'a pattern of shared basic assumptions that have worked well enough to be considered valid and therefore, to be taught to new members as the correct way to perceive, think and feel in relation to those problems'* (Schein, 1992: 9). Organisations, both small and large, that prioritise control over the innovation process are more reluctant to source innovation externally and tend to adopt 'closed' innovation models. One of the respondents indicated: *'The corporate culture is such that we must give priority to internal development for reasons of control and secrecy.'*

For SMEs, control is framed in terms of intellectual property (IP) rights protection. When intellectual assets are defended by secrecy and not by patents, the cooperation may pose threats that have to be carefully balanced against the opportunities. In such a case, external sourcing is more probable if the partner is already known from previous experiences. In the case of large

firms, previous knowledge does not hamper the search for new partners. The selection criteria are based on the partners' competence for large firms. As one of the respondents of a large firm stated: *'You work better if you know each other but this does not have to limit us ... we do not want to limit ourselves to what we know and what we have.'* And another said: *'We want to have the best partner, the most competent in the field.'*

Large companies are more open to partnering with competitors than SMEs if the process is not prohibited by legislation restrictions (e.g. antitrust regulation), especially if they aim at influencing the adoption of industry technology standards. Some of the SMEs tend to avoid competitors because of knowledge protection concerns. As a respondent of a small company commented: *'it is risky to be so close to a competitor.'*

SMEs may (especially those that are focused on customer intimacy) agree to work with competitors when their clients demand it. In such a situation, the cooperation is not a spontaneous choice but a necessity that is accepted to satisfy the customers' needs or wishes. As one of the respondents explained: *'We are absolutely against having relationships with competitors ... unless it is requested by our customer. This may happen.'*

During the interviews, it emerged that one factor, the relative size of the potential partner, is carefully accounted for in the decision process by SMEs. Power imbalance in the relationship due to size differences limits the willingness of small firms to cooperate. A respondent said: *'We have to worry especially with respect to relationships with large companies. They can overcome us easily: if they get interested in something they can put much more people to work on it than we can.'* As it could be expected large firms do not have these concerns.

### 5.4.2 The governance decision

In order to verify the extent to which the proposed decision framework reflects current managerial practice, we have performed an initial empirical validation of the model's key elements.

In the present section, we structure the presentation of the results around the decision drivers that we have highlighted in the decision model as per the phases 1, 2, 3 and 4.

The two main factors which influence the governance decision in the proposed model are the expected returns and the uncertainty that is associated with the governance modality. In terms of expected returns, we have classified two types of benefits. The first refers to gaining access to a technological knowledge and the second to market advantages. The costs and the time are related to the expected benefits. In terms of risk, we have made a distinction between the uncertainty that derives from the external relationship itself (endogenous) and the one that derives from the unexpected changes in the technology or market developments. Endogenous uncertainty is reduced by trust and previous experiences with the partners (Van de Vrande

*et al.*, 2009). In the proposed portfolio approach we suggest that the expected benefits are assessed against each other in a trade-off balance.

In the following sections we present the important factors that we have highlighted in a PT context and that have emerged from our analyses as important elements in the decision process. In Figure 5.4 and 5.5 we differentiate for SMEs and large firms. Among large firms, we then distinguish between best-in-class in Figure 5.6 and 5.7.

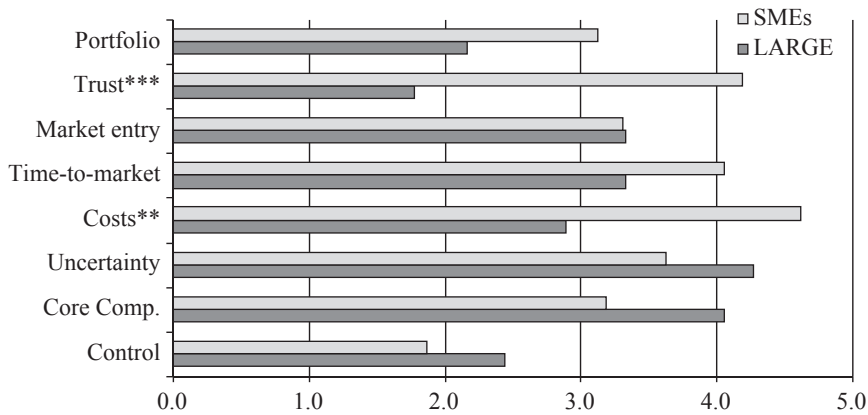


Figure 5.4. The rationale for SAs governance choice: large firms vs. SMEs. (Mann-Whitney test is significant at the: \*\*\* 1% level; \*\* 5% level).

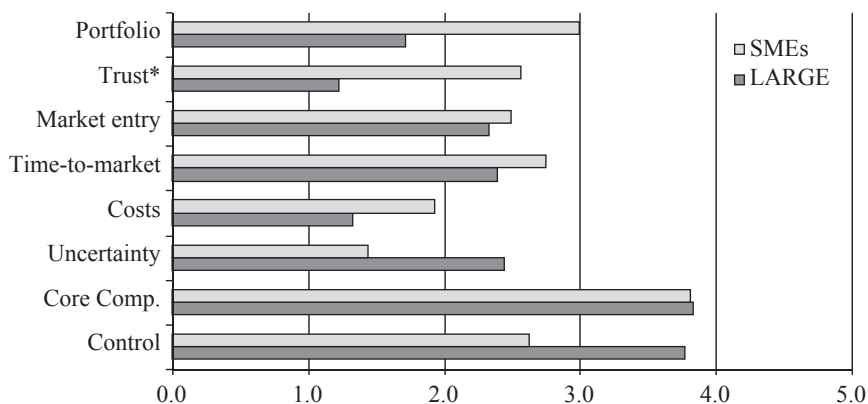


Figure 5.5. The rationale for M&As governance choice: large vs. SMEs. (Mann-Whitney test is significant at the: \*10% level).



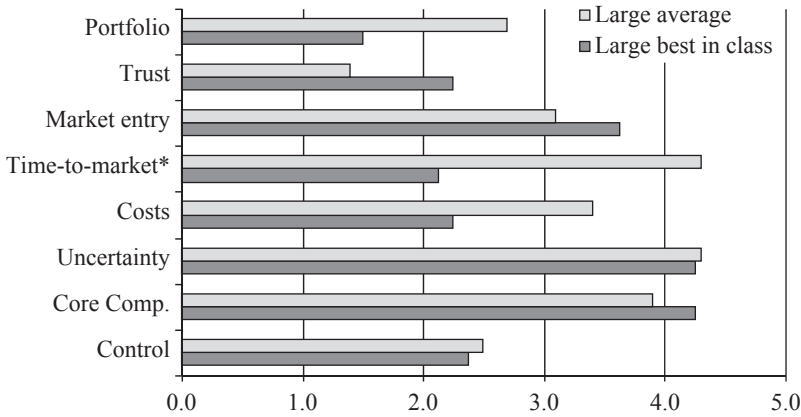


Figure 5.6. The rationale for SAs governance choice: large best-in-class vs. large average. (Mann-Whitney test is significant at the: \*10% level).

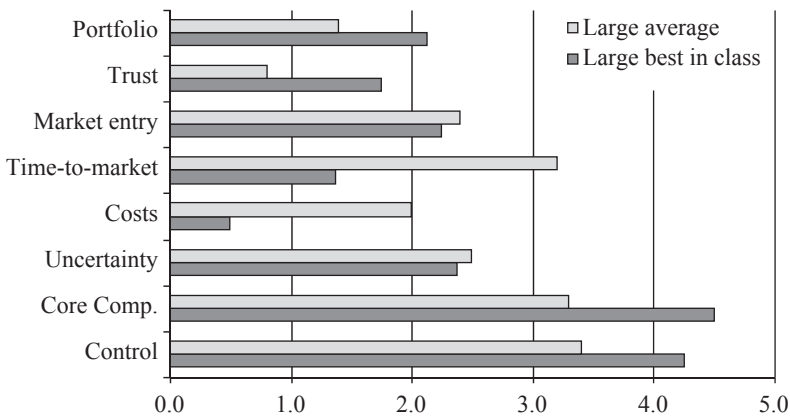


Figure 5.7. The rationale for M&As governance choice: large best-in-class vs. large average. (Mann-Whitney test is not significant).

As can be concluded from the comments of our respondents during the interviews, development and access to new knowledge has been recognised by our respondents as a relevant determinant of the external sourcing decision. The strategic relevance of the technological knowledge influences the preference for SAs or M&As. Large firms tend to use both SAs and M&As when they need complementary knowledge within a core business area. When this need is associated with the desire to control the new knowledge M&As have been reported by our respondents to be the choice of preference. In order to cope with high uncertainty, SAs are preferred. In best-in-class companies, for the use of M&As, core competence and control are

the most important governance choice drivers. Additionally, it has been pointed out by our respondents that what influences the decision to use an alliance or an acquisition is the extent of the knowledge the company aims at. When the benefit from the target company is specific, then alliances are the choice of preference as the acquisition of the entire company is perceived as an action on a too large scale (De Man and Duysters, 2005). SMEs prefer to give priority to acquisitions when the needed technology is core to their business. This is in line with the previously highlighted concern of small firms to protect their intellectual assets.

Development of or entry into a new product or geographical market has been reported by large and small firms as an important objective which is best achieved by means of SAs. In this respect the time-horizon plays a role. When the decision to enter a new market has long-term relevance for the company, acquisitions are the preferred option. When the expansion in the new market is considered more as an opportunity to be explored episodically, alliances are favoured. In the view of one of our respondents: *'The long term is for M&As, the short term is for SAs'* For market access, our respondents have indicated that the governance modality may be largely restricted by external factors. The local legislation, the cultural differences, as well as the level of protection against contract infringements in the country of the target company have to be considered when choosing the governance mode. One of the respondents commented: *'In those countries you do only alliances, if you buy there you are never sure about what might happen'*. Accelerating the time-to-market orients decision-makers towards alliances. One of our respondents commented that if there is time pressure with respect to the technology, large firms are more likely to be the partner of preference and alliances are the most viable governance choice.

For all classes of company cost reduction means there is a tendency to choose SAs rather than M&As. The above is in line with the view that M&As are in themselves expensive transactions. Although valid for all sizes, the above is more relevant for small firms that continuously face a scarcity of economic resources (Narula, 2004). Indeed, the difference between small and large companies with respect to cost considerations is confirmed by the Mann-Whitney test.

Endogenous risk is more relevant for the decision to enter into alliances rather than choose acquisitions. As it may be expected, endogenous risk is more critical for small companies than for large firms, as also statistically confirmed. As we have previously pointed out large companies are more focused on the partners' quality and capability of its contribution to corporate goals. Previous experiences with the partner or build-up trust appear to be of limited interest to large firms. SMEs tend to assign great importance to establishing alliances with known partners and, although to a lesser extent, also when dealing with acquisitions. As one of our respondents summarised: *'If there is no trust, there is no alliance'*.

In SMEs, risk concerns about the technological development are relevant when choosing alliances but they are less important for selecting M&As. In this respect it seems that alliances are preferred in situations of high technological uncertainty (see Van de Vrande *et al.*, 2006).

From the comments of our respondents, it follows that SAs and M&As display different profiles in terms of expected benefits and risks and that they are considered in the governance choice as formulated in our Proposition 4.

The portfolio of existing technology sourcing modes is relevant for both SAs and M&As in small firms, respectively at the second highest level of importance for M&As and at the forth level of importance for SAs. The result is remarkable especially noting that for large firms, portfolio considerations rank at the lowest levels of importance for both SAs and M&As. A potential explanation is that small companies have a reduced range of technologies and therefore focus on properly integrating their relationships. Synergistic effects were reported by the respondents to be of critical importance. One of our respondents said: *'Of course, the choices are not independent of each other, they are always integrated in order to achieve synergies among them. It is not a matter of piling them up without interconnections. We develop one piece of a technology with one relationship, another piece with another partner, we develop certain aspects ourselves and then we integrate the whole'*. Another of our respondents commented on the importance of a portfolio perspective in the decision process: *'The key is to combine the new relationship with the existing ones: the complete picture has to make sense'*. With respect to risk considerations in the portfolio, a respondent stated: *'There must be a risk balance in the portfolio'*. Proposition 5, suggesting that interactions among relationships are considered in the decision process, seems to receive a support from the comments of the respondents. In this respect, our analysis can only suggest the existence of a pattern but it cannot claim an effect of causality of portfolio considerations on the governance choices. For best-in-class companies portfolio considerations are especially relevant in case of M&As. One respondent said: *'In the acquisitions we pay special attention to the synergies that can be generated'*.

Finally, in line with our Proposition 6, our respondents have pointed out that the governance decision has to be interpreted as an element of a dynamic process. The portfolio of relationships has to follow the evolution of the corporate strategic orientation, as was indicated in phase 4 of our model. In the words of one of our respondents: *'We decide where we want to be in the future and then we see if the new alliances and acquisitions are in line with these objectives'*. Two specific types of dynamics have been pointed out. The first is that companies may enter into alliances as an initial step for a subsequent acquisition. One respondent commented: *'In countries with politically complex situations, we start with an alliance to see how things are going and we move to an acquisition only in a later phase'*.

The second is that acquisitions and alliances are often chosen as a first step for internal development. The above is in line with the dynamic loop that we have described in Figure 5.1, where the decision process evolves over time. One respondent stated: *'We may start with an acquisition and then we proceed on the same technology by internal development: choices are not mutually exclusive'*.

Two viewpoints that have emerged during the interviews have attracted our attention. A corporate preference for one governance modality has emerged during the conversations: companies may favour *a priori* one form of relationship over the other. The preference is mainly driven by the fit of the governance modality with the corporate culture or by current practice and historical experiences. Some respondents have reported that their company has a general preference for doing acquisitions or, on the contrary that M&A are not considered by the firm or that entering into alliances is not consistent with the corporate culture and historical identity. In the words of one of our respondents: *'We do only acquisitions because for our company having total control is a strategic priority'*. And another said: *'We have not the culture of doing alliances'*.

The relative size of the potential partner is another relevant aspect that is considered. For small firms, larger companies are out of reach in terms of acquisitions so there is a limitation in the range of possible governance alternatives. A respondent said: *'Acquisitions are not a possibility because of our financial means'*. Similarly, large companies acquiring a company of similar size operating in the same market can be prohibited by the legislation. In all the above circumstances, the governance decision is limited. One of our respondents commented: *'We have only very few competitors in the world: we are not allowed by legislation to acquire any of them'*.

### 5.5 Discussion and conclusions

In the present study we aimed at two objectives: first, identifying patterns in sourcing innovation externally and, second, clarifying the governance decision process. For the purpose of our study we have collected, through semi-structured interviews, detailed information on the decision steps that are taken. First, we compared the findings in large and small firms. Second, we derived additional insight from considering the practices of the best-in-class firms. Our findings suggest that external sourcing comes under consideration if internal R&D is not a viable option. Openness to external relationships is also positively related to corporate values and attitude towards partnering. External sourcing is more likely to occur when there is a need for absolute control over a specific knowledge and when sharing internal knowledge with a partner is considered as a win-win situation. Our results are in line with the study of Omta and Van Rossum (1999) who argued that external relationships are harmed by the company's fear of losing sensitive information and technology. The results are also consistent with previous research which highlighted that external sourcing is less likely to be used if the activities are at the core of the company's business (Parmigiani, 2007), or when it is a corporate priority to guarantee control over the generated knowledge (Jones *et al.*, 2001). This might be more critical for small companies since high costs and complex procedures prevent small firms from protecting their intellectual assets through formal methods like patents (Masurel, 2005). A study of Lanjouw and Schankerman (2004) also showed that small firms are at a disadvantage when protecting their intellectual property rights. In line with the findings of Blomqvist *et al.* (2005), for small companies in particular, trust is essential when using external sources.

In line with the previous results of Narula (2004), the need to access new knowledge through increasingly complex technologies is the main driver inducing companies to adopt 'open innovation' practices, for large and small companies alike. Similar to Narula (2004), however, we found that sharing costs and risks are not relatively more important for small companies than for large ones. The findings of Narula (2004) were derived from companies in the ICT sector. The specific sector characteristics may explain the differences between our results and his work. Our results also differ from those of Van de Vrande *et al.* (2009). Although market motives are more important for small firms than for large ones, they are not the most important driver for external sourcing.

Finally, our research enriches previous works by pointing out the practices of best-in-class companies. In particular, we highlight the importance of technology monitoring for external sourcing decisions. The importance of scouting activities has been pointed out by Vuola and Hameri (2006) in the relationship between CERN (European Laboratory for Particle Physics) and the industry. Our study indicates that further studies should explore in more detail the implications and the importance of the above sourcing driver.

For the governance decision, we have proposed a conceptual model. To assess the contribution of the proposed model, we have tested the extent to which the PT reasoning is taken into consideration in managerial practice. Our study seems to contribute to both the managerial practice and the literature by linking decision process and strategy (Cyert and Williams, 1993). From a managerial perspective, the study provides a 'best practice' model by discussing how the governance decision may increase the innovation results of external technology sourcing activities. Matching the practice with the model's benchmark is beneficial for the management of technology sourcing modes, as it encourages companies to look at their relationships in an integrated fashion. By leveraging the interdependencies and the time dynamic effects in the governance decision process, companies optimise their portfolio of technology sourcing modes to enhance innovation performance. The relevance of this work resides in its three main contributions. The first is to attempt to link process and content perspectives by conjugating the literature on external technology sourcing performance to the governance decision process. Second, by proposing an application of Portfolio Theory to the governance decision process, the study enriches the literature of new conceptual tools for approaching the organisational choices. Third, we suggest a new conceptualisation of the decision process outcome. Previous research follows three main lines. The first approaches SAs and M&As as 'interchangeable' forms of governance, the second isolates one of the two alternatives and focuses on either SA or M&A (Wang and Zajac, 2007). A third research stream compares the circumstances under which an alliance should be preferred to an M&A or *vice versa* (for example, Chiesa and Manzini 1998; Garette and Dussauge, 2000; Hagedoorn and Duysters, 2002; Hennard and Reddy 1997; Vanhaverbeke *et al.*, 2002; Villalonga and McGahan, 2005). We contribute to previous literature by proposing a fourth approach that conceives of the governance choice not as a simple binary outcome, either M&A or SA, but in terms of its balance and integration within a portfolio.

Monitoring the governance portfolio of SAs and M&As has been reported by our respondents as a critical strategic task that is performed on a regular basis. The process we propose can serve as a support for structuring a sequence of decision steps for portfolio management. In a theoretical context, the Financial Portfolio Theory approach grounds our proposed decision model. By expanding the range of application of PT from economics to an organisational context, we contribute to the literature by proposing a new conceptual paradigm that supports the governance decision process. To the best of our knowledge, this is the first attempt to apply PT to the governance decision of external relationships.



## 6. General discussion and conclusions

In the last few decades, we have witnessed an exceptional increase in the speed, complexity and variety of technological advancements. Companies have responded to the challenge of innovating in an increasingly dynamic context by profiting from external technology sourcing and using partnerships, especially strategic alliances (SAs) and mergers & acquisitions (M&As). The above trend has attracted considerable attention and interest from management researchers. As described in Chapter 1, a rich assortment of books, scientific articles and publications have been devoted to investigating the link between external sourcing and innovation. Although external technology sourcing can take on a broad range of governance modes, the literature typically refers to the above-mentioned two broad categories: SAs and M&As.

### 6.1 Main findings

The aim of the present book is to increase the understanding of the impact of the governance choices on innovation performance and to define a benchmark framework for the governance decision process. Companies face the challenge of choosing between internal or external sourcing of innovation and then deciding the governance mode of their external relationships.

Deepening our understanding of the effects on innovation of different governance modes provides the insights needed to be able to formulate a framework for the governance decision process. To achieve the research goal, we have formulated a list of questions that we have addressed in the different chapters of this book. For the first part of the study (and also for answering the subsequent research questions 2 and 3) we have used secondary data from the Dutch Community Innovation Survey which were linked to the Business register (ABR). The CIS waves include: CIS 2 (from 1994 to 1996), CIS 2.5 (from 1996 to 1998), CIS 3 (from 1998-2000), CIS 3.5 (from 2000 to 2002) CIS 4 (from 2002 to 2004) and CIS 4.5 (from 2004 to 2006). Each wave contains information on the characteristics and innovation activities of more than 10,000 companies. Innovation is '*at the very top of the political agenda*' and CIS provides the key statistics about innovation in the different EU states '*for informing policy-makers about where Europe stands on the path to more knowledge and growth*' (Eurostat, 2008).

In the Chapter 2 we investigated the effects on innovation of using SAs by addressing the following research question:

RQ1: *What is the effect on innovation of using SAs as the governance mode for external sourcing by SMEs and large firms?*

Table 6.1 contains the hypotheses that were tested and the results.

For the purpose of the analysis in Chapter 2 we used the dataset linking the CIS waves 3 and 4. As Table 6.1 shows, our analyses proved that SAs have a positive effect on the likelihood



Table 6.1. Results for the hypotheses connected to research question 1.

Hypotheses	Results	Reference
H1: SAs have a positive effect on the likelihood of companies becoming (H1a) and/or remaining (H1b) innovators	H1a: confirmed H1b: confirmed	Table 2.3, 2.4
H2: SMEs benefit less from SAs than large companies with respect to becoming (H2a) and/or remaining (H2b) innovators	H2a: not confirmed H2b: confirmed	Table 2.3, 2.4

of companies becoming and remaining innovators. SAs turned out to be an effective means of improving innovation. The support provided by SAs applies even in extreme conditions: SMEs that are not innovative can overcome their limitations and become innovators. The positive effects are, however, not limited to SMEs but extend also to non-innovative large firms that may surmount their constraints by innovating through SAs. Medium-sized companies and large companies benefit from SAs to remain innovators over time and sustain their competitive advantage. Interestingly, the positive effects on innovation are only achieved over time and manifest after 2-6 years. In the decision framework we propose in Chapter 5, the time-dimension is therefore of crucial importance. It appears that firms which engage in SAs to access complementary knowledge have a relatively high R&D intensity (see Table 2.3). SAs appear not to be a substitute for internal innovation, but complementary to it. An exception is the situation of large firms that strive to become innovators. In this case, SAs appear to be a sufficient mechanism to foster innovation, and R&D in the previous period (in  $t-1$ ) is not a determinant for crossing the innovation threshold (see Table 2.3). A potential explanation is that external sourcing may provide the capabilities that the company cannot develop in-house. Theoretically, this is grounded by the discerned advantages of accessing complementary resources as propagated by the Resource Based View and the Dynamic Capabilities framework.

In Chapter 3 the effects of M&As on innovation were analyzed. The second research question was formulated as follows:

*RQ2: What is the effect on innovation of using M&As as the governance mode for external sourcing by potentially dominant firms?*

The second research question was put in a largely unexplored context: potential market dominance. The case of market dominance is not only interesting from a theoretical point of view, but also in the light of the current political debates, since positive effects on innovation might outweigh the negative effects of concentration on the competition in the market. European legislation prohibits concentration unless positive effects on innovation may more than counteract the negative aspects on competition. Using a dataset linking the first 5 CIS waves, we distinguished the potential dominant firms by selecting the firms above the 85<sup>th</sup> percentile of the size distribution of each 3-digit sector. In our analysis, we have distinguished

the effects on inputs (measured as R&D expenses and total cost of innovation), outputs (measured as sales from products introduced to the market that are new to the market and new to the firm), and on the overall efficiency (unit of output per unit of input) of the innovation process. For efficiencies we have used both the sales from products new to the firm and new to the market. This approach is useful to identify the phases of the innovation funnel that are most sensitive to M&As. The hypotheses in Table 6.2 were tested.

We expected lower inputs because of synergies in R&D, and higher outputs and higher efficiencies as a result of M&As. However, the first hypothesis had to be rejected. This finding is in contrast to the results of Hitt *et al.* (1990, 1991) but in line with those of Cefis *et al.* (2009). One explanation comes from the interviews with decision-makers who indicated that M&As are often considered as the starting point for internal R&D in a new technology field. Our results in Chapter 3 indicate that potentially dominant firms may rely on M&As to achieve higher levels of innovation in the dimensions that have been investigated (with the exception of the cost efficiencies for new products to the firm). Our results are surprising compared to the previous literature on M&As (e.g. Hitt *et al.*, 1991) and to evidence that the majority (between 65/85 percent) of M&As fail to generate shareholder value and innovation (Schenk, 2008). The failure rates of M&As leave unexplained their popularity suggesting the existence of a ‘merger paradox’ (Schenk, 2006). In Chapter 3, we have found evidence of a significantly positive effect of M&As if they take place in the previous 3-5 years and in the specific context of potential market dominance. It is worth linking the findings in Chapter 3 with those of Chapter 4 indicating that using M&As only does not contribute to the innovation performance in the short term (within 3 years), especially for SMEs. From the comparison, two contingencies seem to be relevant when explaining M&A effects: (1) the time lag that is considered in the analyses, and (2) the size and the competitive position of the acquiring firm. Our findings indicate that a time lag longer than 3 years is needed before M&As display a positive effect on innovation. The above explanation would reconcile our findings with those of Hitt *et al.* (1991) who considered a time span of only three years when reporting the negative effects of M&As on innovation. An additional explanation of our results arises from considering that the period of our analyses coincides with the 5<sup>th</sup> (1995-

Table 6.2. Results for the hypotheses connected to research question 2.

Hypotheses	Results	Reference
H1: In potentially dominant firms, M&As have a negative effect on innovation inputs	H1: rejected	Table 3.3
H2: In potentially dominant firms, M&As have a positive effect on innovation outputs	H2: confirmed	Table 3.4
H3: In potentially dominant firms, M&As have a positive effect on innovation efficiencies	H3: confirmed	Table 3.5

2000) M&A wave. It has been suggested that intertemporality plays a role in the performance of large M&As and that successful results are more likely to occur in the early phases of the merger wave (Schenk, 2006). Our results also indicate that the size of the acquirer and its competitive position in the market (potentially dominant) foster the effects of M&As on innovation. We expand previous findings by indicating that the relative size of the companies hampers the post-merger innovation performance of M&As (Cloodt *et al.*, 2006) and that the absolute size of the acquired company contributes to innovation (Ahuja and Katila, 2001).

To summarise, the results of Chapters 2 and 3 confirm that both SAs and M&As are valid governance modalities that companies may use to improve innovation.

For a complete picture of the governance choice process, however, we need to further advance our understanding of the implications of choosing one governance mode over the other. In particular, we proceed by asking if companies may benefit from specialising in a single governance mode, M&A or SAs. We ask ourselves which strategy performs better with respect to innovation. Research question 3 – which is put central in the first part of Chapter 4 – is therefore:

*RQ3a: What is the effect on innovation of M&As compared to SAs as a governance mode?*

In this phase of the research we have distinguished between exploitative innovation, explorative innovation and total innovation level of the companies. For this, we used data from Community Innovation Survey (CIS 3) which covered the period 1998-2000. In order to complement previous analyses we have chosen a shorter time span by selecting a single CIS-wave. To answer RQ3a, we have adopted a comparative approach, in line with previous studies (e.g. Keil *et al.*, 2008; Schildt *et al.*, 2005; Rothaermel and Hess, 2007), which are few in number. By focusing on the specific advantages of SAs compared to M&As (and *vice versa*) we can assess whether the preference for one governance mode over the other may be justified. As already mentioned in Table 1.1, M&As and SAs present specific characteristics that influence the potential of their contribution to innovation. The consequence of this is that one governance mode may be preferable for a specific purpose. In particular, if we make a distinction between explorative and exploitative innovation (March, 1991), flexible forms of governance like SAs are likely to favour exploration while M&As tend to benefit exploitation (Schildt *et al.*, 2005). The hypotheses as shown in Table 6.3 were tested.

Our focus on SAs and M&As from a specialisation strategy perspective differentiate our study from previous works so that a complete direct comparison is not possible. Our results, however, point in a different direction with respect to the findings of previous comparative studies. These have reported a positive effect of M&As – but not of SAs – on innovation (e.g. Rothaermel and Hess, 2007), or a positive effect of both (Keil *et al.*, 2008). Our results show that SAs significantly contribute to all the investigated dimensions of innovation. M&As are positively but not significantly associated with exploitation and with total innovation

Table 6.3. Results for the hypotheses connected to research question 3.

Hypotheses	Results	Reference
H1a: A governance strategy focusing only on alliances will show a more positive effect on explorative innovation than a governance strategy specialised in M&As	H1a: confirmed H1b: not confirmed	Table 4.3
H1b: A governance strategy focusing only on alliances has a less positive effect on exploitative innovation than a governance strategy specialised in M&As		
H2a: An ambidextrous governance strategy will show a less positive effect on explorative innovation than a strategy specialised in strategic alliances only	H2a: not confirmed H2b: not confirmed H2c: confirmed	Table 4.3
H2b: An ambidextrous governance strategy will show a less positive effect on exploitative innovation than a strategy specialised in M&As only		
H2c: An ambidextrous governance strategy will show a more positive effect on both exploration and exploitation (total innovation performance) than specialised strategies		

performance. Especially SMEs are likely to have only a limited benefit from M&As as a single sourcing mode, in the discerning period for data analysis (within 3 years).

By linking the results of Chapter 2 with those of Chapter 4, we can conclude that SAs represent a governance mode that is effective in the short run (within 3 years), and over a longer time span (from 2 to 6 years) for both large firms and SMEs.

Although the above results of specialising in SAs versus M&As shed new light on the relationship between governance choice and innovation performance, our understanding would be incomplete without considering the existence of potential links between different governance modes. A rich literature (e.g. Belderbos *et al.*, 2006; Duysters and Lokshin, 2007; Faems *et al.*, 2005; George *et al.*, 2001; Hoffman, 2005; Lavie, 2007; Parise and Casher, 2003) suggests that a *portfolio approach* allows for optimal capturing of the value-generating potential from external partnerships. We therefore proceeded by asking what the effect is of a portfolio of M&As and SAs on innovation and how these effects compare to using a single governance mode. In Chapter 4, therefore, we ask the following.

RQ3b: *What is the effect on innovation of using a portfolio of SAs and M&As compared to using only M&As or SAs?*

We argue that SAs and M&As display different characteristics (see Table 1.1) and that being able to use both requires a special capability that is referred to as ambidexterity of governance modes. Our results clearly show the superiority of an ambidextrous strategy. Hence, hypotheses H2a, H2b (Table 6.4) are not confirmed while H2c is confirmed. Our findings indicate that an ambidextrous governance strategy that combines SAs and M&As in a portfolio is, on average, favoured by firms of a larger size in the sample. However, a high standard deviation (see Table 4.1) suggests that SMEs firms also rely on an ambidextrous strategy. The above point is worth noting as it shows that a portfolio perspective is adopted by various size classes.

The results show that a portfolio-based approach leads to higher levels of explorative, exploitative and total innovation compared to governance strategies of either using SAs or M&As. Combining diverse governance modalities in a portfolio fosters innovation regardless of the size of the firms, which implies that an ambidextrous approach is suitable for both SMEs and large firms. The above is consistent with the results of Chapter 5, clearly indicating that portfolio considerations are relevant for SMEs and large companies that are best-in-class (top-three world leaders in their reference market). Interestingly, the analyses suggest that M&As, even if they have no direct positive effect on innovation, contribute to it if they are combined with SAs. M&As and SAs both appear to be key building blocks of a successful governance portfolio. The existence of synergistic and risk diversification benefits that occur in a portfolio (Mahnke and Overby, 2005) may explain our findings. Other studies have also postulated a complementary role of multiple governance modes (Van de Vrande, 2007; Garette and Dussauge, 2000). Our results add to these findings by suggesting that integrating multiple governance modes is a successful strategy for explorative as well as exploitative purposes. The above consideration is speculative if we consider only the results from Chapter 4, as CIS does not provide information at the transaction level about the specific motivations of SAs and, in particular, M&As. The findings of Chapter 5, however, confirm that different governance modes serve diverse purposes and the synergies from their integration generate value.

An interesting insight emerges from considering the impact of time in our analyses for SAs and M&As both as independent or jointly considered governance modes. The outcomes in chapters 3 and 4 show that M&As need a longer time (3-5 years) to exhibit their impact. The findings of Chapter 2 and Chapter 4 show that SAs start to display their effects sooner. This is in line with the pattern that De Man and Duysters (2005) have reported in their literature review about the effects of M&As and SAs on innovation. A potential explanation for the earlier benefits of SAs is that these are flexible forms of governance (Dittrich and Duysters, 2007) that adjust more easily to changing environments. The fact that M&As and SAs affect innovation in different time patterns indicates that a balanced portfolio, including both SAs and M&As, may be able to harvest innovation advantages in the short as well as the long run.

Bearing in mind the three principal insights that were gained from the previous chapters, we discuss the sourcing decision process. Referring to Chesbrough's '*open innovation*' concept (see

Chapter 1) we first focus on the drivers of the decision to develop new technologies internally or to choose external partnerships. We therefore formulated research question 4 as follows.

RQ4: *What drives the decision to source innovation externally in management practice?*

This research question was answered in Chapter 5, after investigating the positive and negative outcomes of single or combined external sourcing modes in Chapters 2, 3 and 4. In order to gain insights from and for managerial practice, we have collected data from 37 interviews with companies and experts that are recognised for their innovation achievements and expertise. The sample included SMEs (less than 250 employees) and large companies (more than 250 employees). With very few exceptions the database includes companies that are global players and that are in the list of the top ten world leaders with respect to their market of reference. The SMEs category contained companies with personnel numbers of 2-150, the large firms 900-350,000, while a best-in-class category (firms which belong to the top three in their industry) was defined with employee numbers ranging from 5,000-350,000. The location of the companies' headquarters was Europe and the USA. In all cases sourcing of innovation was a combination of internal (2/3 or more) and external (1/3 or less). Six propositions were formulated (Table 6.4).

The results of Chapter 5 suggest first that companies mainly rely on internal sources for new technologies and second that external sources are tapped if these provide access to new knowledge which complements or expands existing know-how, in line with the corporate culture and strategy. Companies are aware of the limitations of a '*closed innovation model*'. Complementary external sources are used to overcome internal constraints. As a consequence, innovations derive from internal as well as from external sources. Investing in internal R&D is a necessary prerequisite to develop '*absorptive capacity*' which, in turns, allows companies to fully exploit the potential of external technology sourcing (Cohen and Levinthal, 1990). Our findings confirm that internal R&D is an essential determinant of innovation performance and that external sourcing does not represent a substitute but rather a complement to internal R&D investments, both in the short and long term. This result is in line with the findings reported in previous literature (Cassiman and Veugelers, 2002; Rothaermel and Alexandre, 2009; Van de Vrande, 2007; Veugelers and Cassiman, 1999). Factors which influence the internal-external trade-off are control, strategic importance of the technology, complementarities, relational uncertainty and financial costs and benefits. Cost reduction, which in general is regarded as a decisive motive (Mander and Brenner, 1995), is ranked especially high by SMEs although it is not significantly more important for SMEs than for large firms. Also, SMEs more than large firms fear the loss of control over their intellectual property assets. One factor which appeared as highly important and is not stressed in the literature is the fit of the technology sourcing mode (internal or external, SA or M&A) with the company culture. Capability-building is regarded as a dynamic process: what a company does now is influenced by past decision-making as well as future goals and orientations. Finally, our results indicate that best-in-class companies use external partnerships to scan their technological environment. Monitoring the



Table 6.4. Results for the propositions for research question 5.

Propositions	Results	Reference
P1: <i>SMEs are more motivated than large firms to source innovation externally in order to gain access to new knowledge</i>	P1: not statistically confirmed, in contrast to the expectations large firms tend to be more motivated to source innovation externally	Figure 5.2
P2: <i>SMEs are more motivated than large firms to source innovation externally in order to share (2a) (uncertainty) risks and (2b) costs</i>	P2a and P2b: both not statistically confirmed, but both show the tendency that SMEs are more motivated to source externally to reduce uncertainty and costs	Figure 5.2
P3: <i>SMEs are more motivated than large firms to source innovation externally in order to reduce (P3a) time to market and (P3b) to access new markets</i>	P3a and P3b: statistically rejected and not confirmed. No statistical evidence could be found for the proposition	Figure 5.2
P4: <i>The risk return profiles of M&amp;As and SAs are actually considered by decision makers and affect the preference for the governance mode</i>	P4: evidence from interview comments	Section 5.4
P5: <i>The interactions with the present portfolio of existing relationships affect the governance mode decision for new M&amp;As and SAs</i>	P5: evidence from interview comments	Section 5.4
P6: <i>The governance decision of SAs and M&amp;As is interpreted by decision makers as part of a dynamic process</i>	P6: evidence from interview comments	Section 5.4

changes and the opportunities that may arise outside the boundaries of the firm is a strategy that emerges as a practice that the best-in-class adopt.

After deciding to use external sourcing, companies are faced with a decision about whether to use SAs or M&As. As discussed in Chapter 1, we suggest using an application of financial Portfolio Theory (PT) (Markowitz, 1952) to support the governance decision. The fifth research question that we address is therefore:

RQ5: *What would a decision model for the governance of a portfolio of SAs and/or M&As look like from a Portfolio Theory perspective?*

A model is proposed (see Figure 5.1) where the decision process is articulated in four steps applying the conceptual pillars of the PT, which originates from business economics, to a context in which governance modes are selected and combined to source new technologies. First, the profile of risks and expected benefits of the governance mode has to be defined as they are different for SAs and M&As. Second, the interactions with the existing relationships in which the firm is involved have to be highlighted and put central. Third, the governance mode has to be chosen in order to enhance the value-generating potential of the entire portfolio of relationships. The model explicitly accounts for changes over time. In a dynamic perspective, the fourth step regards monitoring the evolution of the portfolio itself and of the external conditions that may alter the corporate strategy and therefore the orientation of the portfolio.

In Chapter 5 we have investigated whether the factors that drive the governance decision in our model are actually taken into consideration by companies. M&As are preferred for developing core competencies and maintaining control over new knowledge especially by large companies and best-in-class. For SMEs expanding core competencies is also central when choosing M&As. SAs are considered especially suitable by large firms that want to reduce the uncertainty of technological developments and by SMEs as tools for sharing innovation costs. From the interviews that we have performed with top executives, we have been able to confirm that the main aspects of our model are indeed considered during the decision process. Our results confirm the findings in Chapter 4, where we have pointed out that portfolio theory is adopted by various size classes. The above may be explained by the outcome of the interviews indicating that SMEs, very large and best-in-class companies use a portfolio perspective in their governance decision process.

## **6.2 Discussion and conclusions**

### **6.2.1 Limitations**

The present study is not exempted from limitations. One major limitation is vested in the data that has been used for the empirical analyses. CIS undoubtedly represents a rich source of precious information about the innovative behaviour of firms. However, the nature of the data has prevented us from using a more fine-grained approach in our analyses in three main respects. First, CIS do not contain counts of the number of partnerships. It is therefore not possible to estimate the degree of specialisation of the single governance mode strategy or to determine the size of the portfolio. Second, each CIS survey covers a period of 3 years. However, it is not possible to attribute to an exact temporal location the occurrence of the external relationships. Our results suggest that the time effect represents a relevant component in explaining the influence of external sourcing on innovation. If we had had more detailed information about the exact timing of external sourcing, it would have allowed us to test those dynamic effects more precisely. Third, CIS mainly contains information on two broad governance mode categories (M&As and SAs). A more refined classification (distinguishing, for example, joint ventures from alliances and acquisitions) would have given better insights



into the decision process. In this sense, part of the divergence of our results from other comparative studies may derive from the above limited range of governance modes which were at our disposal.

The qualitative analyses in this study (Chapter 5) offered us the opportunity to acquire a deeper understanding of the rationale that drives decision-makers. Some of the results helped us to explain the outcome of the quantitative part of the study. However, greater levels of detail come at a price: the possibility to generalise our findings. Although in the interviews our sample included companies from different countries and sectors that are active at the global level, we cannot exclude the fact that our results might have been different by studying a different sample.

All the limitations of our study represent therefore at the same time a constraint for the present research and an opportunity for further research in the future. Our contributions to scientific knowledge, policy development and managerial practice which we address in the final paragraphs, should be valued within these stated limitations.

### 6.2.2 Scientific contributions

From a scientific perspective, this study has contributed to theory. The main theoretical contributions of this work reside in the following points.

First, we have helped bridge the content and the process research in line with the suggestions of Huff and Reger (1987) and Khanna *et al.*, (2000). Content research focuses on increasing performance (Chakravarthy and Doz, 1992) while process research aims at clarifying how decisions are taken (Khanna *et al.*, 2000). In a decision analysis approach (Keeney, 1982), the awareness of the effects of governance modes on innovation is used to identify the key aspects that the governance decision process should account for.

Second, in line with the above, we have proposed the application of Portfolio Theory (Markowitz, 1952) principles to the governance mode decision. In doing so, we have attempted to reconcile economics and management sciences. In expanding PT reasoning to the management challenges, we have also enriched the theoretical and conceptual tools which are available for approaching the governance decision next to Resource Based View (RBV), Transaction Costs Economics (TCE), Real Option Reasoning (ROR), and Network Theory (NT). From a PT viewpoint the governance decision is taken by focusing on the portfolio as units of analysis. In this sense, our approach expands the previous literature that, according to Villalonga and McGhan (2005), has paid attention to the transaction (TCE, ROR), the company (RBV) or the network (NT). Time considerations are central in the PT framework: present governance decisions are influenced by past choices, present corporate profile and strategic orientation. Additionally, interactions generate value and they have to be accounted

for in the decision process. A conceptual framework about the governance decision should therefore include the above aspects. PT is suitable for this purpose.

Third, we have contributed to the literature by sustaining the portfolio approach to M&As and SAs by using the concept of ambidexterity. Ambidexterity traditionally refers to the capability to apply both exploration and exploitation simultaneously (Tushman and O'Reilly, 1996; O'Reilly and Tushman, 2008). Ambidexterity is essential when dealing with balancing trade-off needs as in external or internal technology sourcing (Rothaermel and Alexandre, 2009). As explorative learning is associated with SAs and exploitative learning with M&As (Im and Rai, 2008) we propose that to deal simultaneously with M&As and SAs in a portfolio requires a form of ambidexterity that we call governance ambidexterity.

### 6.2.3 Contributions to public policy <sup>9</sup>

Our study also has implications from the policy-makers' perspective. With respect to M&As, we have pointed out that M&As can contribute to innovation in the context of potential market dominance. The USA and the EU take a fundamentally different approach. In Europe, as we mentioned in Chapter 3, the focus is still on the output market and an otherwise prohibited M&A can be authorised if it helps stimulate innovation. In the mid-1990s, in the U.S.A., the Innovation Markets debate suggested that a special future market should be taken into account by antitrust authorities when evaluating the impact of a merger: the market of innovation. The innovation markets analysis is motivated by the desire to account for the dimensions of competition other than prices (Rapp, 1995). Under the innovation markets approach, the focus is on the input side, antitrust authorities favouring more R&D investments and/or more research lines. (Dahdouh and Montgoven, 1995). By investigating the effects of M&As on both innovation inputs and outputs we have considered both the EU and the USA perspective. In all the cases, our results confirm that mergers and acquisitions have a beneficial effect on innovation. Integration between the EU and USA approach would allow a more comprehensive analysis of a merger's impact. The analysis of innovation inputs as well as outputs, can offer a richer perspective on the potential competitive impact of a merger.

Our findings reveal that SAs stimulate innovation and competitive success. SMEs, however, are refrained from using SAs because of the fear of losing their intellectual assets. The above is especially the case when their knowledge is not protected by IP rights but by secrecy. High costs and complicated administrative procedures limit the use of patents by SMEs and therefore hamper the use of SAs to innovate. Policy-makers should consider that innovative activities of SMEs can be sustained by making patenting protection methods more accessible.

<sup>9</sup> This paragraph is based on the NWO report, project number 472-04-08 published as (in alphabetical order): Cefis, E., Grondsmas, M., Sabidussi, A. and Schenk H., 2007. The role of innovation in merger policy. Europe's efficiency defense versus America's Innovation Market approach. Two cases. Working Paper series 07-21 2007. T.C. Koopmans Institute, Utrecht School of Economics, Utrecht University, Utrecht, the Netherlands.

### 6.2.4 Contributions to management

With respect to managerial practice, our study has made the following contributions.

First, we found that the combination of M&As and SAs in one portfolio offers the greatest contribution to innovation performance. The value of a governance mode does not lie in its individual contribution but in its interaction with other organisational modes. For the external sourcing decisions, there is no absolute superiority of one single governance mode over the other. The benefits of M&As and SAs are higher when they are used simultaneously to contribute to the corporate goals. Managerial practice in both SMEs and large firms should therefore focus more on optimising and balancing a portfolio of SAs and M&As than on the achievements of an individual relationship.

Second, the decision framework we have proposed in Chapter 5 can be used as a tool to structure the decision process from the external/internal sourcing decision and the governance choice. The model provides a managerial tool in formalising the decision process and in supporting continuous control over the portfolio in order to maintain the alignment between its composition, the strategic objectives of the firms and the technology and market evolutions.

Third, companies should be aware of the time lag that governance modes require to display their effects on innovation. The external sourcing and the governance mode should not be conceived as a static point-in-time decision but as elements in a dynamic process where short-term and long-term objectives have to be balanced.

Fourth, external technology sourcing should be considered as complementary to internal R&D activities. Internal knowledge stimulates absorptive capacity and investing in internal innovative efforts is therefore necessary to be able to profit fully from external sourcing. Both internal and external developments have to be balanced to achieve high levels of innovation performance.

Fifth, corporate culture plays an important role in the adoption of '*open innovation*' practices and in selecting governance modes for external technology sourcing. The emphasis on control induces companies to favour internal development or integrated governance modes. Regular monitoring of technology evolutions and changes through flexible external relationships has emerged as a practice of best-in-class companies. External sourcing should therefore not be considered only as an *ad-hoc* remedy for an internal constraint but as a continuous practice to seize the opportunities that arise outside the boundaries of the firm.

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## Summary

The focus of this book is on external sourcing of innovation and on the governance modes: that is the way the external relationships are organised. This book aims at increasing the understanding of the impact of governance modes, like M&As and SAs, on innovation and defining, from the gained insights, a framework for the external sourcing decision and governance choices. Innovation is one of the most studied fields in economic and management literature, due to its relevance for the success of companies and the national economies. Innovation is, indeed, at the corporate level, a strategic priority and the key element discriminating between higher and lower market performers. In the present book, we refer to innovation as technological change (Tidd *et al.*, 2005). Our research starts by investigating the ‘*consequences of the alternatives*’ (Keeney, 1982), especially mergers and acquisitions (M&As) and strategic alliances (SAs). We claim that decision-makers should first of all be aware of the effects on innovation of external sourcing modes like M&As and SAs.

SAs refer to ‘*cooperative efforts in which two or more separate organisations, while maintaining their own corporate identities, join forces to share reciprocal inputs*’ (Vanhaverbeke *et al.*, 2002). M&As denote a situation in which one company acquires control over another corporate entity. The research questions (RQs) that this part of the research (Chapters 2 and 3) aims to answer are the following:

RQ1: *What is the effect on innovation of using SAs as the governance mode for external sourcing by SMEs and large firms?*

RQ2: *What is the effect on innovation of using M&As as the governance mode for external sourcing by potentially dominant firms?*

As the research questions reveal, the aim was to investigate whether SAs and M&As provide a positive contribution to innovative performance. If this were not the case, the governance decision process should be adjusted accordingly. In answering the above research questions, we concentrate on two extreme conditions. For SAs, we focus in particular on SMEs that are not innovative and for M&As we pay special attention to potentially dominant firms, as this has not been previously investigated by the literature. Next, in Chapter 4, we focus on confronting, under the same conditions, strategies that rely only on the use of SAs or M&As with strategies that combine SAs and M&As in one portfolio. Research question 3 is formulated as follows:

RQ3a: *What is the effect on innovation of using M&As compared to SAs as a governance mode?*

RQ3b: *What is the effect on innovation of using a portfolio of joint SAs and M&As compared to using only M&As or SAs?*

## Summary

After increasing our understanding of the effects of governance modes on innovation, we focus on the decision process. The decision process is articulated in two steps. The first step is to choose between developing innovation internally or through external sourcing. Second, if external sourcing is preferred, the governance mode has to be defined. For the first step, we formulate research question 4:

*RQ4: What drives the actual decision to source innovation internally or externally?*

With respect to the governance choice, we note that it has been discussed principally within the conceptual frameworks of the Resource Based View (RBV), Transaction Costs Economics (TCE), Network Theory (NT) and Real Option Reasoning (ROR). In order to serve as a tool for managerial decisions, we need a single conceptual framework which is comprehensive enough to deal simultaneously and consistently with the several facets of the governance choice. Existing models tend to isolate the governance choice decision. The interactions between different governance modes are not central in previous studies. The governance choice criteria proposed by previous studies appear to give only marginal consideration to the time perspective and its effects on the governance decision process. Enhancing the innovation performance and the success of external partnership activities encourages the quest for a theoretical approach that considers the above points. We propose using Financial Portfolio Theory (PT) as a conceptual framework. This brings us to the final research question 5 (RQ5):

*RQ5: What would a decision model for the governance choice look like from a Portfolio Theory perspective?*

The Dutch Community Innovation Survey data was used to test whether external sources of technology, organised in M&As or SAs, contribute to innovation performance. A unique data set was composed by linking the CIS waves from 1996 to 2004, each wave containing information on the characteristics and innovation activities of more than 10,000 companies. In our Probit analysis in Chapter 2 we use CIS3 and CIS4, which refer to the years 1998-2000 and 2002-2004, to capture the effects of SAs on innovation. The hypotheses that were tested based on RQ1 and the results are included in Table 1:

*Table 1. Hypotheses connected to RQ1 and results.*

Hypotheses	Results	Reference
H1: SAs have a positive effect on the likelihood of companies becoming (H1a) and/or remaining (H1b) innovators	H1a: confirmed H1b: confirmed	Table 2.3, 2.4
H2: SMEs benefit less from SAs than large companies with respect to becoming (H2a) and/or remaining (H2b) innovators	H2a: not confirmed H2b: confirmed	Table 2.3, 2.4

We note that SAs are especially beneficial for small firms with respect to becoming innovators. Interpreting the Resource Based View approach from an ‘open innovation’ perspective (Chesbrough, 2004), we support the view that companies can become or remain innovators using SAs to access critical resources and knowledge. SAs, however, appear not to be a substitute for but rather a complement to the internal effort aimed at innovation. With respect to medium and large companies, the probability of becoming innovators increases but the effect is less intense than for small firms. SAs help large and medium-sized companies remain innovative, however the effect is positive but not significant for small firms.

Next, we concentrated on the effect of M&As on innovation. More than 1500 companies were included in the Tobit random effects analyses. Potentially dominant firms are the most exposed to the economic and legislative (antitrust) consequences of choosing M&As as a governance form for their external sourcing. We formulate three hypotheses which refer to the effects of M&As on innovation inputs (R&D), outputs (sales from new products) and innovation efficiency (outputs in relation to inputs). With the exception of Ikeda and Doi (1983) empirical studies have reported mainly negative effects of M&As on R&D inputs (De Man and Duysters, 2005; Hitt *et al.*, 1991). This explains hypothesis 1. One reason why M&As might have a positive effect on innovation output is that technological knowledge often has a strong tacit component and tacit knowledge can be absorbed better through the acquisition of a whole company (Bresman *et al.*, 1999; De Man and Duysters, 2005). Furthermore, two merging companies might own different knowledge bases that need to be combined in order to be able to generate an innovation that otherwise would not be achievable (De Man and Duysters, 2005; Gerpott, 1995). Finally, economic literature recognises that M&As can stimulate different types of efficiencies: (a) allocative, (b) productive, (c) transactional, and (d) dynamic (Kolaski and Dick, 2003). However, existing studies have found little empirical evidence of any positive effect (DeMan and Duysters, 2005). This explains hypothesis 3 (Table 2).

We expected lower inputs because of synergies in R&D, higher outputs and higher efficiencies as a result of M&As. Our results indicate that potentially dominant firms may rely on M&As

Table 2. Hypotheses connected to RQ2 and results.

Hypotheses	Results	Reference
H1: In potentially dominant firms, M&As have a negative effect on innovation inputs	H1: rejected	Table 3.3
H2: In potentially dominant firms, M&As have a positive effect on innovation outputs	H2: confirmed	Table 3.4
H3: In potentially dominant firms, M&As have a positive effect on innovation efficiencies	H3: confirmed	Table 3.5

## Summary

to achieve higher levels of innovation in the dimensions that have been investigated. Therefore, the only hypothesis that we reject is the first one predicting a negative effect of M&As on innovation inputs. A potential explanation arises from the interviews. Decision-makers have pointed out that M&As may serve as an entry point into a new technological area that is then further developed internally. Therefore, after the M&As the R&D effort increases in the new technological field.

To answer Research Question 3, we have distinguished between exploitative innovation, explorative innovation and the total innovation level of the companies. For this, we used data from an improved Community Innovation Survey (CIS 3) which covers the period 1998-2000. More than 800 companies were included in the Tobit analysis. The hypotheses as included in Table 3 were tested.

Ambidexterity is the capability to simultaneously use SAs and M&As. The hypotheses we formulated serve to assess which governance mode has a more positive effect on innovation: specialisation strategies or an ambidextrous strategy. Interestingly, an ambidextrous strategy proved to be superior compared to specialising in M&As or SAs. This gave ground to the adoption of a portfolio approach to explain managerial behaviour and serve as a foundation for a decision model. The results show that a portfolio-based approach leads to higher levels of explorative, exploitative and total innovation compared to governance strategies of either using SAs or M&As. Combining diverse governance modes in a portfolio fosters innovation

*Table 3. Hypotheses connected with RQ3 and results.*

<b>Hypotheses</b>	<b>Results</b>	<b>Reference</b>
H1a: A governance strategy focusing only on alliances will show a more positive effect on explorative innovation than a governance strategy specialised in M&As	H1a: confirmed	Table 4.3
H1b: A governance strategy focusing only on alliances has a less positive effect on exploitative innovation than a governance strategy specialised in M&As	H1b: not confirmed	
H2a: An ambidextrous governance strategy will show a less positive effect on explorative innovation than a strategy specialised in strategic alliances only	H2a: not confirmed	Table 4.3
H2b: An ambidextrous governance strategy will show a less positive effect on exploitative innovation than a strategy specialised in M&As only	H2b: not confirmed	
H2c: An ambidextrous governance strategy will show a more positive effect on both exploration and exploitation (total innovation performance) than specialised strategies	H2c: confirmed	



regardless of the size of the firms, which implies that an ambidextrous approach is suitable for both SMEs and large firms.

To answer RQ4, we have collected data from companies and experts that are recognised for their innovation achievements and expertise. The sample included SMEs (fewer than 250 employees) and large companies (250 employees or more). With very few exceptions the database includes companies that are global players. Thirty-five interviews were performed with top managers and two with experts. Eight companies are best-in-class (top-three world leaders in their reference market). Six propositions were tested (Table 4).

The results of Chapter 5 suggest first that companies mainly rely on internal sources for new technologies, and second that external sources are tapped if these provide access to new

Table 4. Propositions connected to RQ4 and 5 and results.

Propositions	Results	Reference
P1: <i>SMEs are more motivated than large firms to source innovation externally in order to gain access to new knowledge</i>	P1: not statistically confirmed, in contrast to the expectations large firms tend to be more motivated to source innovation externally	Figure 5.2
P2: <i>SMEs are more motivated than large firms to source innovation externally in order to share (2a) (uncertainty) risks and (2b) costs</i>	P2a and P2b: both not statistically confirmed, but both show the tendency that SMEs are more motivated to source externally to reduce uncertainty and costs	Figure 5.2
P3: <i>SMEs are more motivated than large firms to source innovation externally in order to reduce (P3a) time to market and (P3b) to access new markets</i>	P3a and P3b: statistically rejected and not confirmed. No statistical evidence could be found for the proposition	Figure 5.2
P4: <i>The risk return profiles of M&amp;As and SAs are actually considered by decision makers and affect the preference for the governance mode</i>	P4: evidence from interview comments	Section 5.4
P5: <i>The interactions with the present portfolio of existing relationships affect the governance mode decision for new M&amp;As and SAs</i>	P5: evidence from interview comments	Section 5.4
P6: <i>The governance decision of SAs and M&amp;As is interpreted by decision makers as part of a dynamic process</i>	P6: evidence from interview comments	Section 5.4



## Summary

knowledge which complements or expands existing know-how, in line with the corporate culture and strategy. External sourcing is mainly used to overcome internal constraints. Investing in internal R&D is a necessary prerequisite to develop absorptive capacity. Our results indicate that SMEs and large companies use external sourcing to gain access to new knowledge. Our results show that SMEs and large companies use external sources for the acquisition of new knowledge. Furthermore, when comparing SMEs with large companies the interviews revealed that:

- the lack of possibilities of intellectual property right protection is a key factor that prevents SMEs entering into cooperative activities;
- time-to-market is a more important factor in choosing external sourcing for large companies than for SMEs.

For best-in-class, risk and cost factors are least important as drivers for external sourcing decisions. For best-in-class, the key motive for external sourcing is monitoring technological changes that take place in their environment.

Finally, a model is proposed (see Figure 1) where the decision process is articulated in four steps that applies the conceptual pillars of the PT, which originates from business economics, to a context in which governance modes are selected and combined to source new technologies.

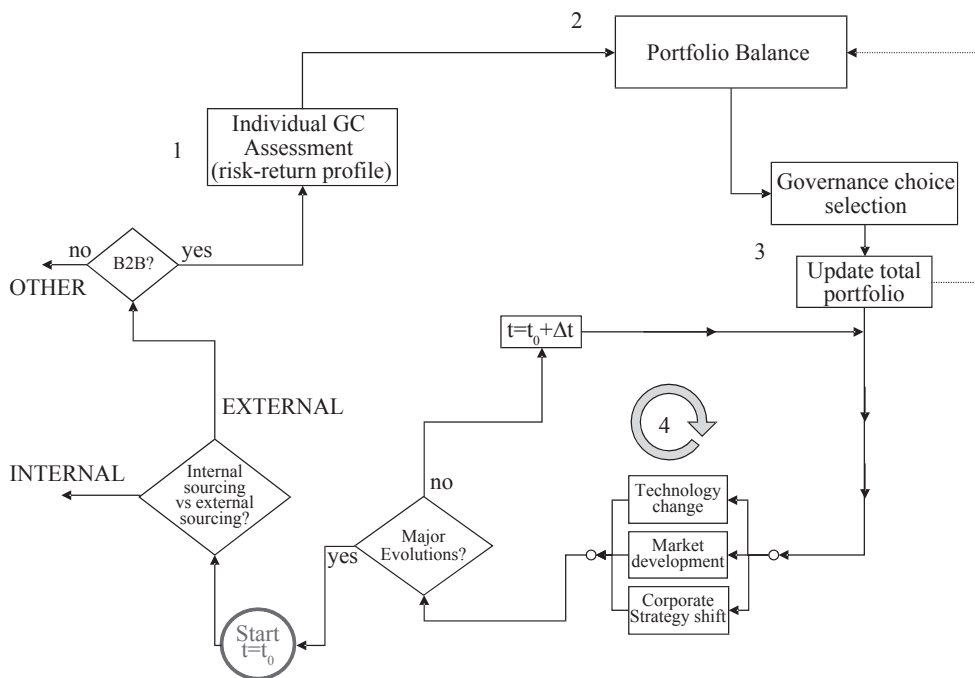


Figure 1. Decision model based on Portfolio Theory.

First, the profile of risks and costs & benefits of the governance modality has to be defined as they differ for both SAs and M&As. Second, the interactions with the existing relationships in which the firm is involved have to be highlighted and put central. Third, the organisational modality has to be chosen in order to enhance the value-generating potential of the entire portfolio of relationships. The model explicitly accounts for changes over time. In a dynamic perspective, the fourth step aims at monitoring the evolution of the portfolio itself and of external conditions that may alter the corporate strategy and therefore the orientation of the portfolio. In Chapter 5 we have investigated whether the factors that drive the governance decision in our model are actually taken into consideration by companies. From the interviews that we have performed with top executives of 35 companies, we have found confirmation that the main aspects of our model are indeed considered.

## **Contributions**

The main contributions to science from a theoretical viewpoint are summarised in the following three points. First, we have linked content and process research by trying to articulate the governance decision process (Chapter 5) in the light of the factors that enhance innovation performance (Chapter 2,3,4). Second, we have tried to bridge economics and management sciences by proposing an application of Portfolio Theory to the managerial challenges of the governance choice. Third, we have expanded the concept of ambidexterity to the governance modes context and linked it to the capability to simultaneously use M&As and SAs in a portfolio.

The most important contribution to public policy is vested in the analysis of possible negative consequences of M&As on competition in European and American markets. We can confirm that even in the case of potentially dominant M&As, when they have gone through the difficult period of the first three years in which the integration succeeds or fails, a positive effect occurs on innovation.

Last, the contribution to management is summarised in the following points. First, managers should be aware that the combination of M&As and SAs in one portfolio makes the highest contribution to innovative performance. The value of a governance modality does not lie in its individual contribution but in its interaction with other organisational modes. Second, the decision model can be used as a tool to align the portfolio to the corporate goals and adjust it to technological evolutions. Third, we point out that managers should be aware that governance modes display their effects on innovation with different time lags. Time dynamics should be included in the governance decision process in order to tailor the decision process to maximise innovation results. Forth, external technology sourcing should be considered as complementary to internal R&D activities. Investing in internal innovative efforts is therefore not substituted by partnership activities. Fifth, cultural aspects are a determinant of the use of external sourcing. An excessive emphasis on control may hamper the full exploitation of open innovation practices and benefits.



## Samenvatting

Het doel van dit onderzoek is het vergroten van het inzicht in de effecten van twee alternatieve wijzen van het verwerven van externe technologische kennis en vaardigheden, namelijk via fusies en overnames (F&Os) dan wel via strategische allianties (SAs) op het innovatief vermogen van bedrijven en het ontwerpen van een besluitvormingsmodel hiervoor. Innovatie is een van de meest bestudeerde terreinen in de economische en management-literatuur, vanwege de relevantie voor het succes van bedrijven en voor de welvaart van nationale economieën. Innovatie is een strategische prioriteit voor bedrijven en één van de sleutels voor de verklaring van het verschil in prestatie van goede en minder goede bedrijven. F&Os en SAs zijn de eindpunten van een samenwerkingscontinuüm (zie Figuur 1.1. van dit boek). SAs zijn volgens Van Haverbeke et al. (2002) samenwerkingsvormen waarin twee onafhankelijke organisaties kennis en vaardigheden inbrengen en de krachten bundelen. Bij fusies wordt een nieuwe gezamenlijke entiteit gevormd, terwijl bij overname een bedrijf de zeggenschap over een ander bedrijf verkrijgt. De onderzoeksvragen (OV) die we in de Hoofdstukken 2 en 3 willen beantwoorden zijn de volgende:

*OV1 en OV2: Wat is het gevolg voor het innovatief vermogen van een bedrijf indien gekozen wordt voor SAs (OV1) en/of F&Os (OV2) voor het verwerven van externe technologische kennis en vaardigheden?*

Deze onderzoeksvragen maken duidelijk dat onze eerste activiteit erin bestaat te onderzoeken of SAs en F&Os een positieve bijdrage leveren tot de innovatieprestatie. Zou geconstateerd moeten worden dat dit niet het geval is dan zouden SAs en F&Os afvallen als bestuurlijke opties voor het verwerven van technologische kennis. Bij het beantwoorden van de bovenstaande vragen richten we de aandacht op twee situaties. Bij de SAs concentreren we ons op kleine en middelgrote bedrijven (SMEs) en grote ondernemingen die hetzij een transitietraject doorgaan van niet innovatief naar innovatief hetzij innovatief blijven. Voor wat betreft de F&Os richten wij ons met name op een extreme situatie, namelijk die waar door de F&O een mogelijke marktdominantie kan optreden. Hier speelt namelijk de zowel wetenschappelijk als maatschappelijk zeer relevante vraag van de afname, het behoud dan wel toename van het innovatief vermogen bij zo'n grote F&O. De aandacht is tot nu toe met name gericht geweest vanuit concurrentieperspectief, maar de vraag naar het innovatief vermogen is nog niet eerder in de literatuur op deze wijze aan de orde gesteld.

Vervolgens verleggen we onze aandacht in hoofdstuk 4 naar het vergelijken van specialisatiestrategieën, waarbij uitsluitend gebruik wordt gemaakt van SAs dan wel F&Os, met strategieën die SAs en F&Os combineren in één portefeuille. OV 3 luidt:

*OV3a: Wat is het effect op innovatie van een specialisatie op F&Os vergeleken met een specialisatie op SAs voor het verwerven van externe technologische kennis en vaardigheden?*

*OV3b: Wat is het effect op innovatie van het gebruik van een portefeuille bestaande uit SAs en F&Os in vergelijking met een specialisatie op SAs of F&Os?*

In Hoofdstuk 5 richten we ons op het besluitvormingsproces in de managementpraktijk. Dit proces bestaat uit twee stappen: Er moet gekozen worden tussen het intern ontwikkelen dan wel het extern verwerven van bepaalde technologische kennis en vaardigheden. Indien het extern verwerven van de technologische kennis en vaardigheden de voorkeur verdient, zal vervolgens de modus SA of F&O gekozen moeten worden. De eerste stap is tot uitdrukking gebracht in OV4:

*OV4: Waarvan is het besluit om bepaalde technologische kennis en vaardigheden intern te ontwikkelen dan wel extern te verwerven afhankelijk in de managementpraktijk?*

De studie van de besluitvorming over de inzet van SAs en/of F&Os is tot nu toe voornamelijk gevoerd binnen de afzonderlijke kaders van de Resource Based View, de Transactiekostentheorie, de Netwerk Theorie en de Reële Optie Theorie. Om het mogelijk te maken een instrument te ontwikkelen dat het management faciliteert, zullen de richtlijnen die voortkomen uit de hier genoemde theorieën moeten worden geïntegreerd. We constateren allereerst dat er nog geen conceptueel raamwerk beschikbaar is dat omvattend genoeg is om alle factoren die een rol spelen bij de besluitvorming over het intern ontwikkelen, of het gebruik van SA dan wel F&Os voor het verwerven van technologische kennis en vaardigheden in de beschouwing te betrekken. Daarnaast neigen de bestaande studies er toe om nieuwe beslissingen geïsoleerd te beschouwen, de interactie tussen de verschillende bestuurlijke alternatieven staat niet centraal. Op de derde plaats zijn de criteria die als maatgevend worden beschouwd voor het keuzeprocess overwegend statisch van aard: het tijdsaspect en de gevolgen ervan voor de besluitvorming komen slechts marginaal aan de orde. Om de innovatieprestatie te bevorderen en het extern aantrekken van technologie succesvol te laten verlopen is een theoretische benadering nodig die aan al deze aspecten aandacht besteedt. We beargumenteren dat de financiële portefeuille theorie (PT) een dergelijk conceptueel raamwerk kan bieden. Onderzoeksvraag 5 luidt daarom:

*OV5: Hoe ziet een besluitvormingsmodel voor het samenstellen van een portefeuille bestaande uit SAs en/of F&Os eruit vanuit het perspectief van de portefeuille theorie?*

Statistische data van het CBS (de Community Innovation Survey data van 1994 tot 2006) werden gecombineerd met gegevens van de Kamers van Koophandel om te onderzoeken of externe bronnen van technologie via F&Os of SAs bijdragen aan de innovatieve prestatie van de bedrijven. Een unieke dataset werd ontworpen, die informatie bevat over de kenmerken en de innovatieactiviteiten van meer dan 10.000 bedrijven. De hypothesen die getest werden en Bij onze probit-analyse in hoofdstuk 2 maken we gebruik van CIS3 en CIS4 die betrekking hebben op respectievelijk de jaren 1998-2000 en 2002-2004. We hebben meer dan 2.500 bedrijven uit de dataset in de analyse betrokken. de resultaten die werden verkregen zijn opgenomen in Tabel 1.

Tabel 1. Resultaten voor de hypothesen met betrekking tot onderzoeksvraag 1.

Hypothesen	Resultaten	Referentie
H1: SAs hebben een positief effect op bedrijven om innovatief te worden (H1a) en of innovatief te blijven (H1b)	H1a: Aanvaard H1b: Aanvaard	Tabel 2.3, 2.4.
H2: SMEs hebben minder voordeel van SAs dan grote bedrijven om innovator te worden (H2a) of the blijven (H2b)	H2a: Niet aanvaard H2b: Aanvaard	Tabel 2.3, 2.4

Wij hebben geconstateerd dat externe samenwerking vooral voordelen biedt aan SMEs. Gelet op de Resource Based View en deze geïnterpreteerd vanuit een open innovatie perspectief (Chesbrough, 2004), onderschrijven we de zienswijze dat bedrijven innovatief kunnen zijn of blijven indien SAs als samenwerkingsvorm worden gezocht om externe technologische kennis te verwerven. SAs blijken echter geen substituuat te zijn voor interne innovatieactiviteiten, maar zijn veeleer complementair daaraan. Voor de middelgrote en grote bedrijven neemt eveneens de kans toe dat ze innovatief worden maar het effect is minder sterk dan voor kleine bedrijven. SAs dragen bij aan het innovatief blijven bij middelgrote en grote bedrijven; dit effect is positief maar niet significant voor kleine bedrijven.

Vervolgens hebben we de aandacht gericht op het effect van F&Os op innovatie. We hebben meer dan 1.500 bedrijven in onze Tobit random effects analyses betrokken. We richten onze aandacht op potentieel dominante bedrijven. Deze groep bedrijven staat het meest bloot aan economische en wettelijke beperkingen vanwege het effect van F&Os op de concurrentie in de sector. We formuleren een drietal hypothesen (Tabel 2) die betrekking hebben op de gevolgen van F&Os voor de innovatie-inputs (bijv. R&D), outputs (verkopen uit nieuwe producten) en efficiënties (outputs ten opzichte van inputs). Met uitzondering van Ikeda en Doi (1983) hebben bestaande empirische studies voornamelijk negatieve effecten gerapporteerd van F&Os op R&D-inputs. Een reden voor een door ons verwacht positief effect op innovatie-output is gelegen in het feit dat technologische kennis vaak moeilijk grijpbaar is en dergelijke kennis beter door middel van de verwerving van het gehele bedrijf kan worden verkregen (Bresman *et al.*, 1999; De Man and Duysters, 2005). Twee fuserende bedrijven kunnen over verschillende kennis beschikken die gecombineerd innovaties opleveren die anders niet tot stand gebracht kunnen worden (De Man and Duysters, 2005; Gerpott, 1995).

De derde hypothese die hieronder staat geformuleerd is gebaseerd op het feit dat de economische literatuur erkent dat F&Os verschillende vormen van efficiëntie kan stimuleren: (a) allocatieve, (b) productieve, (c) transactie, en (d) dynamische (Kolaski and Dick, 2003).

We verwachtten lagere R&D inputs vanwege synergie, hogere innovatie-output en hogere innovatie-efficiëntie voor de bedrijven die betrokken waren bij F&Os. Onze resultaten tonen aan dat potentieel dominante bedrijven F&Os kunnen aangaan om hogere niveaus van

innovatie te bereiken. Een verklaring hiervoor komt voort uit de uitgevoerde interviews. De managers hebben gedurende de interviews aangegeven dat F&Os gebruikt kunnen worden om een nieuw technologisch gebied te betreden, dat vervolgens intern verder wordt ontwikkeld. Daarom nemen de R&D-uitgaven toe in het nieuwe technologische gebied. Daarom wordt alleen hypothese 1 verworpen (Tabel 2).

Om onderzoeksvraag 3 te beantwoorden hebben we een onderscheid gemaakt tussen exploratieve, exploitatieve en totale innovatie. We hebben de informatie uit de verbeterde CIS 3 gebruikt, die de periode 1998-2000 beslaat. Er werden meer dan 800 bedrijven in een tobit analyse bedroegen. De hypothesen die werden geformuleerd, staan vermeld in Tabel 3.

Een gemengde strategie ('ambidexterity') staat voor het gelijktijdig inzetten van SAs en F&Os. Door middel van de vermelde hypothesen willen we nagaan welke bestuurlijke strategie een positiever effect heeft op verschillende vormen van innovatie: specialisatiestrategieën of een gemengde strategie.

Interessant is het feit dat een dergelijke combinatiestrategie superieur bleek te zijn aan een strategie waarbij specialisatie op SAs dan wel M&As wordt nagestreefd. Dit heeft een fundament gecreëerd voor de door ons gepropageerde portefeuillebenadering als fundament voor een beslissingsmodel. De resultaten laten zien dat een portefeuillebenadering leidt tot hogere niveaus van zowel exploratieve, exploitatieve als totale innovatie in vergelijking met strategieën die uitsluitend gebaseerd zijn op SAs of F&Os. Het combineren van SAs en F&Os in een portefeuille blijkt de innovatiepotentie van bedrijven te bevorderen ongeacht de grootte ervan. Een gemengde strategie is dus geschikt voor zowel SMEs als grote bedrijven.

Om onderzoeksvraag 4 te beantwoorden hebben we data verzameld van bedrijven en experts die erkend zijn vanwege hun innovatieprestaties en expertise. De steekproef bevatte SMEs (minder dan 250 personeelsleden) en grote bedrijven (250 personeelsleden of meer). Uitzonderingen daargelaten bestaat de dataset uit bedrijven die mondiale spelers zijn, veertien van de grote bedrijven behoorden tot de top-10 en 8 zelfs tot de top-3 in hun sector. 35

*Tabel 2. Resultaten voor de hypothesen met betrekking tot onderzoeksvraag 2.*

Hypothesen	Resultaten	Referentie
H1: <i>In potentieel dominante bedrijven hebben F&amp;Os een negatief effect op innovatie inputs</i>	H1: Verworpen	Tabel 3.3
H2: <i>In potentieel dominante bedrijven hebben F&amp;Os een positief effect op innovatie outputs</i>	H2: Aanvaard	Tabel 3.4
H3: <i>In potentieel dominante bedrijven hebben F&amp;Os een positief effect op innovatie efficiënties</i>	H3: Aanvaard	Tabel 3.5



Tabel 3. Resultaten voor de hypothesen met betrekking tot onderzoeksvraag 3.

Hypothesen	Resultaten	Referentie
H1a: Een bestuurlijke strategie die specialiseert in SAs heeft een positiever effect op exploratieve innovatie dan een bestuurlijke strategie die specialiseert in F&Os	H1a: Aanvaard	Tabel 4.2
H1b: Een bestuurlijke strategie die specialiseert in SAs heeft een minder positief effect op exploitatieve innovatie dan een bestuurlijke strategie die specialiseert in F&Os	H1b: Niet aanvaard	
H2a: Een gemengde bestuurlijke strategie zal een minder positief effect op exploratieve innovatie vertonen dan een strategie die specialiseert in SAs	H2a: Niet aanvaard	Tabel 4.2
H2b: Een gemengde bestuurlijke strategie zal een minder positiever effect op exploitatieve innovatie hebben dan een strategie die specialiseert in F&Os	H2b: Niet aanvaard	
H2c: Een gemengde bestuurlijke strategie zal een positiever effect op zowel exploratie als exploitatie (totale innovatie-prestatie) hebben dan strategieën die specialiseren	H2c: Aanvaard	

interviews werden afgenomen met top managers en twee met experts. De getoetste proposities zijn weergegeven in Tabel 4.

De resultaten, die zijn opgenomen in Hoofdstuk 5, laten in de eerste plaats zien dat de bedrijven voornamelijk vertrouwen op interne bronnen voor nieuwe technologieën. Op de tweede plaats dat externe bronnen met name worden gebruikt als ze toegang verschaffen tot nieuwe kennis die bestaande kennis vergroot of aanvult, echter voor zover dit past binnen de bestaande organisatiecultuur en -strategie. Complementaire externe bronnen worden aangeboord om interne beperkingen te overwinnen. Dit heeft tot gevolg dat innovaties voortkomen uit de combinatie van interne en externe bronnen. Investeren in intern Onderzoek en Ontwikkeling is een voorwaarde om de capaciteiten te ontwikkelen om externe kennis te kunnen absorberen. Onze resultaten tonen aan dat SMEs en grote bedrijven externe bronnen gebruiken voor het verkrijgen van nieuwe kennis. Als we SMEs en grote bedrijven vergelijken constateren we dat:

- het gebrek aan mogelijkheden intellectuele eigendomsrechten te beschermen een voornaam factor is die SMEs hindert in het aangaan van samenwerkingsverbanden;
- tijd tot marktintroductie is een belangrijker factor voor extern verwerven van kennis voor grote ondernemingen in vergelijking met SMEs.

Voor de best-in-class bedrijven vergeleken kunnen we concluderen dat risico- en kostenfactoren minder belangrijk zijn bij de beslissing om extern samen te werken. Bij de best-in-class

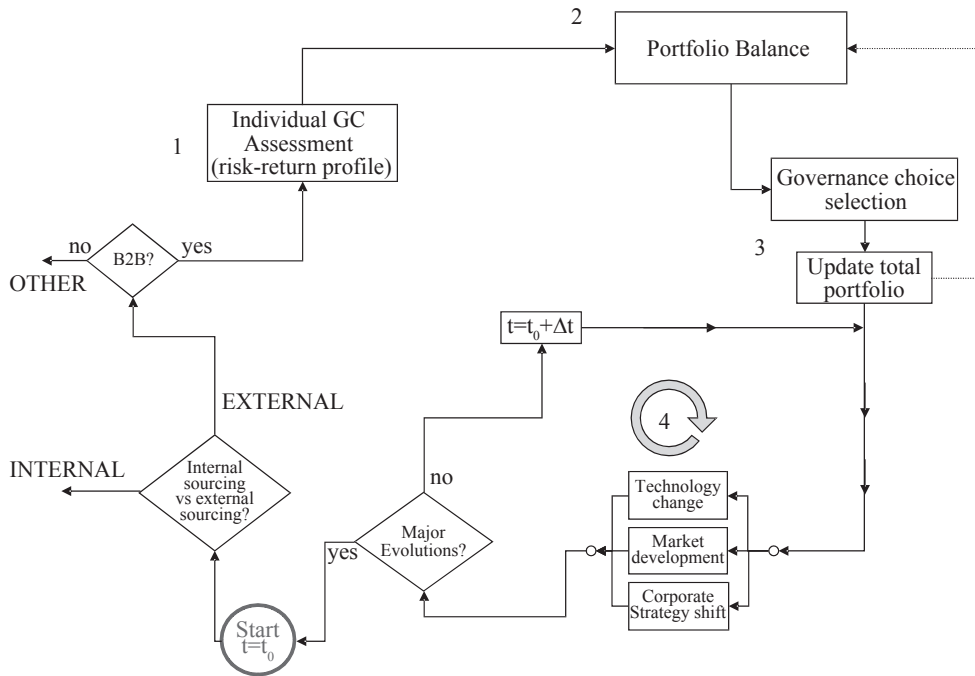
Tabel 4. Resultaten voor de proposities verbonden met de onderzoeksvragen 4 en 5.

Proposities	Resultaten	Referentie
P1: <i>SMEs zijn meer dan grote bedrijven geneigd om innovatie extern te verkrijgen om zo toegang te krijgen tot nieuwe kennis</i>	P1: niet statistisch bevestigd: in tegenstelling tot wat werd verwacht lijken grote bedrijven meer geneigd te zijn om hun innovatie van buiten te betrekken	Figuur 5.2
P2: <i>SMEs zijn meer geneigd dan grote bedrijven om innovatie extern te verkrijgen teneinde (onzekerheid) risico's te delen (2a) en (2b) kosten te delen</i>	P2a, P2b: beiden niet statistisch bevestigd, maar beiden laten zien dat SMEs meer geneigd zijn om externe bronnen te benutten om onzekerheid en kosten te reduceren	Figuur 5.2
P3: <i>SMEs zijn meer geneigd dan grote bedrijven om extern innovatie te verkrijgen om de tijd tot introductie van een product op de markt te verkorten (P3a) en om toegang te krijgen tot nieuwe markten (P3b)</i>	P3a, P3b: statistische verworpen en niet bevestigd. Er kon geen ondersteuning gevonden worden voor de propositie	Figuur 5.2
P4: <i>SAs en F&amp;Os vertonen verschillende profielen van verwachte voordelen, die de voorkeur voor een bestuurlijke modus beïnvloeden</i>	P4: positieve aanwijzingen op basis van de interviews	Sectie 5.4
P5: <i>De interacties met de portefeuille van bestaande relaties hebben invloed op de beslissing F&amp;Os of SAs te gebruiken</i>	P5: positieve aanwijzingen op basis van de interviews	Sectie 5.4
P6: <i>De beslissing SAs of F&amp;Os in te zetten is een erkend onderdeel van een dynamisch besluitvormingsproces</i>	P6: positieve aanwijzingen op basis van de interviews	Sectie 5.4

bedrijven, is het belangrijkste motief het monitoren van technologische veranderingen die in de bedrijfsomgeving plaatsvinden.

Sluitstuk van ons onderzoek vormt het ontwerpen van een beslissingmodel (zie Figuur 1 hieronder). Het door ons ontworpen model onderscheidt 4 stappen. De conceptuele basis van de oorspronkelijk bedrijfseconomische portefeuille theorie is hierbij gebruikt in een context waarin bestuurlijke alternatieven worden geselecteerd en gecombineerd.

De eerste stap in het besluitvormingsmodel omvat het vaststellen van het profiel van risico's, kosten en baten van een alternatief, aangezien dit profiel verschillend is voor SAs in vergelijking met F&Os. De tweede stap omvat onderzoek naar mogelijke interdependenties van potentiële



Figuur 1. Besluitvormingsmodel op basis van de Portefeuille Theorie.

nieuwe samenwerkingsverbanden met de bestaande portefeuille. Vervolgens moet de wijze worden gekozen waarop nieuwe technologie wordt verkregen. Het model houdt expliciet rekening met dynamiek. De vierde stap is daarom het volgen van de ontwikkeling van de portefeuille en de externe omstandigheden in de tijd. Immers, zowel de bedrijfsstrategie als de omgevingsomstandigheden kunnen mettertijd veranderen.

In Hoofdstuk 5 hebben we onderzocht of de factoren die volgens ons model de selectie beïnvloeden in de praktijk werkelijk in aanmerking worden genomen. Door middel van interviews met 35 top-managers van bedrijven hebben we bevestiging gevonden dat de belangrijkste aspecten van ons model inderdaad in de beschouwing worden betrokken.

De belangrijkste bijdrage van onze studie vanuit theoretisch oogpunt is dat wij een toepassing van de portefeuilletheorie hebben voorgesteld ter ondersteuning van het besluitvormingsproces rond het extern verwerven van technologische kennis waarin zowel F&Os en Sas zijn opgenomen. De belangrijkste bijdrage voor het beleid ligt in de analyse van de mogelijke negatieve effecten van F&Os op de concurrentie in Europese en Amerikaanse markten. We kunnen echter bevestigen dat zelfs potentieel marktdominante F&Os, indien deze de belangrijke eerste periode van drie jaren zijn doorgekomen waarin de al dan niet succesvolle

integratie optreedt, een positief effect hebben op innovatie. De belangrijkste bijdragen tot het management van bedrijven zijn de volgende.

- Managers moeten zich ervan bewust zijn dat de combinatie van F&Os en SAs in een portefeuille de hoogste bijdrage kan leveren voor de innovatieprestatie. De waarde van een bestuurlijk instrument (F&O dan wel SA) is niet gelegen in de afzonderlijke bijdrage maar in de interactie.
- Het besluitvormingsinstrument in Figuur 1 kan gebruikt worden als hulpmiddel om de portefeuille af te stemmen op de organisatiedoelstellingen en aan te passen aan technologische veranderingen.
- Managers moeten zich ervan bewust zijn dat de bestuurlijke modaliteiten F&Os en SAs met verschillende vertragingfactoren effect hebben op innovatie.
- Het extern verwerven van nieuwe technologieën moet in samenhang worden beschouwd met de interne innovatieactiviteiten. Investeren in interne innovatieactiviteiten is daarom geen substituuut voor externe samenwerking.
- Een overmatige nadruk op beheersing ['control'] kan de volledige benutting van open innovatie schaden, mede gezien de invloed van de bedrijfscultuur op de besluitvorming.

# Appendix A. Interview protocol

## Definitions

- Innovations are defined as products and/or processes that are new to the firm and/or new to the market and that are introduced to the market.
- Portfolio refers to all the business-to-business relationships in which the firm is involved.

## General questions

1. What has been the experience with innovation in the last three years?
2. How many employees do you have (in fte)?
3. How many R&D-E personnel do you have (in fte)?
4. On a scale from 1 to 7, where 7= very important, 4= neutral and 1= not important, how would you define the importance of innovation for your competitive success?

1      2      3      4      5      6      7

5. On a scale from 1 to 7, where 7= ahead of competition, 4= neutral and 1= follower, how would you define the strategic orientation of your firm?

Follower   1      2      3      4      5      6      7      Ahead of competition

6. What is the importance of the following strategic orientations for your company?
  - Operational excellence.
  - Customer intimacy.
  - Product leadership.

7. Are your sales:
  - a. Regional.
  - b. National.
  - c. Continental.
  - d. Global.

8. Are your competitors:
  - a. Regional.
  - b. National.
  - c. Continental.
  - d. Global.

9. On a scale from 1 to 7, where 7= very high, 4= neutral and 1= very low, how would you categorise the competition levels in the industry in which your company operates?

1            2            3            4            5            6            7

10. How much of your innovation in percentage terms comes from:

In-house R&D                                .....%  
 Internal development\*                    .....%  
 Non equity alliances                        .....%  
 Joint ventures                                 .....%  
 M&As    .....%  
     100%

\*engineering

11. From 1 to 6, how would you rank the following motives for sourcing innovation externally: (1 is the most important, 6 is the least important)

	Motives	Ranking (1 to 6)
A	Increased complexity of technology developments and access to new knowledge	
B	Reducing uncertainty in internal development	
C	Reducing costs in internal development	
D	Monitoring environmental changes/technological opportunities	
E	Entry into new product markets/internationalisation	
F	Reducing the time to market	

12. Does your company have alliances, joint ventures and M&As for reasons other than innovation? Please, mention.

13. From 1 to 8, how would you rank the relevance of the following motives to innovate internally (R&D), to have alliances, mergers or acquisitions (1 is the most important, 8 is the least important):

	Ranking order for choice	Internal development	Alliances	M&A
A	Control over the developed technology/new knowledge			
B	Strategic importance/expertise related to the technology (core to the company)			
C	Uncertainty/risk connected to the technology (product/process)			
D	Uncertainty/risk connected to the market (product differentiation/business model)			
E	Cost reduction			
F	Time to market			
G	Past experiences and/or trust with respect to the partner			
H	Existing portfolio of external sources of technology modalities			

14. On a scale from 1 to 7, where 7= continuously, 4= sometimes and 1= on demand, how often do you monitor/rebalance the composition of business relationships?

### Simulation hypothetical decision case

- (A) Suppose you want to modify and **improve an existing product**. You already have a level of **expertise** with respect to the **technology** that has to be applied because it is a technology that is already known or you have already developed it, so you are confident about the technological success. The market acceptance of the product is relatively **certain**. You can introduce it to a geographical or product market that is already familiar to your company. An **existing** business partner can contribute. The possibility of using a partner refers to joining forces for the technological/product improvement or for subsequent introduction of the incrementally new product in the market.
- Under which conditions would you **develop exclusively in-house (and reject the external partner)**? Please think aloud step-by-step about the logic, the arguments that you elaborate and the factors you would consider when making your decision.



- b. Suppose that you accept that the external partner would enter into an **alliance, joint venture or acquisition**? Please give your argumentation about the elements supporting your decision.
  - c. Is your choice influenced by **other existing alliances/joint ventures/acquisitions** you already have? How?
  - d. What would change in your decision if the technology was **not** well-known to you (higher technology risk)? In what way?
  - e. What would change in your decision if the market success was highly **uncertain**?
  - f. Would the nature of the potential partner -(1) **supplier** or a (2)**customer** or a (3) **competitor** -change your decision? How?
  - g. What would change in your decision if your partner was already involved with one of your competitors? Do you verify the portfolio of your partner before taking a decision?
  - h. What would change in your decision if you did not have previous experience with the potential business partner?
- (B) How would the above answers change if you were developing a radical new product with respect to the in-house vs. external decision, and with respect to the partnering modalities decision (for each of the arguments you have pointed out)?
- (C) How would the above answers change if you were entering a new market with an existing product with respect to the in-house vs. external decision, and with respect to the partnering modalities decision (for each of the arguments you have pointed out)?
- (D) How would the above answers change if you were developing a new process with respect to the in-house vs. external decision, and with respect to the partnering modalities decision (for each of the arguments you have pointed out)?
- (E) How would the above answers change if the development costs were substantial with respect to the in-house vs. external decision, and with respect to the partnering modalities decision (for each of the arguments you have pointed out)?
- (F) How would the above answers change if you needed to reduce time-to-market with respect to the in-house vs. external decision, and with respect to the partnering modalities decision (for each of the arguments you have pointed out)?

## About the author

Anna Sabidussi (1972) graduated with honors in International Political Sciences in 1996 (Università Cattolica del Sacro Cuore, Italy). She obtained a diploma on the laws and economics of European Union (Université de Sciences Sociales, Centre d'études, de documentation et de recherche européennes, France) and a Master degree in International Business (MIB, Italy). She worked as professional investor in financial institutions before moving to The Netherlands. In 2005, she joined the Department of Business Administration of Wageningen University as part time assistant professor in financial management and part time researcher while conducting her PhD thesis at the same department. Her research area of interest is at the crossroad between strategy and innovation management with a focus on external technology sourcing like strategic alliances and mergers and acquisitions.



## **Citation of sponsors**

The research described in this thesis was partially supported by the Netherlands Organisation of Scientific Research (NWO, program 472-04-008). The NWO financial support is gratefully acknowledged.



# Completed Training and Supervision Plan

Anna Sabidussi, PhD student  
Mansholt Graduate School of Social Sciences (MG3S)



Description	Institute / Department	Year	ECTS*
<b>I. General part</b>			3.9
Scientific publishing	Wageningen Graduate Schools (WGS)	2008	0.3
Project and time management	WGS	2008	1.5
Personal efficacy	WGS	2007	0.5
Interpersonal communication for PhD students	WGS	2007	0.6
Mobilizing your scientific network	WGS	2009	1.0
<b>II. Mansholt-specific part</b>			4
Mansholt introduction course	MG3S	2005	1
Mansholt multidisciplinary seminar		2009	1
Conferences:		2006-2008	2
5 <sup>th</sup> International Conference on Innovation and Management, Maastricht, the Netherlands			
2 <sup>nd</sup> Israel Strategy Conference, Israel			
7 <sup>th</sup> International CINet Conference, Lucca, Italy			
<b>III. Discipline-specific part</b>			18
Summer school of advanced econometrics	MG3S	2007	8
Panel data analyses (Prof. M. Veerbeek, Erasmus University, Rotterdam)			
Discrete choice modelling (Prof. Greene, Stern School of Business, NY, USA)			
Advanced econometrics (Prof. Burrell and Dr. Gardebroek)	MG3S	2007	6
Quantitative research methods (Ivo Van Der Lans)	MG3S	2005	4
<b>IV. Teaching and supervising activities</b>			4
Courses: Financial business management (course coordinator); Corporate financial management; Advanced financial management		2005-2009	
Supervising 3 MSc theses		2005-2009	
<b>V. Writing Research Proposal</b>		2005	6
Total (minimum 30 ECTS)			35.9

(\*1 ECT=28 hours)

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