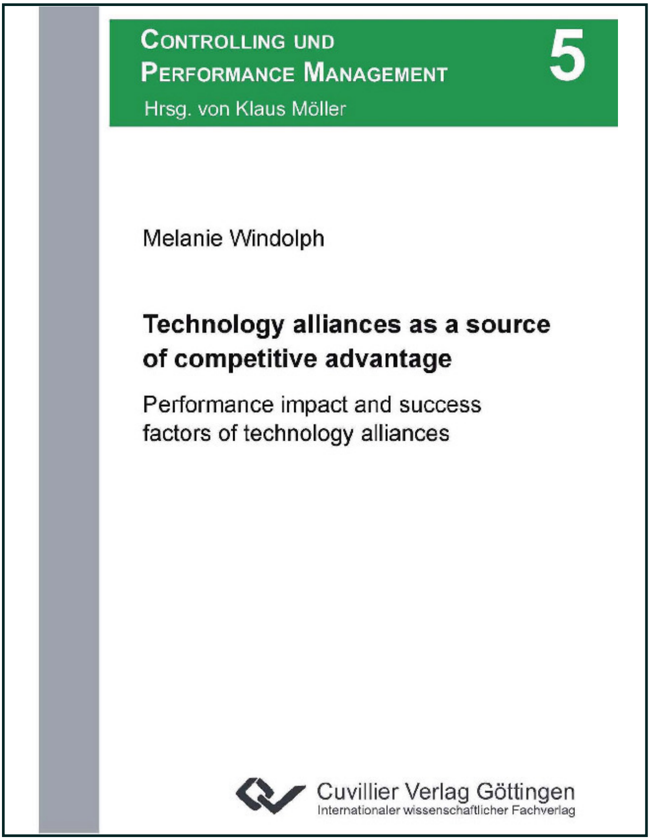
Melanie Windolph (Autor)

Technology alliances as a source of competitive advantage

Performance impact and success factors of technology alliances



https://cuvillier.de/de/shop/publications/247

CHAPTER 1

General introduction:

The role of technology alliances in firms' R&D activities

1.1 Introduction and research focus

The thesis at hand focuses on the question to what extent technology alliances may serve as a source of competitive advantage for firms. Specifically, the impact of technology alliances on firm performance as well as success factors of technology alliances are examined in five independent papers. The papers are presented in Chapters 2 – 6. Hence, this thesis contributes to literature and practice in two key areas of research and development (R&D) management: The discussion regarding (1) the performance impact of technology alliances and (2) alliance success factors.

Understanding the performance impact of technology alliances has been a long-standing goal of researchers because it has important implications for managers, designers of government R&D policy, and academic researchers alike. However, despite the extensive research on collaborative relationships and R&D networks during the past decades, our understanding of technology alliances' performance impact is still relatively limited as the findings are often inconsistent and contradictory. Thus, one key contribution of this thesis is the systematic analysis of the results from prior studies and, by doing so, the provision of an empirical generalizations of the diverse findings from previous research.

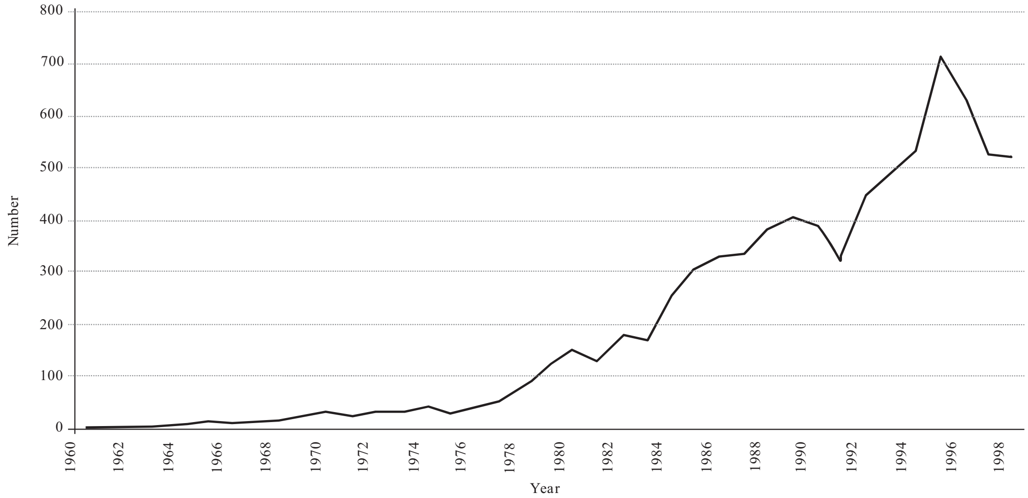
Second, by helping to identify partner characteristics and managerial factors influencing alliance success, the thesis contributes to the ongoing discussion regarding the importance of initial conditions and alliance execution factors for technology alliance success. By analyzing both the influence of key partner characteristics and managerial practices on alliance success, we follow Dyer et al. (2007) who emphasize that researcher need not only focus on alliance formation factors and/or initial conditions but should pay "…greater attention to the processes that influence the exchange and absorption of knowledge during the alliance execution phase" (p. 5).

The next section of this chapter gives an overview over technology alliance characteristics, recent trends, as well as the rationale behind firms' participation in technology alliances. Afterwards, a short summary of risks and managerial challenges inherent in technology alliances is presented and the further composition of the thesis as well as the research focus are described. Following this, a short summary of all five chapters included in this thesis is given. The chapter concludes with a short presentation of the main findings and their implications for managers and academics.

1.2 Definition, rationale, and recent trends of technology alliances

As Caloghirou et al. (2003) point out inter-organizational collaboration and/or inter-organizational alliance is not a new phenomenon. New, however, is the dramatic growth of alliances during the past couple of decades (see Figure 1.1) (Hagedoorn, 2002; Mowery et al., 1998; Narula and Hagedoorn, 1999; Sadowski and Duysters, 2008) and the attention alliances have attracted by managers, academics, and policy makers (Belderbos et al., 2004; Fontana et al., 2006; Okamuro, 2007; Vonortas, 1997b). Furthermore, the nature of inter-organizational alliances has shifted not only regarding the organizational form (from equity to non-equity collaboration), but also regarding the motivation and function. Today, inter-organizational alliances not only address peripheral interests of firms but issues concerning firms' very core functions such as research and the development of new products and processes which have previously been kept strictly in-house (Caloghirou et al., 2003; Narula and Hagedoorn, 1999). In this thesis, technology alliances (also referred to as R&D partnerships) are defined as collaborative arrangements where two or more independent organizations share some of their R&D activities (Eisenhardt and Schoonhoven, 1996; Hagedoorn, 1993, 2002; Rindfleisch and Moorman, 2001). These agreements encompass informal arrangements as well as formal arrangements and range from discrete, short-term contractual arm-length agreements – such as joint R&D pacts and joint development agreements – to equity-based joint ventures. Thus, technology alliances may vary considerably regarding the degree of inter-organizational interdependency and level of internalization depending on the different types of agreements (Hagedoorn 2002; Hagedoorn et al., 2000).

Thereby, R&D is defined as activities undertaken on a systematic basis in order to increase the stock of scientific or technical knowledge and the application of this stock of knowledge to the creation of new and improved products and processes (Hagedoorn, 2002; OECD, 2002).



Source: Vonortas and Hagedoorn, 2002, p. 18

Figure 1.1: Growth of newly-established technology alliances worldwide

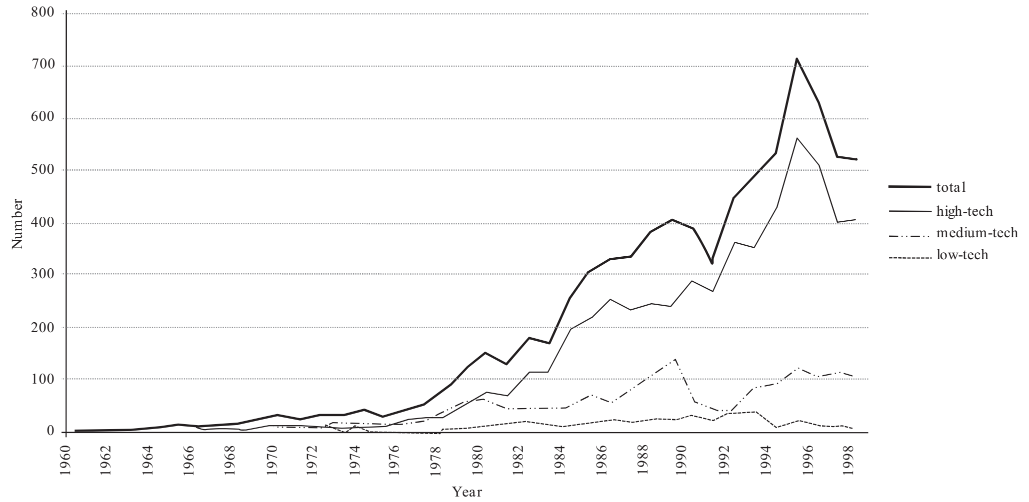
The participation in technology alliances is considered as an increasingly important strategic means to address the new challenges firms face resulting from the reshaping of the competitive business environment by globalization. Globalization ignites new technologies, markets, and industries and, thus, rapidly changes criteria for competitive advantage and firm survival. It is shortening product life cycles by higher rates of technical obsolescence and accelerates the pace at which firms must develop new technologies, products, and processes to stay competitive and to survive (Barkema et al., 2002; Narula and Dunning, 1998; Narula and Hagedoorn, 1999; Piachaud, 2002). Added to this are the continuously increasing technology complexity caused by the inter-sectoral nature of new technologies, escalating R&D costs, and increasingly sophisticated customers (Brockhoff et al., 1991; Coombs et al., 1996; Mowery et al., 1996). This intensely competitive environment makes innovation a risky business and decent returns of R&D investments difficult to attain. Many firms started to realize that the traditional focus on internal R&D activities may be insufficient (Brockhoff et al., 1991). Thus, firms started to form technology alliances with other firms, government agencies, or universities as these are increasingly viewed as a vital option to maintain firms' long-term competitiveness and to ensure the survival of the firm (Bayona et al., 2001; Häusler et al., 1994).

Thereby, the importance of technology alliances with customers and/or customer integration in the R&D process to help to define features and requirements of innovative new products and processes and, by doing so, to enhance the probability of market acceptance, has been recognized since at least the 1970s (e.g., Mowery and Rosenberg, 1979; Rothwell, 1977, 1986; Shaw, 1985; Tether, 2002 Von Hippel, 1978, 1988). Collaboration with customers during the R&D process is considered to be important to reduce the risk associated with the market introduction of new products and/or processes. Not only may technology alliances with customer help to find the right balance between product features, quality, and price, they may also provide a deeper understanding about customer behavior which may be important to identify requirements and important refinements. Furthermore, customers may provide complementary knowledge and technical know-how. If the customer is a well-known, respected member of its community, the technology alliance may also increase the chances that the innovation will be adopted by other firms from this community (Belderbos et al., 2006; Tether, 2002; Shaw 1994). Thereby, collaboration with customers may be especially important to ensure market acceptance and diffusion of innovations when the products and processes under development are more novel or complex or when the market needs are still only poorly defined (Belderbos et al., 2004; Tether, 2002).

Technology alliances with suppliers share many features of customer alliances as both alliance types are in the same vertical relationship (Tether, 2002). However, supplier alliances have been widely examined in the context of firms' trend to focus on core competencies and the outsourcing of a high percentage of the value-added of firm products (Dess et al., 1995; Prahalad and Hamel, 1990). In fact, interest in the early involvement of suppliers in the research and development of new products and processes rose from the success, especially during the 1980s, of Japanese automobile and electronics firms as the performance gap between Western and Japanese firms has been associated amongst others to the close buyer-supplier relationships of Japanese firms (Bidault et al., 1998; Liker et al., 1996; Sako, 1994; Tether, 2002). Thereby, technology alliances with suppliers are instrumental to reduce the lead time and development costs as well as to avoid costly downstream production problems and product quality improvements. In other words, technology alliances with suppliers are often related to firms' improved efficiency of research and development activities and process improvements aimed at further cost reductions and heightened product quality (Aschhoff and Schmidt, 2008; Belderbos et al., 2004; Clark, 1989; Gupta and Souder, 1998; Handfield et al., 1999; Kang and Kang, 2009).

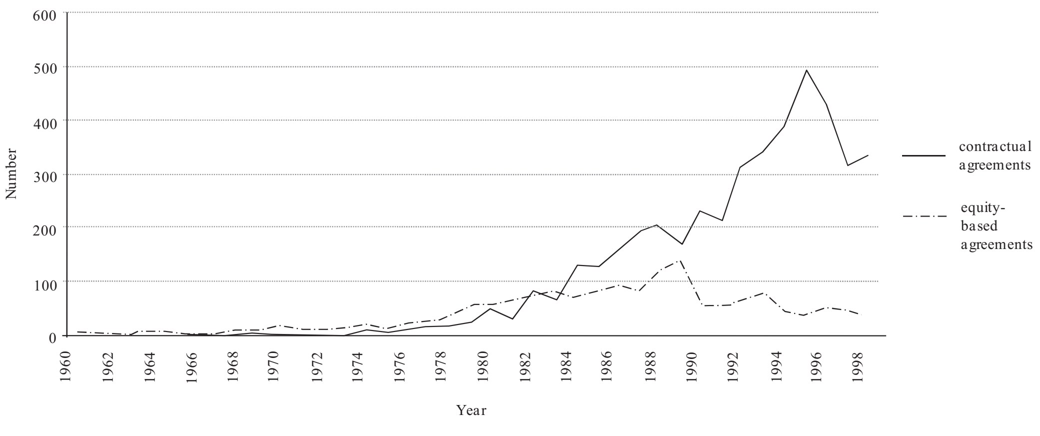
Apart from technology alliances within the supply chain (i.e., customer and supplier alliances), firms can engage in co-operative arrangements for innovation with several other types of partner organizations beyond the supply chain (Tether, 2002). Alliances with universities, research institutes, research and technology organizations (Gerwin et al., 1992; Santoro and Bierly, 2006; Santoro and Gopalakrishnan, 2000), consultants (Kaufmann and Tödtling, 2001), and even with existing industry competitors (Dodgson, 1993; Hamel, 1991) have all been advanced in this respect. Universities and public research institutes are widely considered to be important sources of new scientific and technological knowledge (Beise and Stahl, 1999; Caloghirou et al., 2001; Mansfield, 1991, 1998). Numerous government have sought to encourage university-industry alliances in order to assist the competitiveness of national industries and industrial growth (Barnes et al., 2002; D‘Este and Patel 2007; Motohashi, 2005). In fact, politicians applied considerable pressure upon universities and research institutes to collaborate closer to industry in recent years (Tether, 2002). Moreover, as research grows increasingly expensive and product and technology life cycles shortened, even large, diversified, and R&D-intensive firms experienced a wave of decentralization and globalization as well as downsizing and contracting out of their corporate R&D (e.g., Coombs and Richards, 1993; Gerybadze and Reger, 1999; Howells, 1990), and a reduction of their investments in basic research (Gregory, 1997; Van Gils, 2010). Following from this, firms have looked to leverage external knowledge from academia and government research institutes to complement internal R&D as well as to access specialist technical support and research results on the latest emerging technology (Kang and Kang, 2009; Marques et al., 2006; Tidd et al., 2005). Thereby, alliances with universities and research institutes are viewed as especially useful for basic research and research directed at long-term, radical technological breakthroughs (Aschhoff and Schmidt, 2008; Hanel and St-Pierre, 2006; Kaufmann and Tödtling, 2001; Rothaermel and Deeds, 2006), i.e. the sorts of research that many firms regard as highly uncertain and excessively expensive to go at it alone (Tether, 2002).

In contrast to university-industry alliances, which are actively promoted by many governments, alliances between competitors have frequently raised suspicions as they entail the potential for anti-competitive behavior and/or cartelization (Brodley, 1990; Jorde and Teece, 1990; Katsoulacos and Ulph, 1998; Tether, 2002). However, firm motives for forming technology alliances with competitors are complex and not necessarily (directly) anti-competitive (Fusfeld and Haklisch, 1985; Hamel et al., 1989; Tether, 2002). Competitors may, for example, form alliances to acquiring new skills from its alliance partners, build a better understanding of competitors' behavior, and enhance their competitive position. While the danger of learning races, where one partner acquires the skills of its partners and then leaves the alliance, is quite real in competitor alliances (Hamel et al., 1989; Khanna et al., 1994), firms frequently compete only in some of their activities and/or product markets, but not in others (Tether, 2002). Thus, there may be areas where the skills and capabilities of partially competing firms are complementary for developing new products and processes (Tether, 2002). Especially when these firms face other competitors or alliances that already have all the required skills and assets, it makes sense to pool their capabilities rather than undertake time-consuming and costly efforts to replicate the specific capabilities of the partner (Gomes-Casseres, 1994; Teece, 1992; Tether, 2002). Furthermore, alliances between competitors may be crucial to develop and promote technical standards as they allow firms to gain the critical mass and market power required to persuade more businesses to use their design (Besen and Farrell, 1994; Gomes-Casseres, 1994; Gemünden et al., 1992; Teece, 1992). Firms may also enter competitor alliances to avoid investments, reduce financial risks, and obtain subsidies (Hamel et al., 1989; Sakakibara, 1993). Finally, cost reductions may motivate alliance formation between competitors. Competitors or firms from the same sector often have similar processes and, thus, might offer valuable input for the development of new or improved production processes (Aschhoff and Schmidt, 2008).



Source: Vonortas and Hagedoorn, 2002, p. 18

Figure 1.2: Sectoral patterns in newly-established technology alliances worldwide



Source: Vonortas and Hagedoorn, 2002, p. 20

Figure 1.3: Governance forms of newly-established technology alliances with U.S. participants

It is not surprising, therefore, that technology alliances are nowadays often regarded as a first-best option instead of merely being a last resort (Narula and Hagedoorn, 1999). Research indicates that, after only small growth during the 1960s and 1970s, the number of newly formed technology alliances has grown dramatically since the 1980s (see Figure 1.1). Thereby, analysis on the data from the MERIT-CATI database [1] revealed a number of trends:

- The growth in the use of technology alliances is particularly pronounced amongst firms from the world's most developed economies. The majority of technology alliances documented in the MERIT-CATI database (1960 to 1998) are formed amongst firms within the Triad, i.e. North America, Europe, and Japan. During the 1970s and 1980s the share of the Triad in all newly established technology alliances was over 95% (Hagedoorn et al., 2000), a picture that parallels the worldwide distribution of technological capabilities as reflected by R&D expenditures and patenting (Freeman and Hagedoorn, 1994). However, the share of other combinations rose to about 20% in the 1990s, and following from this, the dominance of firms from the Triad became weaker (Hagedoorn et al., 2000).
- Interestingly, the concentration of technology alliances in R&D intensive industries, which has been suggested frequently in the literature (e.g., Bayona et al., 2001; Fritsch and Lukas, 2001; Miotti and Sachwald, 2003), seems to have developed only gradually (see Figure 1.2). In fact, in the 1960s, the share of newly established technology alliances in high-tech industries was substantially lower than the share for medium-tech industries. In the mid-1980s, however, high-tech industries' dominance in forming technology alliances became apparent and at the end of the 1990s over 80% of the newly established alliances documented in the MERIT-CATI database are found in high-tech industries (Hagedoorn, 2002).
- Research results further indicate that the unprecedented growth in newly formed technology alliances since the early 1980s is primarily due to informal, contractual alliance modes (see Figure 1.3) and that their share in the total of technology alliances by far exceeds that of formal, equity-based alliance agreements (Hagedoorn, 2002). It has been argued that this change in preference reflects some aspects of globalization such as the need to adapt quickly to a fast changing and highly competitive environment (Narula and Hagedoorn, 1999). Although alliance partners can renegotiate contractual agreements as well as equity-based joint ventures, contractual alliances without shared-equity agreements tend to take less time to establish, are less binding, and have lower exit costs than equity agreements (Gulati, 1995; Harrigan, 1986, 1988). Consequently, contractual alliance agreements provide much greater strategic flexibility (Harrigan, 1986).

1.3 Challenges of technology alliances: risks and high failure rates

In spite of the enormous growth in terms of the number of technology alliances and their numerous advantages, failure rates of alliances have always been extremely high (Duysters et al., 1999; Sadowski and Duysters, 2008). Lokshi et al. (2011, p. 26) stress that "technology partnerships are inherently difficult to manage and as a result partnership instability rates are notoriously high." Results from empirical studies, using various samples of joint ventures and other strategic alliances, support this view suggesting that failure rates of about 30% to 60% for alliances in general are not an uncommon finding in the literature (Beamish 1985; Bleeke and Ernst, 1991; Harrigan, 2002; Park and Russo, 1996; Pekar and Allio, 1994; Reuer and Zollo, 2005). In the case of technology alliances, where firms jointly perform R&D, failure rates seem to be especially high. Findings from Sadowski et al. (2005), for example, indicate that up to 79% of technology alliances end up failing. Similarly, data reported by Teixeira et al. (2008) suggests that

[1] The MERIT-Cooperative Agreements and Technology Indicators (CATI) information system contains information on strategic technology agreements. These agreements includes any alliance between independent industrial partners that entails the transfer of technology or the undertaking of joint research and development where the partners are not linked through majority ownership. Other types of agreements such as simple production or marketing agreements are excluded. Agreements involving only universities or government labs as well as agreements formed between firms and governmental or academic institutions are generally not included in the MERIT-CATI database unless they involve at least two industrial partners. In order to collect information on inter-firm alliances literature-based alliance counting is used where various sources are consulted that report on business events (e.g., newspaper and journal articles, books dealing with relevant topics) (Hagedoorn, 2002; Roijakkers and Hagedoorn, 2006; Schilling, 2009).

only about 9% of collaborative R&D projects formed between low-tech small and medium-sized enterprises (SMEs) were successfully completed. Thus, even though technology alliances have become an important element in corporate strategy, they seem to entail serious competitive risks and considerable managerial difficulties. As Spekman et al. (1996, p. 346) summarize:

> *“Let the potential alliance partner beware - all is not as it seems. It is true that one can leverage resources, jump-start technology and facilitate market development. It is also true that one can learn a great deal from one's partner in a shorter time than it would have taken to develop that particular skill set or tacit technology internally. The espoused gains are many and well documented. The data, however, paint a different and more somber picture.”*

In fact, firms entering technology alliances face considerable challenges. Not only do they need managers to cope with the ambiguities related to innovation activities themselves, but also with the complexities and uncertainties inherent in managing R&D projects across the boundaries of different partner organizations (Rothaermel and Deeds, 2006). Effective alliance management is thus hampered not only by uncertainty surrounding market changes and R&D outcomes but also by uncertainty regarding partner contributions and behavior (Sampson, 2005). It is not surprising, therefore, that research identified a considerable number of potential drawbacks and managerial difficulties that technology alliances’ member firms face, including the following (e.g., Brockhoff et al., 1991; De Carvalho, 2002; Diez, 2000; Motohashi, 2005; Sadowski and Duysters, 2008; Sakakibara, 1997):

- Unclear alliance contract and alliance goals and arising conflicts of interest regarding R&D contents
- Complexity of the alliance management in general and coordination difficulties such as problems with project leadership, unclear responsibilities, difficulties in sharing results, and problems related to communication within the alliance
- Delays in task accomplishment by alliance partners and lack of partners’ commitment
- Difficulties in maintaining secrecy leading to risk of technology leakage, dissemination of proprietary technology, and loss of knowledge leadership
- Overconfidence at the beginning and/or unrealistic level of optimism
- Difficulties in generating the expected technological and commercial results
- Different and/or inadequate capabilities of alliance partners and inadequate alliance experience
- High maintenance costs of the alliance due to high negotiation and transaction costs and overrun of the alliance budget
- Failure to meet time schedule and/or ineffective time schedules
- Inflexibility in adapting alliance goals to changing competitive challenges and resulting obsolescence of individual alliance goals and/or the alliance itself
- Emergence of dependencies between alliance partners and loss of firms’ independence
- Difficulties regarding the technology adaption between partners
- Alliance as obstacle to internal R&D activities as financial and personnel resources are tied within the alliance project
- Diminished returns to participating firms in case alliance results (e.g., patents) belong to the government as conditions of subsidies

Given the high failure rates of technology alliances and the many managerial difficulties, the question is whether technology alliances are indeed an appropriate means for firms to generate competitive advantage and to ensure the long-term survival of the firm. Furthermore, it seems more important than ever to identify success factors for managing technology alliances as we have witnessed a huge growth in the number of newly-established technology alliances despite the high failure rates.

The thesis at hand addresses these two questions in five independent chapters. In Chapter 2, the impact of participation in technology alliances on firm performance is analyzed. In Chapter 3 and Chapter 4, success factors for project based technology alliances within and beyond the supply chain (i.e., collaborative R&D projects) are examined. The impact of partner characteristics is addressed in Chapter 3 whereas Chapter 4 focuses on managerial practices regarding the enhancement of information transparency between project partners. Chapter 5 and Chapter 6 address success factors for formal and informal technology alliances within the supply chain (i.e., buyer-supplier partnerships). Thereby, the thesis focuses on the supplier integration in the product development process. Specifically, Chapter 5 examines the determinants of the two managerial practices open-book accounting (OBA) and inter-organizational cost management (IOCM), which aim at further cost reductions. Chapter 6 investigates their performance effect. Taken together, this thesis thus addresses three key research topics:

- The relevance of technology alliances for firm performance.
- The relevance of partner characteristics and managerial practices aimed at enhancing information transparency for the success of technology alliances within and beyond the supply chain.
- Determinants of managerial practices aimed at cost reductions and their impact on the performance of technology alliances within the supply chain.

The next section of this chapter contains a short summary of all five chapters included in this thesis. Thereafter, a short conclusion of the main findings and their implications for academics and managers are presented.

1.4 Summary: content of this thesis

Five independent papers will be presented in this thesis with regard to the performance impact and success factors of technology alliances. In the next sections, a short summary of these five papers will be given together with a brief description of the theoretical background, the methodology, and their main findings. Thereby, the analysis is based on three different samples: Chapter 2 draws on existing literature, using a meta-analysis to analyze technology alliances' performance impact. The analysis regarding success factors of collaborative R&D projects (Chapter 3 and 4) is based on a sample of 138 projects (cross-sectional data) collected in 2010 using structural equation modeling. Chapter 5 and 6 rely on cross-sectional data from 164 automotive suppliers collected in 2006 to examine determinants of open-book accounting and inter-organizational cost management as well as their impact on buyer-supplier partnership performance (see Figure 1.4). The data for Chapter 5 and 6 was provided by Klaus Möller.

Chapter 2: The relevance of technology alliances for firm performance

• Technology alliances - Are they worth the effort?

• **Methodology:** Meta-analysis at the firm level based on product-moment correlations (sample 1: 76 empirical data sets across 71 studies)

Chapter 3: The relevance of partner characteristics for the success of technology alliances within and beyond the supply chain

• Collaborative R&D project efficiency, target achievement and managers' information perception: Simply dependent on partner proximity?

• **Methodology:** Analysis of cross-sectional data at the project level using structural equation modeling (sample 2: survey data from 138 collaborative R&D projects)

Chapter 4: The impact of managerial practices directed at enhancing the information transparency on the success of alliances within and beyond the supply chain

• How to manage collaborative R&D projects: The importance of information transparency

• **Methodology:** Analysis of cross-sectional data at the project level using structural equation modeling (sample 2: survey data from 138 collaborative R&D projects)

Chapter 5: Determinants of managerial practices aimed at cost reductions in technology alliances within the supply chain

• The effect of relational factors on open-book accounting and inter-organizational cost management in buyer–supplier partnerships

• **Methodology:** Analysis of cross-sectional data at the supplier level using structural equation modeling (sample 3: survey data from 147 automotive suppliers, subsample)

Chapter 6: The impact of managerial practices aimed at cost reductions on the success of technology alliances within the supply chain

• Open-book accounting: Reason for failure of inter-firm cooperation?

• **Methodology:** Analysis of cross-sectional data at the supplier level using structural equation modeling (sample 3: survey data from 164 automotive suppliers)

Figure 1.4: Overview over the content of this thesis

I rely on meta-analysis to analyze technology alliances' performance impact to combine the (often inconsistent and/or conflicting results) from previous studies on the relationship between participation in technology alliances and firm performance (Chapter 2). Meta-analysis is a method for the quantitative synthesis of research findings from separate studies (Bijmolt and Pieters, 2001; Hedge and Olkins, 1985). In contrast to narrative reviews, meta-analysis takes a quantitative approach using statistical techniques to integrate findings across large numbers of studies (Glass et al., 1981; Hunter and Schmidt, 2004; Rosenthal and DiMatteo, 2001). As Glass et al. (1981, p. 21) emphasize "the essential character of meta-analysis is that it is the statistical analysis of the summary findings of many empirical studies." Consequently, meta-analysis is "truly an analysis of the results of statistical analyses" (Hedge and Olkins, 1985, p. 13) as it relies on statistical data derived from primary analyses conducted in prior studies. By doing so, meta-analysis offers considerable advantages over narrative reviews as it allows the author to assess the magnitude of an effect and its statistical significance as well as to account for differences in sample sizes (Fern and Monroe, 1996; Franke, 2001). Furthermore, meta-analysis also allows the author to generally compare studies to investigate the specific conditions (e.g., research design, sample characteristics, time periods, or study sources) which may account for differences in the reported effect sizes by conducting a moderator analysis (Hunter and Schmidt, 2004; Franke, 2001; Rosenthal and DiMatteo, 2001). It is not surprising, therefore, that meta-analysis has become by far the "most common approach to establishing 'the scope and the limits' of empirical generalizations" (Franke, 2001, p. 186).

Structural equation modeling (SEM) is employed (Bollen, 1989; Kline, 2005) to estimate the relationship between potential success factors and collaborative R&D project performance and/or buyer-supplier partnership performance (Chapter 3-6). SEM is accepted "as a major component of applied multivariate analysis" (Bentler and Chou, 1987, p. 78). An important characteristic of this methodology and one of the main reasons for its widespread use is SEM's ability to estimate simultaneously both a measurement model and a structural model, while directly accounting for measurement error in the estimation. Thereby, measurement models test the relationship between the measurement items (i.e., observed variables) and the unobserved theoretical constructs (latent variables and/or constructs) that they represent. In contrast, the structural model specifies the multiple and interrelated dependence relationships between the latent variables of interest allowing the simultaneous examination of several dependent variables and mediator effects (Byrne, 2001; Hair et al., 2006; Landis et al., 2000). SEM, thus, allows the estimation of complex research models (Shook et al., 2004) and has become a popular data analysis method in the social and behavioral sciences (Baumgartner and Homburg, 1996; Landis et al., 2000; Medsker et al., 1994; Shah and Goldstein, 2006; Shook et al., 2004).

1.4.1 Chapter 2: The relevance of technology alliances for firm performance

In Chapter 2, I focus on the impact of participation in technology alliances on different aspects of firm performance. The study attempts to bring clarity to the diverse and even contradictory findings from prior research and offers additional insights into the question whether technology alliances indeed have a positive performance impact. The empirical analysis is based on a meta-analysis of the evidence on technology alliances' effect on firm performance.

The impact of technology alliances on firm performance – and the resultant implications for managers and designers of government R&D policy – has been the focus of much recent academic research. The predominant view in prior research is that technology alliances are positively associated with firm performance (e.g., Becker and Dietz, 2004; Belderbos et al., 2004; Branstetter and Sakakibara, 1998; Campart and Pfister, 2007; Cincera et al., 2003; Czarnitzki and Fier, 2003; Huang and Liu, 2007, Lööf and Broström, 2008). However, despite the significant volume of research on the relationship of technology alliances and performance, the findings regarding this relationship often vary considerably in terms of magnitude. Moreover, some results even indicate that collaboration on innovation activities might have a negative impact on firm performance (e.g., Belderbos et al., 2010; Ledwith and Coughlan, 2005; Lööf and Heshmati, 2002; Vonortas, 1997a).

Using product-moment correlations as effect size statistics, I conduct a meta-analysis to analyze the findings of 76 independent samples on the performance impact of technology alliances from 71 studies with a total sample size of 52,868 firm data yielding 291 correlations. The review of research on alliances' performance impact encompasses studies from 1996 through 2011 (53 studies published in different journals, 2 doctoral dissertation, 3 conference proceedings, and 13 working papers and/or internal reports. I distinguish between a number of different types of alliance partners (universities and/or research organizations, competitors, suppliers, customers amongst others) and consider six categories of performance measures: R&D input, innovation potential, R&D results, R&D performance, business performance, and firm value (see Figure 1.5).

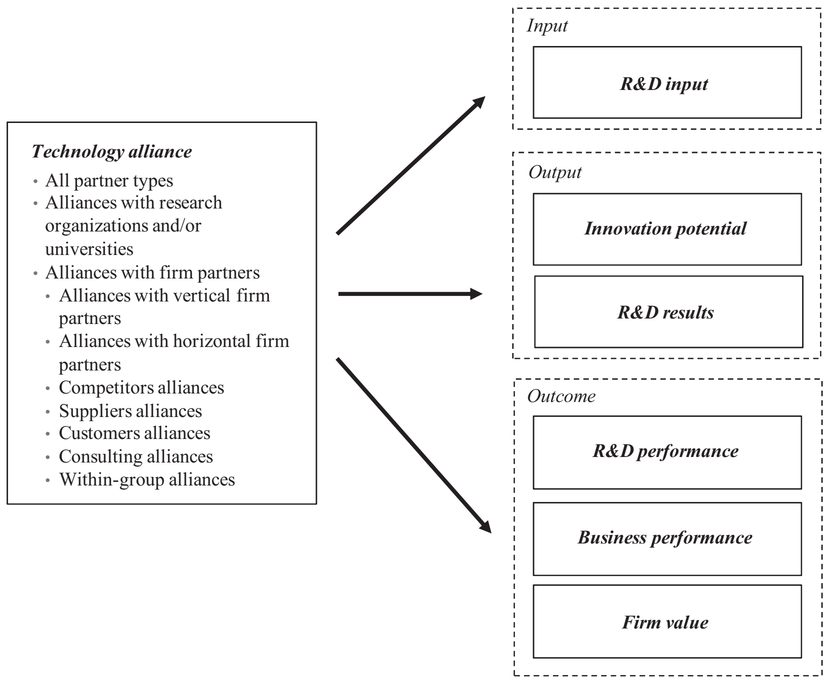


Figure 1.5: Impact of technology alliances on firm performance

The majority of studies do not distinguishes between the different partner types but aggregate over alliances partner types. Only four types of alliance partners (suppliers, competitors, customers, and research organizations such as universities and research institutes) have been reported frequently enough as affecting firm performance to permit a meaningful investigation of their effects in a meta-analysis. Similarly, the review of the coded performance measures showed that only R&D results, R&D performance, business performance, and firm value were reported frequently enough to permit the analysis of effect size statistics.

The results reveal that the view of alliances' positive performance impact does generalize across samples for technology alliances, indicating that the positive performance impact of technology alliances is supported for alliances regardless of whether alliances are formed with different firm partners or universities and/or research institutes. Furthermore, the data indicates that the positive performance impact of technology alliances is supported across samples for the performance dimensions R&D results, R&D performance, business performance, and firm value. The performance dimensions R&D input and innovation potential are not reported frequently enough to allow for a meaningful analysis of central tendencies and variance statistics. However, it has to be noted that in contrast to the other performance dimensions both the simple mean as well as the corrected-mean of the relationship between technology alliances and R&D input is negative. This indicates that – even though the sharing of R&D costs is an important motive for alliance participation – technology alliances might not lead to lower R&D expenses but to an increase. Further research should address point.

Our results are consistent with the view that technology alliances constitute an important source of competitive advantage for firms. Thereby, managers can use technology alliances not only to enhance firms' R&D output, such as the probability to develop new products and processes, but also firms' business performance and even as a means to increase firms' market value.

1.4.2 Chapter 3: Partner characteristics as success factors for technology alliances within and beyond the supply chain

In this chapter, I analyze to what extent partner proximity influences collaborative R&D project performance in co-authorship with Klaus Möller. We rely on social network theory to argue that partners with low technological, geographical, cultural, and organizational proximity may offer high potential to access new and diverse information, knowledge, and capabilities as it is likely that "structural holes" (Burt, 1992, p. 18) exist between the firm and these partners. The empirical analysis is based on cross-sectional survey data from 138 collaborative R&D projects, using structural equation modeling to analyze these data.

Partner selection is an important issue in the context of technology alliances since accessing complementary knowledge, technology, and skills of partner organizations is a key motive for participating in technology alliance (Gulati, 1998; Hamel, 1991; Khanna et al., 1994, Kogut, 1988; Pisano, 1990). As a consequence of the increased technology complexity and the inter-sectoral nature of new technologies, firms need to incorporate a wide scope of technical expertise for technological innovation (George et al., 2002; Grandstrand, 1998, Grandstrand and Sjölander, 1990; Harrigan, 1986; Mowery, 1989). However, with increasing competitive pressure, even very large and diversified firms have neither the time nor the resources for developing all the knowledge and internal capabilities necessary for the development of innovative new products and processes (Hamel et al., 1989; Leonard-Barton, 1999; Nooteboom, 2000; Powell et al., 1996). Technology alliances with partners with different technological capabilities, information, and ways of thinking may offer crucial input to the R&D project. Yet it is precisely this high diversity between the partners that reduces the likelihood of successful collaboration as it diminishes the firms' ability to evaluate and utilize the partners' knowledge (Ahuja, 2000; Cohen and Levinthal, 1990; Lane and Lubatkin, 1998). Thus, firms face trade-offs when selecting alliance partners. On the one hand, alliances between partner organizations with highly diverse profiles provide access to a range of tacit skills, different technological capabilities, and knowledge sources which may be critical to product innovation and the technical project success. On the other hand, increased diversity can considerably increase project complexity, the potential for misunderstandings, and conflicts between partners, and, hence, increased coordination and managerial costs.

We empirically investigate to what extent partner proximity regarding technological capabilities, the geographic location, culture, and organization influences alliance performance based on data from 138 collaborative R&D projects. Thereby, we employ multiple measures of alliance success addressing both collaborative R&D project efficiency (i.e. project time and cost), and project target achievement regarding product specifications as well as financial and/or market objectives. By doing so, we can investigate the trade-off between partner proximity's contribution to the technical and economic project success and potential difficulties in a time and cost-efficient project execution due to dissimilarities between partners. Additionally, we consider the mediating effect of project managers' timely perception of critical information to investigate partner proximity's potential negative impact on project management due to an increased information ambiguity. Finally, we investigate to what extent the relationship between partner proximity and project performance is contingent upon the degree of product innovativeness (see Figure 1.6).

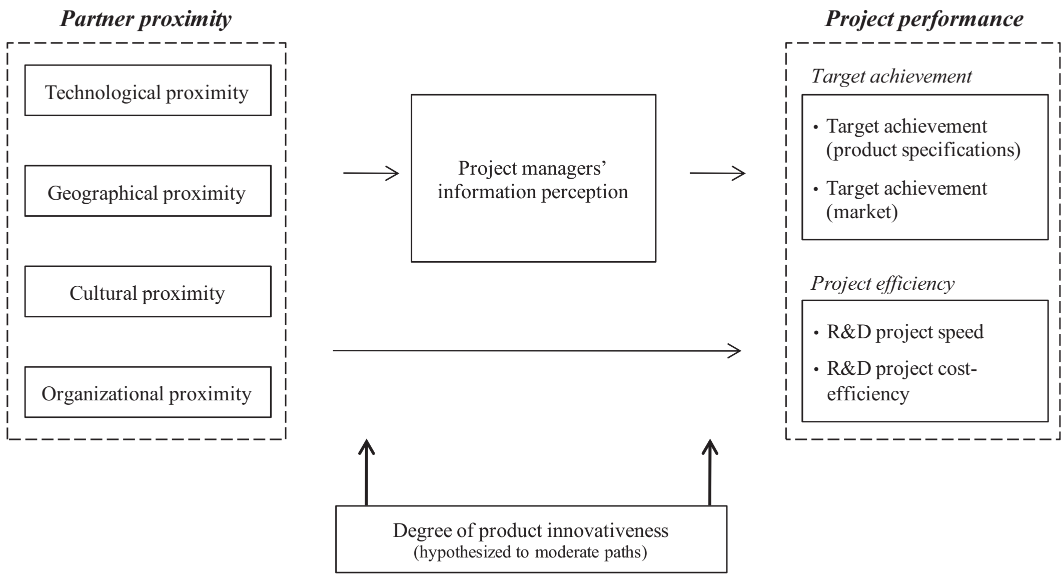


Figure 1.6: Partner proximity's effect on collaborative R&D project performance

Our results partially support our hypotheses. Specifically, we found that organizational proximity between the partners positively influences the achievement of product specifications and market objectives. Geographical proximity between partners was found to be positively related to a time-efficient R&D process whereas cultural differences between partners may hinder the timely perception of relevant information. Manager's ability to identify critical information in a timely manner in turn was found to influence both the achievement of product specifications and the market success of the product. A moderator effect of product innovativeness regarding the relationship between partner proximity and project target achievement was not supported by our data.

Taken together, our findings indicate that initial conditions such as partner characteristics do influence project success up to a certain extent. Consequently, managers' should take potential negative effects of partner proximity into account and address them at an early stage of project execution to ensure target achievement and project efficiency. However, our findings also indicate that while partner proximity does influence project success, it certainly does not determine target achievement or an efficient project execution.

1.4.3 Chapter 4: Managerial practices as success factors for technology alliances within and beyond the supply chain

In this chapter, I focus on the influence of managerial practices aimed at enhancing the information transparency between partners on the performance of collaborative R&D projects. The paper is written in co-authorship with Klaus Möller. We rely on decision dilemma theory to explain the relationship between managerial practices, information transparency, and project performance. Decision dilemma theory proposes that the continuation of a failing course of action – such as hold on to decisions unsuitable to ensure R&D project success – may result from the uncertainty of the situation or available information's equivocality (Bowen, 1987). The empirical analysis is based on cross-sectional survey data from 138 collaborative R&D projects, using structural equation modeling to analyze these data.

Given the dramatic increase of technology alliances formation in recent years, effective management of inter-organizational ventures directed at the research and development of new product and processes is of high importance for managers (Sampson, 2005). However, management of alliances is difficult at best and alliances' outcome has often fallen short of expectations (e.g., Ariño and Doz, 2000; Baardsen and Grønhaug, 1990; Bruner and Spekman,