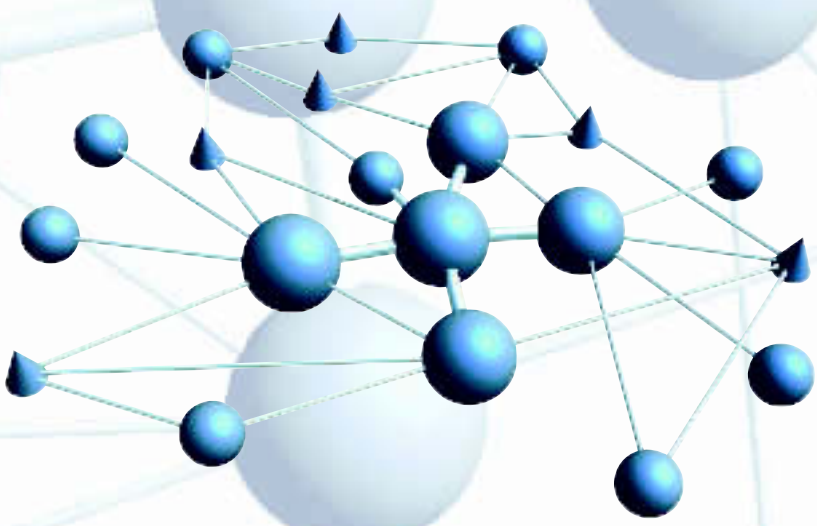
RAYMOND VAN WIJK

Organizing Knowledge in Internal Networks

A Multilevel Study



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HET ORGANISEREN VAN KENNIS IN INTERNE NETWERKEN

EEN MULTI-LEVEL STUDIE

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Preface

This PhD study is about how organizations influence the organization of knowledge through the adoption of internal network forms of organizing. My interest in writing a PhD dissertation on this topic emerged out of my studies in business administration. I wrote a Master's thesis on a topic that closely relates to the topic of this book. Upon completing that project, I felt the intellectual need to delve more deeply into the subject matter. Now, especially for those of you who kept asking about it, that delving is finally completed. In the beginning of my PhD, I started writing papers on its topic, many of which have been presented and published elsewhere. Doing this was surely very helpful, as it incrementally framed my ideas and thoughts about the topic of the PhD study. At some point, however, I had to start writing the book that is now in front of you. Considering that the papers were all related, I decided to rewrite and revise them so that they nicely fit as chapters. I believe the result is surprising. I hope you agree with me.

The last six years were great years. I have been surrounded by many people who made it a wonderful experience. This book would probably not have been completed or be as it currently is without the help and support of them.

At Rabobank, all persons who contributed to the case material are acknowledged for their time, help and support. Specifically, I would like to thank Wim van Dinten at that time at the Strategy Staff, and Pierre van Hedel of Spectrum for their active involvement in the study. They helped identifying the central actors in Rabobank's change journey, and opened doors where necessary so that I could interview them.

Further, I would like to thank all the participants of the INNFORM research program. This PhD study was conducted partly under the umbrella of that group. The INNFORM research program was coordinated by Andrew Pettigrew of Warwick University in the UK, and was funded by the Economic and Social

Research Council of the UK and PricewaterhouseCoopers. The project's original aim was to map organization change, and to understand the dynamics involved in how and why firms transitioned to internal network forms of organizing. To that end, more than 10 meetings were held where all the members exchanged ideas and thoughts. I enjoyed being part of that group. Especially the results reported in chapters 5, 6 and 7 would have not been possible without the help of the participants. For access and help with the Japanese and US data reported in Chapter 6, I would like to thank Arie Lewin, Silvia Massini and Tsuyoshi Numagami. For access to the Continental European data, I would like to thank Andrew Pettigrew and Richard Whittington, as well as the other participants who all helped in administering the questionnaire in the European countries.

Further, I would like to thank the department of strategy and ERIM of the Rotterdam School of Management for financial support. At the strategy department where this PhD was completed, many colleagues contributed to the study. Whenever I was struggling with ideas or statistics, they were easy to find. Many of them also provided comments and suggestions on the papers that underlie the present study. In particular, I am indebted to my promotor, Frans van den Bosch, for his guidance, supervision and support. His door was always open whenever issues or problems surfaced. Also many of the papers on which this PhD is based were co-authored by him and Henk Volberda. It should, therefore, come as no surprise that this study has benefitted from their ideas. Obviously, I am responsible for any errors that have remained.

Finally, I would like to thank my friends and family. Without their support, I am sure I could not have finished it. Marjolijn Dijksterhuis and Marc Huygens have been much more than colleagues and fellow PhD students. They not only read through various versions of this manuscript as well as through the papers that underlie it, but also provided mental and intellectual support. My parents, too, supported me in whatever way they could. Finally, I would like to thank all my friends, who had to deal with the moments I could not join them because I had to finish or figure out something so badly first, but during our drinks also remembered me of the fact that there is more to life than a PhD. You know who you are.

Raymond van Wijk
Leidschendam, April 2003

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CHAPTER 1
Introduction

Aiming to explain how firms create and sustain competitive advantage, many studies in the field of strategy have recently focused on knowledge and networks. Over the past decade, competitive forces have rendered knowledge one of a firm's strategically most important assets (Boisot, 1998; Drucker, 1993; Grant, 1996a; Itami, 1987; Leonard-Barton, 1995; Hansen, Nohria and Tierney, 1999; Nonaka, 1994; Nonaka and Takeuchi, 1995; Quinn, 1992; Winter, 1987). Transformations in the competitive landscape incite firms to innovate and explore new opportunities (Bettis and Hitt, 1995; Hitt, Keats and DeMarie, 1998). Since knowledge is a fundamental ingredient of innovation and exploration, firms are spurred to put knowledge to use as market demands and opportunities dictate, so as to outmaneuver competitors and achieve a competitive edge.

Forwarded by Schumpeter (1934) as the engine of economic development, innovation is mainly brought about by the combination of new knowledge and the combination of existing knowledge in new ways (Dosi, 1988; Galunic and Rodan, 1998; Grant, 1996a; Henderson and Clark, 1990; Huber, 1991; Kogut and Zander, 1992; Zahra, Ireland and Hitt, 2000). Knowledge is distributed among various actors, however, making it dispersed in time and space, as well as differentiated in context (Doz and Santos, 1997; Hayek, 1945; Jensen and Meckling, 1992; Tsoukas, 1996; Von Krogh, Ichijo and Nonaka, 2000). Hence, before knowledge can be combined and put to productive use, it must be available at the site needing it or made accessible there. In that vein, Dierickx and Cool (1989) argue that the underlying knowledge structure of a firm that confers competitive advantage consists not only of knowledge stocks, which are accumulated knowledge assets, but of knowledge flows. These are streams of knowledge between firms or between units of a firm that may be assimilated and developed into stocks of knowledge. The increasing significance of knowledge for a firm's

competitive behavior and survival has for that very reason placed equally significant demands on how knowledge is organized (Brown and Duguid, 1998; Grant, 2001).

Central to organization is the integration of tasks performed by differentiated units (Lawrence and Lorsch, 1967). Likewise, because performing tasks generally involves the use of knowledge, as portrayed in Figure 1.1, organizing knowledge requires the integration of differentiated knowledge. In addition to knowledge flows (DeCarolis and Deeds, 1999; Gupta and Govindarajan, 1991; 1993; 2000; Schulz, 2001), many knowledge processes that pertain to the organization of knowledge have been studied in a variety of contexts. For example, studies have emerged on knowledge creation (Argote, 1999; Boisot, 1998, Nonaka, 1994; Nonaka and Reinmöller, 2000), knowledge sharing (Hansen, 1999; 2002; Hoopes and Postrel, 1999; Postrel, 2002; Tsai, 2002), knowledge transfer (Argote, 1999; Mowery, Oxley and Silverman, 1996; Simonin, 1997; Szulanski, 1996; Tsai, 2001; Zander and Kogut, 1995), knowledge appropriation (Teece, 1998), knowledge leveraging (Quinn, 1992), knowledge dissemination (Teigland, Fey and Birkinshaw, 2000), knowledge acquisition (Darr, Argote and Epple, 1995; Epple, Argote and Murphy, 1996; Lyles and Salk, 1996; Yli-Renko, Autio and Sapienza, 2001), and knowledge absorption (Cohen and Levinthal, 1990; Van den Bosch and Volberda and De Boer, 1999). All these processes share in common that they involve the transfer or flow of knowledge from one actor to another. Successfully transferring knowledge from one actor to another requires that the recipient of that knowledge integrates it into its own stock of knowledge assets. Therefore, as illustrated in Figure 1.1, knowledge integration is central concern in organizing knowledge. As the necessary degree of integration is contingent upon environmental turbulence (Lawrence and Lorsch, 1967), knowledge integration becomes more important when environmental turbulence increases and impels firms to innovate by combining its knowledge stocks (De Boer, Van den Bosch and Volberda, 1999; Doz and Santos, 1997; Grant, 1996a; 1996b; Pisano, 1994).

From the variety of contexts in which knowledge organization has been studied two interfaces can be derived: interorganizational interfaces of a firm with other firms in its environment, and intraorganizational interfaces between units within a firm (cf. Smith, Carroll and Ashford, 1995). Underscoring this distinction, Zahra and Nielsen (2002) found that firms increasingly source their knowledge and capabilities both externally and internally to speed up technology commercialization. The distribution of knowledge over various actors entails that the knowledge critical to processes of innovation and novelty is not always readily

available within a firm. Firms can remedy such deficiencies by acquiring the relevant knowledge from external constituents (cf. Cohen and Levinthal, 1990; Teece, 1998). The critical knowledge may also be present within a firm, however not with the unit or innovating entity where it is most needed. Knowledge is not only distributed among firms, but distributed over the individuals, units and departments of a firm. In such cases, knowledge can be transferred from a unit in the organization where it is available to the unit lacking it (cf. Gupta and Govindarajan, 2000; Hansen, 1999; 2002; Szulanski, 1996; Tsai, 2002). Alternatively, firms and their units can create knowledge internally. However, similar to external and internal sourcing, knowledge creation also involves the integration of knowledge among units and individuals (Nonaka, 1994).

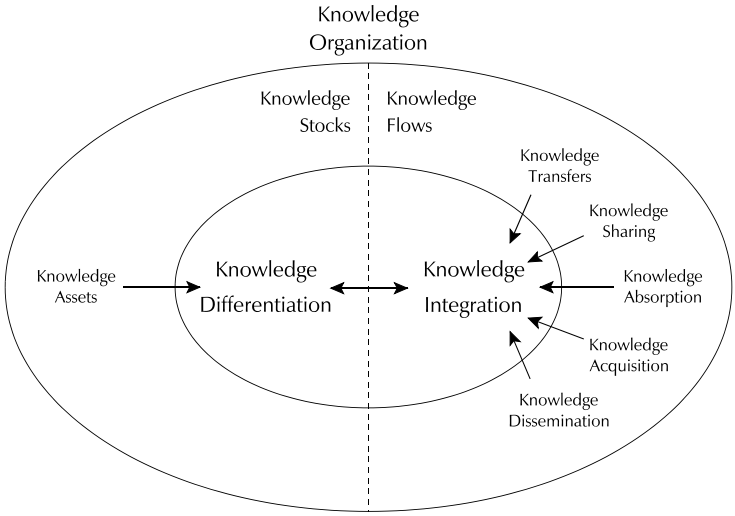


Figure 1.1: Knowledge organization: Integrating differentiated knowledge

To give scope to their knowledge integration and organization activities, many firms have started experimenting with network forms of organizing. Aiming to enjoy the benefits of both market organization and firm organization (Contractor and Lorange, 1988; Powell, 1987; 1990), many firms have formed external

networks by entering into strategic alliances and by establishing joint ventures with other organizations. From a knowledge perspective, external networks provide firms with two main benefits. External networks allow a firm to gain access to new knowledge and acquire that knowledge. In the case that firms have complementary or co-specialized knowledge assets, external networks allow these firms to pool that knowledge together (Badaracco, 1991; Doz and Hamel, 1998; Grant and Baden-Fuller, 1995; Hamel, 1991; Inkpen, 1995; Inkpen and Dinur, 1998; Lyles, 1988; Mody, 1993; Powell, Koput and Smith-Doerr, 1996; Teece, 1992).

Nourished by the view that social relations interfere with the price mechanism of markets as well as with the authority mechanism of hierarchies (Granovetter, 1973; 1985), the entry of firms in alliances has recently also resulted in revived interest in the study of social networks. The study of social networks goes by the notion that 'the structure of any social organization can be thought of as a network' (Nohria and Eccles 1992: 288), and that the actions of network actors are shaped and constrained by their position and embeddedness in the network (Nohria, 1992). Centering on the ties among actors, the main thread of studies under this banner is that social networks provide actors with information benefits that influence network formation (Gulati, 1995a; 1995b; 1998; Koka and Prescott, 2002). Recently, studies have emerged that explicitly focus on social networks as a vehicle through which knowledge is actually transferred and integrated (Dyer and Singh, 1998; Hansen, 1999; 2002; Liebeskind et al., 1996; Nahapiet and Ghoshal, 1998; Tsai and Ghoshal, 1998).

When firms enter into external networks or emphasize social networks, little or no change takes place as to formal internal organization. Hierarchical logics and routines of organizing, such as those of the functional and multidivisional organization that have dominated the organizational landscape in the past century (Chandler, 1962; Williamson, 1975), remain unimpaired and prevent firms from deploying knowledge ambitiously internally (Ghoshal and Bartlett, 1995; 1997). As a consequence, firms have started experimenting with a form of organization, which key advantage 'arises from its ability to create new value through the accumulation, transfer, and integration of different kinds of knowledge, resources, and capabilities across its dispersed organizational units' (Nohria and Ghoshal, 1997: 208). Various labels have been given to this alternative form of organizing. Comparing all the models underlying the many labels, it is evident that they share in common the characteristics of internal network forms of organizing (cf. Ferlie and Pettigrew, 1996a; Hedlund, 1994; 1996, 1999; Nohria, 1996; Perrone, 1997).

While the development of hierarchical organizations rests on the assumption of economic rationality, the ability of internal networks in integrating and organizing knowledge is built on a departure from economic rationality. As Burns and Stalker (1961: 5–6) argue in their pioneering work, in mechanistic organizations the 'command hierarchy is maintained by the implicit assumption that all knowledge about the situation of the firm and its tasks is, or should be, available only to the head of the firm', whereas in organic organizations it is maintained that 'when problems and requirements for action arise which cannot be broken down and distributed among specialist roles within a clearly defined hierarchy, … individuals have to perform their special tasks in the light of their knowledge of the tasks of the firm as a whole'. The specialized knowledge most vital to a firm is usually located in the units operating in the local environments (Bartlett and Ghoshal, 1993). Constraints posed by bounded rationality prevent knowledge from being effectively accumulated at the corporate level.

Grounded in the departure of economic rationality and their ability in knowledge integration and organization, internal networks rely less on organizational elements so characteristic of traditional forms of organizing, but require different organizational elements. For example, many studies of internal network forms of organizing report that these organization forms share in common a reliance on reduced organizational layers, on more decentralization, on dynamic rather than static structures, on increased use and embedding into existing systems of information technology, and on new human resource practices. Managers in those forms of organizing also recognize knowledge as one of the most important and most leverageable assets. Research on internal networks centers, therefore, on network organization as a form of organizing alternative to more traditional organization forms.

AIMS AND SCOPE

Although the importance of knowledge (e.g. Hayek, 1945; Penrose, 1959) and internal network forms of organizing (e.g. Burns and Stalker, 1961) have been recognized decades ago, research in both has developed independently of the other. Much remains to be explained as to how networks influence the organization and integration of knowledge. Many studies have appeared on knowledge integration and organization, as well as on the underlying processes. Similarly, the number of studies on networks and alternative forms of organizing has been strongly progressing. Studies in which knowledge and networks are examined conjointly are of more recent date and still in development. Therefore,

this PhD study seeks to examine *how internal networks influence the integration and organization of knowledge*.

Although firms enter in external networks and by design are social networks, the focus of the present study will be on the organization and integration of knowledge in internal networks. The rationale for so doing is threefold. First, in the literature, calls have been made for uncovering how internal networks operate and developing theories of these alternative forms of organizing (Daft and Lewin, 1993; Foss, 2002; Ilinitch, D'Aveni and Lewin, 1996). Despite these calls, research on internal networks has remained underdeveloped over the past decade. As Pettigrew and Fenton (2000: 3) argue, 'the literature has yet to be united under an overarching theory or perspective and therefore may only be weakly classified as a research focus'. Much of the literature that has appeared on these alternative forms has been developed in the field of international business, in which MNCs are increasingly being conceptualized as networks (Bartlett and Ghoshal, 1989; Ghoshal and Bartlett, 1990; Hedlund, 1986; 1994; Hedlund and Ridderstråle, 1997; Malnight, 1995; 1996;Nohria and Ghoshal, 1997). Most empirical studies on internal networks have remained in the realm of case study research. Moreover, most of this research is cross-sectional and does not focus exclusively on knowledge. The present study also seeks to explain the dynamics of internal networks in a longitudinal study, and to obtain formal results on how networks contribute to the organization of knowledge.

Second, the proportion of firms implementing internal network forms of organizing seems to be progressing. Many studies advert to internal networks as a "new" organization form (e.g. Bartlett and Ghoshal, 1993; Heydebrand, 1989). However, since Burns and Stalker (1961) in their pioneering book *The Management of Innovation* already described an organization that strongly resembles an internal network, it seems that their novelty can be mainly ascribed to their increased adoption by firms. Indicative of this trend is a study among firms in Europe and Japan conducted by Pettigrew, Massini and Numagami (2000). They found that the share of firms adopting organizational elements so characteristic of internal network forms of organizing is increasing.

Third, in study of 431 European and US organizations, Ruggles (1998) found that not every firm is equally adept in organizing knowledge. Examining self-creation, external appropriation, and internal transfer and integration of knowledge, only a small portion of the firms queried in his study reported above-average performance. In his study, 46 percent of the firms queried indicated good or excellent performance in generating new knowledge, while 34 percent of the

firms considered themselves adept in accessing valuable knowledge from outside sources. Only 13 percent of the firms disclosed above-average performance in transferring existing knowledge into other parts of the organization. Similarly, O'Dell and Grayson (1998) and Szulanski (1996) found that firms generally experience many difficulties in transferring knowledge among units. Although both external and internal sourcing of knowledge and capabilities were found important to technology commercialization, additionally, internal sourcing proved more valuable to the development of new products, radical products and new patents (Zahra and Nielsen, 2002). Since transferring and integrating knowledge internally is one of the foremost reasons firms have started experimenting with internal network forms of organizing, these findings underscore the importance of focusing on internal networks.

Research question

The overarching research question that guides the present study is how internal network forms of organizing influence the integration and organization of knowledge at both the corporate and business level. To contribute to this undernourished field of study, two subissues are addressed.

First, the study centers on determinants of knowledge integration and organization that differentiate internal networks from other organization forms. In contrast to the insights gained on the outcomes of knowledge integration, research into the elements that shape knowledge integration is undernourished. In particular studies examining how knowledge integration is influenced at a corporate level of analysis are lacking. Empirical studies uncovering how firms change knowledge integration have mainly focused on subsidiary-level determinants, most notably in multinational corporations (Birkinshaw, Morrison and Hulland, 1995; Ghoshal, Korine and Szulanski, 1994; Gupta and Govindarajan, 1993; 2000; Lamont et al., 2000; Nobel and Birkinshaw, 1998; Nohria and Ghoshal, 1997; Szulanski, 1996). Since organization forms permeate an entire organization, however, the decision to adopt an internal network form of organizing can most likely to be traced back to corporate-level management (Van Wijk and Van den Bosch, 2000). Understanding how corporate-level elements shape knowledge integration is therefore a crucial issue to consider. Nevertheless, business-level determinants remain important to consider for two reasons. First, decisions taken by corporate level executives reverberate at the business-level and create a context in which local managers act. For example, because the adoption of internal networks involves extensive decentralization,

local managers in internal networks are argued to have discretion in making both operational and strategic decisions. Second, existing studies of business-level determinants of knowledge integration have not been conducted in the context of internal networks. Therefore, both corporate and business level determinants are considered.

Second, although the outcomes of knowledge integration have been strongly addressed, the contribution of internal network forms of organizing in determining performance through knowledge-related considerations is sparsely examined. Therefore, this study examines not only how internal networks bear an advantage over other, more traditional forms of organizing in integrating and organizing knowledge, but how that advantage contributes uniquely to performance enhancements. The evidence on the extent to which corporate-level effects influence performance is mixed (Bowman and Helfat, 2001). On the other hand, studies of corporate strategy have tended to exclude the role of organization form. In a study of the multidivisional hypothesis, however, Armour and Teece (1978) found that organization form is a strong contributor to a firm's ability to generate competitive advantage and improve performance. Next to corporate-level effects, business-level effects account for a large part of variance in the performance of multibusiness firms (Bowman and Helfat, 2001). The performance implications of internal networks are, therefore, assessed at both the corporate and business level. Since 'an organization is to engage in sufficient exploitation to ensure current viability and, at the same time, to devote enough energy to exploration to ensure its future viability' (Levinthal and March, 1993: 105), the outcomes of knowledge integration will also be framed along the exploration-exploitation framework advanced by March (1991). Exploitation associates with financial performance, whereas exploration relates to innovative performance. Since knowledge integration is crucial in environments demanding innovation, this study focuses on both financial performance and innovative performance.

RESEARCH APPROACH

The PhD study pivoted on three bodies of literature, as portrayed in Figure 1.2. First, network theory was considered. As indicated above, networks operate at multiple levels: socially between people, externally between firms and internally between units of firms. Although the focus of this study is on internal networks, studies of external and social networks were reviewed as well, because the literature on the three types of networks is not perfectly delineated. For example, many studies of social networks have been conducted in external

networks (e.g. Gulati, 1998; Koka and Prescott, 2002). From these studies it appeared that the processes involved in external and social networks are similar. Therefore, they may also forward insights relevant to internal networks.

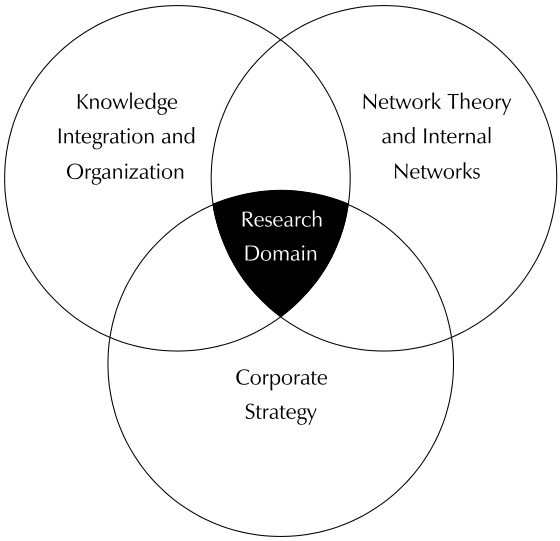


Figure 1.2: Theoretical underpinnings and research domain

Second, the growing body of literature on knowledge integration and organization was considered. The rationale for so doing was that elements affecting knowledge integration in general may have similar effects in internal networks. In addition, this literature delves more deeply into how knowledge manifests itself at the individual, unit, firm and interfirm level. In conjunction with the levels at which networks operate, especially studies examining knowledge processes at the firm and unit level may inform how internal networks influence knowledge integration the corporate and business level.

Third, the current study has strong roots in corporate strategy. In the past years the corporate strategy literature has undergone a shift to the sphere of multibusiness firms managing their set of businesses and units, as well as the interrelationships among them. As part of this transition, works have recently

come to focus on capturing synergies (Brown and Eisenhardt, 1998), on knowledge sharing opportunities, and on recombinations of resources and product market domains (Galunic and Eisenhardt, 1996; 2001) among units through self-organizing processes fostered by a corporate center acting as a facilitator (Goold and Campbell, 2002). This stream of research opposes works signaling corporate headquarters as actively seeking interunit links (e.g. Goold, Campbell and Alexander, 1995; Hill and Hoskisson, 1987; Markides and Willliamson, 1996). In other words, the corporate strategy literature has included business-level considerations into its domain. Since the study sought for the impact of corporate and business-level elements on knowledge integration, this body of research was deemed relevant for current purposes.

Research examining how internal networks shape knowledge integration has left investigators in the field with a variety of research approaches to be pursued. Ideographic case study research covering dynamics and change is still largely absent but invaluable to uncover causal relationships. Furthermore, nomothetic research approaches are virtually absent, but invaluable to obtain generalizable results. Both approaches are pursued in the present study.

Using the insights gained from the literature review as a conceptual frame of reference, next, case studies at multiple levels of analysis were conducted at Rabobank Group as part of the INNFORM research program (Pettigrew and Fenton, 2000; Pettigrew, Whittington and Conyon, 1995) following an embedded case study research design (Yin, 1984). Apart from seeking corroboration for aspects that appeared crucial in the literature review, new and emerging patterns that have not been described in the literature were sought. Also, since case study research on networks has remained largely cross-sectional, a longitudinal research approach was adopted to uncover causal patterns regarding how firms change organizational elements to alter levels of knowledge integration.

Using the outputs of the case study as input, additionally, two formal questionnaires were developed and administered in order to obtain generalizable results. First, a questionnaire was administered to the Chief Executives of the top 4500 companies in Europe, Japan and the United States as part of the INNFORM program. Next to mapping and describing patterns of change in knowledge integration and the organizational elements shaping it in a wider population of companies, this questionnaire was used to probe hypotheses on how corporate-level elements shape knowledge integration. Second, another questionnaire was administered at Rabobank to uncover the organization of knowledge at a business level of analysis. Using these three sources of data not only contributed to

obtaining both longitudinal and generalizable results of knowledge integration in internal network forms of organizing, but allowed for the triangulation of the data and results (Denzin, 1978). Specifics of the research design appear in detail in Chapter 4.

OVERVIEW

After this introductory chapter, chapters 2 and 3 will follow with a theoretical elaboration on knowledge and networks at multiple levels of analysis. Next is chapter 4, which lays out the research design of the empirical studies conducted as part of the present study. Then, chapters 5 through 8 will present the results of the empirical studies. In chapter 9, the main findings will be discussed and conclusions drawn. Figure 1.3 provides an overview of the current study. Table 1.1 lists the nature of the chapters as well as the levels of analysis involved.

In chapter 2, studies on how networks contribute to the organization of knowledge are reviewed. Discerning social, external and internal networks as three different types of networks that facilitate the integration and organization of knowledge, this chapter provides a theoretical background of the present study. The three network types are juxtaposed, and differences and similarities as to how they influence knowledge integration are considered. Additionally, existing studies of how knowledge integration in the three network types influence performance are reviewed. Finally, underscoring that networking in one context may contribute to networking in another, studies considering networks as knowledge are addressed.

In chapter 3, determinants of knowledge integration characteristic of internal networks are scrutinized and hypotheses are developed around their effects. A distinction is made between corporate-level and business-level determinants. At the corporate level, the individual effects on knowledge integration of the number of organizational levels, the size of corporate headquarters, decentralization, the use of product-based and project–based structures, the number and relatedness of divisions, the use of information technology, and the use of human resource practices are hypothesized. Since forms of organizing are systemic entities, the effect on knowledge integration of complementarities between these elements are examined as well as their performance implications. At the business level, hypotheses are developed as to how a firm's knowledge flow configuration, a variable that differentiates internal network forms of organizing from other organization forms, influence depth and breadth of absorptive capacity, and how these dimensions of absorptive capacity relate to exploration and exploitation.

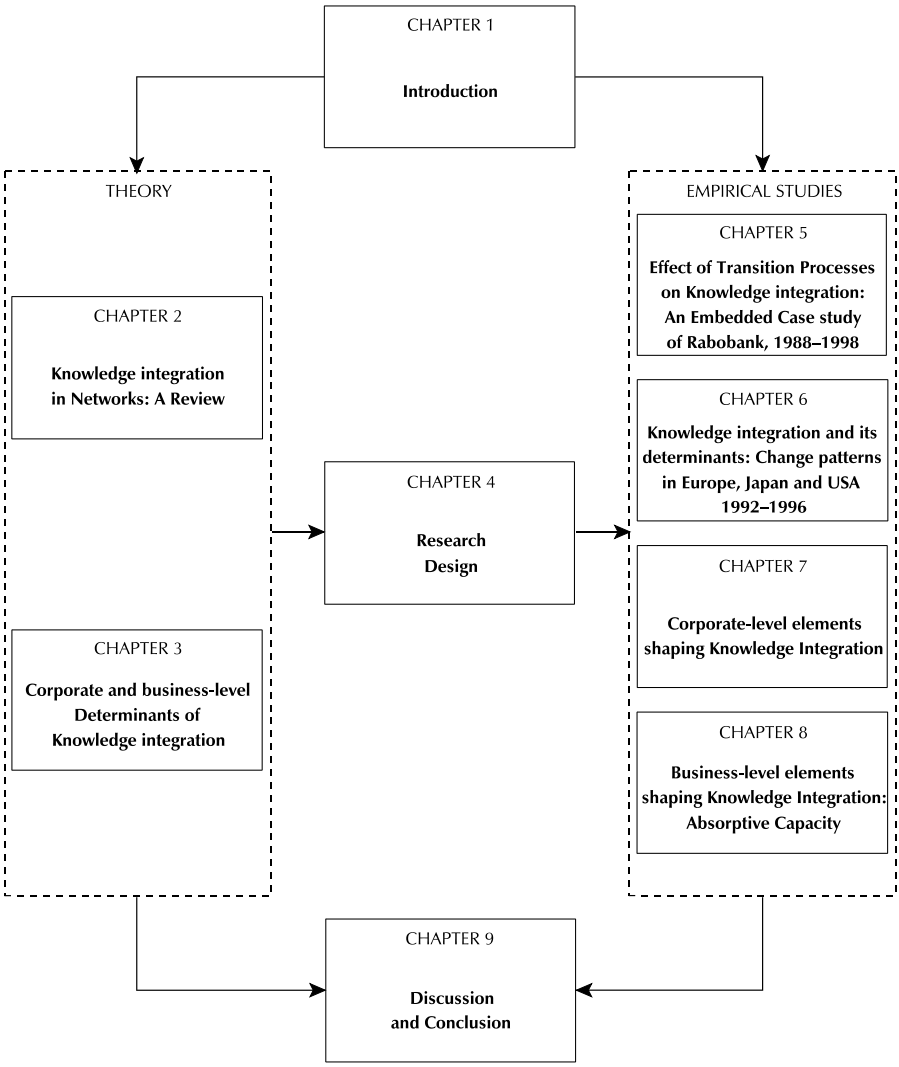


Figure 1.3: Overview of study

Chapter 4 lays out the multi-method, multi-level research design of the present study, which consists of four substudies, one of which is qualitative and remainder of which are quantitative. The qualitative study concerns an embedded case study analyzing the transition process of Rabobank and its effect on

knowledge integration and organization at the corporate and the business level. The quantitative studies concern two questionnaires that also spanned the corporate and business levels of analysis. First, a questionnaire was administered to the CEOs of the top 4500 companies in Europe, Japan and the United States as part of the international research program INNFORM. This questionnaire was used to uncover the determinants of knowledge integration at the corporate level. Second, a questionnaire administered at Spectrum, a facilitatory business unit of Rabobank, was used to uncover at the business level how absorptive capacity is influenced by and facilitates knowledge integration. This chapter concludes by elaborating on how these different methods and data sources allowed for the triangulation of the data.

Chapter	Nature	Content	Levels of analysis
Chapter 1	Introductory		
Chapter 2	Conceptual	Theoretical background	Knowledge integration at unit, firm and interfirm level Networks at social, external and internal level
Chapter 3	Conceptual	Development of hypotheses	Corporate level Business level
Chapter 4	Methodological	Research design	
Chapter 5	Empirical	Qualitative case study	Corporate level Business level
Chapter 6	Empirical	Quantitative (descriptive)	Corporate level
Chapter 7	Empirical	Quantitative (regression)	Corporate level
Chapter 8	Empirical	Quantitative (structural equation model)	Business level
Chapter 9	Discussion and conlusion		

Table 1.1: Nature and levels of analysis of chapters

The embedded case study conducted at Rabobank Group is reported in chapter 5. It illustrates at three levels of analysis how Rabobank and its different parts changed into a network form of organizing so as to influence knowledge integration and organization. Considering the corporate level, the study of Rabobank Group heeds different parts of Rabobank changing at different paces

into different structures, resulting in bipolarities in structure. Addressing the business level, the study of the network of local member banks illustrates in greater detail the problems and difficulties in influencing knowledge integration that may arise when a firm moves towards an internal network form of organizing. Heeding the business level also, the study at Spectrum shows that change into and operating as an internal network is fraught with complications in influencing knowledge integration arising from times of progression and regression.

Using results from the questionnaire that was administered as part of the INNFORM research program, in chapter 6, changes in knowledge integration and organization as well as corporate-level elements shaping it in Europe, Japan and the United States in the period 1992/3–1996/7 are mapped and described as a preliminary test of the hypotheses postulated in chapter 3. Attention is paid to changes in structural elements, such as product-based structures, project-based structures, decentralization and the degree of diversification, and processual elements, such as information technology and human resource practices. The results show that Japanese firms have followed an incremental change pattern, while European and US firms have changed more radically.

In chapter 7, the hypotheses regarding corporate level determinants of knowledge integration are tested. Using data obtained from the Continental European sample of the INNFORM questionnaire, hypotheses are probed as to how product-based and project-based structures, decentralization, diversification, information technology, and human resource practices, as well as complementarities between these determinants influence knowledge integration. The results indicate that firms that adopt determinants that individually decrease knowledge integration, such as hierarchy and product-based structures, together with determinants that individually increase knowledge integration, were able to increase knowledge integration even more. Furthermore, it appears that firms that had such complementarities in place had higher financial performance.

In chapter 8, hypotheses on the role of knowledge transfers in establishing absorptive capacity, and the role of absorptive capacity in establishing the level of exploration over exploitation are tested. The data used for this test was obtained through the questionnaire administered at the Rabobank business unit Spectrum. In that vein, chapter 8 illustrates the effect of business-level determinants on the integration of knowledge, and how that affected performance in terms of exploration and exploitation. From the results it is deduced that internal networks through their configuration of knowledge flows influence both breadth and depth of absorptive capacity, and so balance out exploitation and

exploration, indicating that internal networks create interdependencies between creating and using absorptive capacity.

In chapter 9, the results of the study are discussed. The main findings of each of the four empirical studies reported in chapters 5 through 8 are summarized and consolidated. Then, the limitations of the study are discussed and research directions for future inquiries into knowledge integration and organization in internal networks are suggested. Finally, main conclusions are drawn on how internal network forms of organizing influence knowledge integration and organization.

CHAPTER 2

Knowledge and Networks

A Review

The increasing significance of knowledge and networks for a firm's competitive position and survival has yielded two growing sets of studies examining the complexities of both phenomena. Since firms have embarked on establishing networks to facilitate the organization of knowledge, both literatures have recently also started to converge. With scholars addressing various levels and units of analysis while focusing on a variety of key variables and parameters, the literature is, however, still diverse and fragmented. Although this has resulted in a large number of determinants of knowledge integration in networks being examined, studies have reported mixed results as to their effects and performance implications.

Indicative of the lack of focus in the literature on networks and knowledge is that the term 'network' is used inconsistently. It suffers from semantic ambiguity, and has become an evocative metaphor ascribed to many collaborative ventures and relationships (Baker, 1992; Jones, Hesterly and Borgatti, 1997; Nohria, 1992; Parkhe, 1993; Quinn, Anderson and Finkelstein, 1996; Salancik, 1995). The inconsistency in the use of the network concept has two main, mutually related causes.[1] First, networks have advanced both as a governance mode adopted by organizations and as an analytical tool employed by researchers (Nohria, 1992; Powell and Smith-Doerr, 1994; Salancik, 1995). Second, the manifestation of knowledge processes in networks has been examined at multiple levels of analysis. The inconsistency these two issues have caused in the use of the term network are reflected in studies emerging on three types of networks: social, external and internal networks. Each of these network types constitutes a different perspective.

Inquiries of *social networks* take every organization, irrespective of governance mode or organization form, as a social system with a purpose, operating in a social

structure (Stinchcombe, 1965). Research under this banner builds on the foundation that organizations are differentiated by the network characteristics of the social relations within and between them (Nohria, 1992; Tichy, Tushman and Fombrun, 1979), providing scholars an *analytical tool* in which 'network' is a construct created by the investigator. From this viewpoint, research has recently focused on understanding how social networks promote knowledge transfer and integration among actors.

Whereas social networks have been used mainly as an analytical tool, *external and internal networks* have advanced as *modes of governance*. In studies dissecting knowledge processes and learning in external or interorganizational networks, networks are considered discrete governance modes interjacent to arm's-length market contracting and firm integration, such as joint ventures and strategic alliances. These hybrid forms allow firms to gain access to new knowledge and learn from partner firms, as well as to pool knowledge together (Powell, 1990). Additionally, studies have emerged of how internal or intraorganizational networks, as a form of organizing alternative to, for example, functional and multidivisional organization forms, foster internal knowledge transfer and integration (Hedlund, 1994).

In this chapter, research on networks and knowledge is reviewed. The review provides a theoretical background of knowledge integration not only in internal networks, but in external and social networks as well. It examines how the various types of networks operate and discerns their main parameters, so as to understand how determinants in each type of network influence knowledge integration, and how they influence performance. Although the focus of the present study is on internal networks, studies on external networks and social networks may provide valuable insights as to how knowledge is integrated in internal network forms of organizing. Although the three network types operate at different levels, networking processes and therefore determinants and performance implications of knowledge integration may be similar across them. By juxtaposing the main parameters of knowledge integration in social, external and internal networks, this chapter seeks to discern determinants of knowledge integration in internal network forms of organizing, and serves as the background for developing hypotheses around their effects in the next chapter.

The chapter proceeds as follows. Next, a historical account of research into both knowledge and networks is provided. Then, social, external and internal networks are discerned as three different types of networks. The main parameters that characterize each type of network are presented. In addition, the ways in

which the three network types supplement one another in influencing knowledge integration are also considered. In the next section, major findings on the performance implications of networks, knowledge, and knowledge in networks are reviewed. Then, research considering networks as knowledge is addressed. Finally, conclusions from the review are drawn, which will serve as the input to the following chapter on the determinants of knowledge organization.

THE ORIGINS OF KNOWLEDGE AND NETWORK RESEARCH

The study of knowledge and networks in the management field traces its origins back to the fifties and sixties, with seminal sociological and economic contributions such as those of Cangelosi and Dill (1965) on organizational learning, of Penrose (1959) on the role of knowledge in the growth of the firm, and of Evan (1965) on organization-sets. Strongly establishing themselves as individual streams of inquiry, over the years, these research streams have made major advancements. Research in which knowledge and networks are examined conjointly, on the other hand, has gained momentum predominantly during the past decade or so, since firms have been establishing the latter largely to gain access to and facilitate the organization of the former.

The study of networks has strong roots in the sociological and anthropological sciences. Studies of networks that were among the first to appear focused on sociological issues, notably issues of on power and politics associated with managers occupying executive positions in multiple firms and with executives moving between firms (Benson, 1975; Mills, 1956). Seminal to the study of networks in the management field was Evan's (1965) paper on organization-sets, which considered explicitly the ties of an organization with other organizations in its environment, moving the level of analysis from the intraorganizational to the interorganizational level.

While these studies provided the basis for research into interlocking directorates (e.g. Mizruchi, 1982; Pennings, 1980; Useem, 1984) and joint ventures (e.g. Franko, 1973; Pfeffer and Nowak, 1976), they also were at the root of the application of social network analysis in the study of business (e.g. Tichy, Tushman and Fombrun, 1979). Social network analysis provided management scholars a tool that could be used to examine relations and interactions between actors, such as individuals, groups of individuals and firms (e.g. Burt, 1982; Laumann and Pappi, 1976; Marsden, 1990; Nohria, 1992; Nohria and Eccles, 1992; Tichy, 1981; Wasserman and Faust, 1994).

Rooted in the field of economics, research on external or interorganizational

networks as governance modes started to progress extensively in the seventies and eighties. Adopting the notion that repeated non-contractual ties could substitute for contractual ones resulting from research in the sociological sciences (Macaulay, 1962), in institutional economics the market-hierarchy dichotomy that emerged out of transaction cost theorizing (Coase, 1937; Williamson, 1975) was extended with intermediate governance modes, such as quasi-integration (Blois, 1972), clans (Ouchi, 1980) and relational contracting (Williamson, 1985), rendering the dichotomy a continuum. The rise of Japan and its 'Alliance Capitalism', characterized by groups of firms collaborating in business groups, called *zaibatsu*'s before and *keiretsu*'s after the Second World War (Dyer, 1996a; Gerlach, 1992), offered a prominent example where the market-hierarchy dichotomy has been less than satisfactory to understand boundary choice. Japanese subcontracting illustrated the advantages that could be obtained by interfirm collaboration. In the management field, these developments led to research focusing on alliances, joint ventures, consortia and similar interorganizational collaborations that firms formed with other firms. In addition to partner choice, scholars concentrated particularly on the antecedents of actuating interfirm collaborations and the advantages that can be gained by them. In that vein, research has focused on how external networks allow firms to minimize transaction costs (Williamson, 1975; 1985) or maximize transaction value (Zajac and Olson, 1993), by reducing risk, achieving economies of scale, obtaining access to complementary resources and technologies, co-opting or blocking competitors, overcoming trade barriers, and obtaining initial international presence (e.g. Contractor and Lorange, 1988; Doz and Hamel, 1998; Hagedoorn, 1993; Hamel, Doz and Prahalad, 1989; Harrigan, 1986; Jarillo, 1988; Kogut, 1988; Pucik, 1991; Teece, 1986).

Over about the same time period, as a separate stream of inquiry, studies were conducted on how organizational learning fostered adaptation. One body of research under this banner involved a behavioral perspective on learning and, following Cyert and March (1963) and March and Simon (1958), centered on how learning, expectations and aspirations interrelate in organizational decision-making (Cangelosi and Dill, 1965; Levitt and March, 1988; March and Olsen, 1976). A second body of research focused on the cognitive perspective and moved beyond individual cognition and learning, recognizing that organizations are cognitive enterprises themselves in which learning is socially constructed and relies on consensus (e.g. Argyris and Schön, 1978; Daft and Weick, 1984; Fiol and Lyles, 1985; Hedberg, 1981). In the late eighties and early nineties, mainly under

the influence of the resource-based view (Barney, 1991; Wernerfelt, 1984) and evolutionary theories (Nelson and Winter, 1982), researchers shifted the emphasis to organizational knowledge as a strategic resource of a firm (Grant, 1996a; Itami, 1987; Lyles and Schwenk, 1992; Winter, 1987). Processes of organizational knowledge were dealt with in studies of, for example, organizational knowledge creation (Nonaka, 1994; Nonaka and Takeuchi, 1995), knowledge integration (Grant, 1996a), knowledge replication (Kogut and Zander, 1992) and knowledge transfer (Szulanski, 1996).

Resource procurement has long been a rationale for firms to enter into alliances. Only recently, with the emerging significance of knowledge to competition, this resource has become knowledge (e.g. Badaracco, 1991; Hamel, 1991; Lyles, 1988). Moreover, with Western firms trying to copy the successes Japanese companies had with this governance mode, firms listed on Fortune's global top 500 had on average 24 joint ventures over the period 1978–1992 (Nohria, 1996). Therefore, rather than considering single collaborations, studies converged on the networks of collaborations firms had in operation. In research, this led to the wide-spread recognition of networks as a discrete governance mode in between markets and hierarchies (Powell, 1990). Subsequently, many studies appeared in which the benefits of maintaining and organizing networks of multiple alliances and joint ventures were examined (Baum and Oliver, 1992; Baum, Calabrese and Silverman, 2000; Gomes-Casseres, 1994; Mitchell and Singh, 1996; Singh and Mitchell, 1996; Singh, 1997; Stuart, 2000).

When firms enter into external networks, however, internal organization remains unimpaired and prevents firms from deploying knowledge acquired externally as ambitiously internally (Ghoshal and Bartlett, 1995; 1997). This has triggered the emergence of an alternate corporate model that, alongside a large reliance on external networks, relies on intraorganizational or internal networks to chisel knowledge integration and organization inside a firm's boundaries. Research on this corporate model has developed most notably in the field of International Business. At first, research focused on technology transfer (Mansfield et al., 1982; Teece, 1977; 1981) and information processing approaches to understand the functioning of MNCs (Egelhoff, 1982; 1991). Later this developed into studies identifying that MNCs have an advantage in transferring local knowledge globally and should be viewed as networks (Bartlett and Ghoshal, 1989; Hedlund, 1986; Malnight, 1995; 1996; Nohria and Ghoshal, 1997). Since the focus of this research strain is on internal organization, studies of MNCs have been linked to and used by studies on organization form. In this field of study,

information processing approaches were used to understand, for example, the advantages and limitations of the functional U-form and multidivisional M-form, and led to the identification of the matrix organization as a viable organization form in information-rich environments (Galbraith, 1973; Tushman and Nadler, 1978). These studies were followed in the nineties by studies on internal networks or N-form corporations (e.g. Hedlund, 1994; 1996; Nohria, 1996), to gain insight into how organization form could contribute to knowledge transfer and integration. Because these internal networks were distinct from more traditional organization forms, these studies revitalized a wide variety of studies on organizational elements, such as the Aston studies (Pugh et al., 1968; 1969), the Chicago studies (Hall, 1966), and the studies of Blau and Scott (1962).

Inspired by the view that economic action is embedded in a social structure in which social relations between actors influence outcomes (Granovetter, 1985), most recently, research into social networks has revived with studies investigating how social relations facilitate the formation and development of external networks (e.g. Ahuja, 2000a; 2000b; Dyer and Singh, 1998; Gulati, 1995a; 1995b; 1998; 1999; Koka and Prescott, 2002; Powell, Koput and Smith-Doerr, 1996). With that, scholars moved beyond examining exogenous determinants that characterized research into external networks in the eighties to studying endogenous aspects of forming external networks. Apart perhaps from Nahapiet and Ghoshal's (1998) conceptual work, which has strong application in the study of internal networks, studies of this development in internal networks are still lacking. Some preliminary studies have been conducted on how social networks preceded the establishment of formal intraorganizational linkages between departments and units (Tsai, 2000; 2001; 2002), and how social networks facilitate the transfer and sharing of knowledge (Hansen, 1999; 2002). But these studies were not performed explicitly in the context of an internal network as a governance mode, nor in the context of a firm changing towards such a mode of organizing.

KNOWLEDGE IN NETWORKS

The study of how networks foster the management and organization of knowledge centers around three network types: social networks, external networks and internal networks. The origins of the three banners under which research into knowledge and networks has developed, as well as their applications, contributions to knowledge research, main parameters and performance implications are listed in Table 2.1.

Table 2.1: Three network perspectives

	Social Networks	External Networks	Internal Networks
Origin	Sociology and Anthropology	Economics, mainly Socio-economics and Institutional economics	Management, mainly International Business
Application	Network as an analytical tool to examine social relations and ties between individuals and organizations	Network as a governance mode intermediating markets and hierarchies	Network as a form of organizing alternative to multidivisional and functional organizations
Relation to study of knowledge	- Provide timely access to knowledge and information about potential partners, either directly or indirectly through referrals - Vehicle to transfer knowledge directly	- Internalization of external knowledge - Combination of complementary knowledge bases	- Increase internal knowledge transfer so as to foster internal knowledge integration and organization
Main parameters	- Structural, relational and positional embeddedness - Tie strength - Trust	- Learning races - Competition - Governance structure	- Organization structure - Organization processes
Performance consequences	- Increased innovation - Increased value creation - Increased financial performance	- Increased innovation - Increased product development - Increased financial performance	- Increased innovation - Increased product development - Increased financial performance
Key studies	Ahuja (2000a; 2000b); Dyer and Singh (1998); Gulati (1995a; 1995b; 1998; 1999); Gulati and Gargiulo (1999); Hansen (1999; 2002); Kale, Singh and Perlmutter (2000); Koka and Prescott (2002); Nahapiet and Ghoshal (1998); Powell, Koput and Smith-Doerr (1996); Tsai (2000; 2001; 2002); Tsai and Ghoshal (1998)	Badaracco (1991); Doz and Hamel (1998); Dyer (1996a; 1996b; 1997); Dyer and Nobeoka (2000); Hamel (1991); Inkpen (1995); Inkpen and Crossan (1995); Inkpen and Dinur (1998); Lyles(1988); Lyles and Salk (1996); Mody (1993); Parkhe (1991); Powell (1990); Pucik (1991); Steensma and Lyles (2000); Teece (1992; 1998)	Ghoshal and Bartlett (1997); Hedlund (1994; 1996; 1999); Mendelsson and Pillai (1999); Miles and Snow (1994); Miles et al. (1997); Nohria and Ghoshal (1997); Pettigrew and Fenton (2000); Van Wijk and Van den Bosch (1998)

Knowledge in social networks

The study of social networks goes by the notion that 'the structure of any social organization can be thought of as a network' (Nohria and Eccles 1992: 288), and that the actions of network actors are shaped and constrained because of their position and embeddedness in the network (Nohria, 1992). Or, as Lincoln (1982: 26) puts it more eloquently, 'to assert that an organization is not a network is to strip of it that quality in terms of which it is best defined: the pattern of recurring linkages among its parts'. Social network research has emerged in the management field from the economics critique that, like any other actor, firms are far from atomistic agents, but embedded in networks that influence competitive actions (Granovetter, 1985; 1992; Burt, 1992). A social network perspective entails not only that all organizations are social networks, but that an organization's environment is a network of that organization with other organizations. With that, social network analysis provides management scholars a tool to be used to examine relations between actors, such as individuals, groups of individuals, and firms (Burt, 1982; Marsden, 1990; Tichy, Tushman and Fombrun, 1979; Wasserman and Faust, 1994), in which 'network' is essentially a construct created by the investigator. In that vein, social network analysis has been used to examine relations among individuals and units within and across organizations, as well as among organizations in organizational fields (e.g. Amburgey, Dacin and Singh, 1996; Galaskiewicz and Wasserman, 1989; Galaskiewicz and Zaheer, 1999; Uzzi, 1996a), business groups (Gerlach and Lincoln, 1992; Granovetter, 1994), and regions (Grabher, 1993; Saxenian, 1994).

Centering on the ties between actors, the contribution of social network research to the study of knowledge is twofold. First, social network analysis focuses on the content of ties. Tie content may be (1) assets, (2) information, and (3) status (Galaskiewicz, 1979). With the emergence of knowledge as a strategic asset (Grant, 1996a; 1996b; Winter, 1987), much research in social networks has come to center on knowledge transfer through ties. Second, social network studies address the benefits of ties, notably their information benefits. Ties have information benefits that occur in three forms: access, timing and referrals (Burt, 1992). The presence of ties simply denotes that actors have access to parties. Timing allows actors to obtain information sooner than it becomes available to actors without such contacts. Finally, referrals constitute processes through which information on available opportunities is provided to actors by third-party actors in the network. Hence, the information benefits of ties influence network formation, and consequently, opportunities to combine and exchange knowledge

(see also, Dyer and Singh, 1998; Nahapiet and Ghoshal, 1998). Furthermore, network ties may vary as to volume, diversity and richness of information (Koka and Prescott, 2002). The main parameters determining the information benefits and integration of knowledge in social networks, as listed in Table 2.2, are discussed below.

Main parameter	**Relevance to knowledge integration and organization**	
Embeddedness	- Structural:	structure of network in terms of mutual contacts between actors
	- Relational:	the kind of relationships between actors
	- Positional:	information and knowledge transfer and integration benefits accruing from position
Tie strength	- Strong:	facilitate transferring and integrating complex knowledge
	- Weak:	facilitate searching knowledge and transferring and integrating non-complex knowledge
Trust	alternative to price and authority mechanisms in network formation and transferring and integrating knowledge	

Table 2.2: Main parameters of social networks

Main parameters. Social network analysis describes the network of ties by considering actors' structural and relational embeddedness in the network (Granovetter, 1992). Relating to network density, network cohesion, and with that, the extent to which networks are open or closed, structural embeddedness refers to the structure of the network an actor finds itself in terms of mutual contacts to one another. Relational embeddedness indicates the kind of relationships actors have developed, and is associated with tie strength or intensity (Gnyawali and Madhavan, 2001; Nahapiet and Ghoshal, 1998; Rowley, Behrens and Krackhardt, 2000). In a study on the origins of interorganizational networks, Gulati and Gargiulo (1999) added to these two dimensions an actor's positional embeddedness, which provides information about the information benefits of the ties and network itself. In effect, these dimensions of embeddedness contribute to the volume, diversity and richness of information and knowledge transferred. Volume is mainly determined by the number of partners and ties. Diversity is dependent on the diversity of partners in terms of technological background and country. Richness is increased by repeated ties.

On the basis of these types of embeddedness, two views have emerged on how knowledge and information flow through a network (Burt, 1987; 1997; 2000;

Gargiulo and Benassi, 2000; Hite and Hesterly, 2001; Uzzi, 1996b; 1997; Walker, Kogut and Shan, 1997). The first view, *structural hole theory* (Figure 2.1a), stresses that the information benefits accruing to an actor are highest when that actor is central to the network and has a key role in linking multiple smaller actor networks between which no direct links exist. In other words, every piece of information and knowledge must go through the central actor if it travels from one network to the other, making the central actor structurally autonomous (Burt, 1992). Structural hole theory views the network as an opportunity for entrepreneurs to exploit by seeking partners that are unique or non-redundant and bring new information to be used in, for example, negotiating. Structural hole theory thus concerns the brokering of knowledge and information flows.

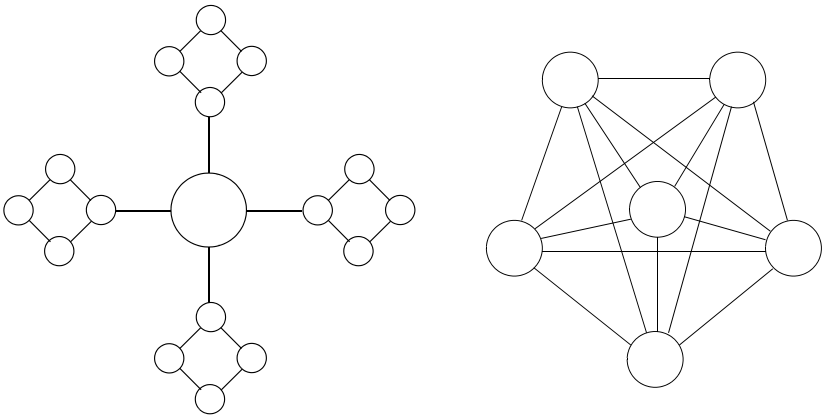


Figure 2.1: Structural hole perspective vs. social capital perspective on social networks

The second view, *social capital theory* (Figure 2.1b), maintains that actors should be linked as much as possible, so as to increase their social capital, which is defined as the set of social resources embedded in relationships. Actors in such

a dense network enjoy information benefits since many actors in such a network share the same direct and indirect ties, and are therefore structurally equivalent. Thus, social capital theory stresses that the network is reproduced due to its value in preserving the social capital of an individual. Nahapiet and Ghoshal (1998: 250) argue that 'social capital facilitates the development of intellectual capital by affecting the conditions necessary for exchange and combination [of knowledge] to occur'. In a social network like this, social capital can act as a resource, but also as a constraint in enforcing norms and values among network members (Coleman, 1988).

Corroborating Uzzi's (1997) 'paradox of embeddedness', Gargiulo and Benassi (2000) found that actors positioned in structural holes were better able to adapt to environmental changes, and that the network closure produced by cohesive ties fostered stability. Walker, Kogut and Shan (1997) argue that structural hole theory best applies to networks of market transactions, while social capital theories best suits networks of cooperative relationships. This is echoed in Hite and Hesterly's (2001) study, who found that in the early growth stages of firms networks are likely to be dense, closed and socially embedded. In later growth stages, firms are likely to exploit structural holes in a balance of embedded, arm's-length relations. Using Granovetter's (1973) distinction between weak ties, which are distant and infrequent, and strong ties, which are close and frequent, in a study of regional network development in the German Ruhr area, Grabher (1993) found that strong ties may lead to functional, cognitive and political lock-ins. A similar detrimental effect of strong ties has been argued by Lyles and Schwenk (1992), asserting that a loosely coupled knowledge structure (cf. Orton and Weick, 1990) fosters adaptation. Conversely, the studies of Ahuja (2000a), Kraatz (1998), and Walker, Kogut and Shan (1997) found support that cohesive and strong ties, which are information-rich, fostered adaptiveness by increasing innovation. In other words, network structures that yield social capital in one situations may become a liability in other situations (Hansen, Podolny, and Pfeffer, 2001).

Hansen (1999) concluded that cohesive ties are less likely to allow firms to adapt to changes in coordination requirements. Strong ties require increased resources to maintain and are prone to network inertia, where nodes in the network stay within their network. In a study of interunit knowledge transfer, he found that a trade-off exists in the use of ties when searching for relevant knowledge and transferring knowledge. This search-transfer problem indicates that weak ties are most effective for searching knowledge and transferring non-complex, easy-to-codify knowledge, but that strong ties characterized, by close

interaction and communication, are necessary for transferring complex, difficult-to-codify knowledge. Strong ties allow an actor to increase the volume, diversity and richness of knowledge to be transferred (Koka and Prescott, 2002). In a later study, Hansen (2002) also found that projects that are dependent on the exchange of knowledge before they can be completed have a shorter completion time when the ties of a network are short, and when the number of direct relations increases in case the knowledge to be transferred is non-codified. When the knowledge to be transferred is codified, the number of direct relations was found to be less important. Complexity of knowledge is thus an important moderator in the decision of optimal linkages (see also, Nonaka and Takeuchi, 1995; Winter, 1987; Zander and Kogut, 1995).

Complex knowledge, however, is a strong contributor of the novelty of innovation, and thus adaptation (cf. Galunic and Rodan, 1998). Using a social capital perspective, which emphasizes cohesion of ties, Tsai and Ghoshal (1998) found that social capital contributes to value creation, as measured by product development performance. Following Nahapiet and Ghoshal (1998), they identified three dimensions of social capital: (1) structural social capital, (2) relational social capital and (3) cognitive social capital. Structural social capital emerges from structural embeddedness, while relational social capital emerges from relational embeddedness. The cognitive dimension of social capital is embodied in shared codes and paradigms that facilitates common understanding of collective goals and proper conduct in the system of relations. Tsai and Ghoshal (1998) found that both structural and cognitive social capital contributed to relational social capital, which in turn increased knowledge and resource combinations, and value creation.

Similar to Stuart's (1998) finding that technological relatedness contributed to alliance formation, Tsai (2000) found that relatedness of resources and knowledge contributes to intraorganizational linkage formation. From an opposite viewpoint, technological distance between network partners has been found to relate negatively to innovation (Ahuja, 2000b). These findings suggest that absorptive capacity is important in network relations. Szulanski (1996) found that lack of absorptive capacity with the recipient of knowledge was the most important barrier in intrafirm transfers of best practices. Absorptive capacity is built on prior knowledge endowments: the more knowledge a firm possesses in a certain knowledge domain, the easier it is to learn new things in that domain (Cohen and Levinthal, 1990). When the knowledge stocks of actors in a network overlap, learning and knowledge transfer are fostered. In a similar vein,

Cummings and Teng (2003) found a negative relationship between knowledge transfer and knowledge distance. At the dyad level, the capacity to absorb knowledge from one partner is different from capacity to absorb knowledge from another partner, because the relevant knowledge bases of actors differ (Inkpen and Crossan, 1995; Dyer and Singh, 1998; Lane and Lubatkin, 1998). In that vein, Kumar and Nti (1998) suggested that firms leverage absorptive capacity so that knowledge absorbed from one partner may increase the ability to absorb knowledge from another partner. Similarly, the findings of Liebeskind et al. (1996) suggest that social networks in which actors maintain many ties increase the scope of learning and knowledge transfer.

Relatedness of units and divisions may also inhibit effective knowledge sharing, since related units may be competing for scarce resources, may serve similar markets, or their rewards and status may depend on their performance relative to the performance of other units. Introducing variables from the organizational form literature, Tsai (2002) found that, next to the inhibiting role of centralization and the supportive role of social interaction in knowledge transfer, social interaction facilitates the transfer of knowledge between units that are competing with each other. Social interaction allows competing units to communicate with each other and know each other, so that possible behaviors are better predicted and trust can be developed.

Trust has been a central concern in social network studies of how firms obtain information about the competencies, needs and reliabilities of potential partners in alliances (Gulati, 1995a, 1995b; Gulati and Gargiulo, 1999). Earlier studies found that personal ties between members of different organizations are important to the creation of new alliances (Ring and Van de Ven, 1992; 1994; Doz, 1996). Doz, Olk and Ring (2000) studied two types of alliance formation processes: emergent and engineered processes. The existence of personal ties was found crucial in engineered processes, because in these alliance formation processes a triggering entity exists which actively recruits new partners. Emergent network formation processes develop when changes in the environment take place and trigger shared views and interests in an alliance among the partners involved.

The possibility surfaces that information is imperfect, which raises search costs. Reliable information may be difficult to obtain before the alliance is initiated, and thus faces concerns of moral hazard and opportunistic behavior. One way firms can overcome the possibility of opportunism to occur and obtain reliable information is by considering the reputation of partners. As Granovetter (1985: 490) argues, individuals have 'widespread preference for transacting with

individuals of known reputation'. Reputation may be established by a track record in innovating. In a longitudinal study of firms in the semiconductor industry, Stuart (1998) found that the alliance opportunity sets of prestigious organizations and organizations in crowded positions were highest. Organizations with crowded network positions are those that participate in networks in technological segments in which many firms actively innovate. Prestigious organization are those organizations that have a track record of producing innovations that turn out to be dominant designs. A similar result was found by Ahuja (2000a), whose study indicates that linkage formation in networks is dependent on the technical, commercial and social capital of the actors in the network, and the occurrence of a major invention or breakthrough.

Another source of reputation is that actors are trustworthy. As such, trust is found important to network formation and maintenance: trust enables network formation, it preserves the network through repeated ties, and repeated ties contribute, in turn, to the development of trust (Gulati, 1995a). Adler (2001) argues that the price mechanism of markets and the authority mechanism of hierarchies suffices to govern coordination in firms demanding efficiency. However, in knowledge-intensive firms, where the premium is on innovation, trust is fundamental to transfer and integrate knowledge both internally between units and externally between firms. Trust, as the alternative (Bradach and Eccles, 1989; Ouchi, 1980) or supplement (Adler, 2001) to market prices and hierarchical control , is, therefore, also considered crucial in external networks.

Knowledge in external networks

External network research focuses on network organization as a governance mode interjacent to market organization and firm organization, extending the make-or-buy decision with the decision to cooperate (Powell, 1987; 1990; Williamson, 1975; 1985). Research in this tradition focuses on the networks that firms maintain in the shape of joint ventures and strategic alliances.

From a knowledge perspective, external networks are initiated (1) to gain access to new knowledge and acquire and internalize that knowledge, and (2) to pool complementary, co-specialized knowledge together (Badaracco, 1991; Hamel, 1991; Inkpen, 1995; Inkpen and Crossan, 1995; Inkpen and Dinur, 1998; Shenkar and Li, 1999; see Table 2.1). Knowledge and product domains of a firm may not overlap, preventing firms to develop new products. Such inconsistencies trigger firms to look outside for knowledge and internalize it through alliances (Grant and Baden-Fuller, 1995). Firms may also have knowledge bases that are

complementary or cospecialized, in such a way that innovation can only occur when those complementary knowledge bases are brought together in separate entity, such as a joint venture (Dyer, 1997; Larsson et al., 1998; Shenkar and Li, 1999; Teece, 1986). When built on relation-specific assets and knowledge sharing routines, idiosyncratic interfirm linkages may emerge that allow firms to combine knowledge and other resources in unique ways, and lead to the generation of relational rents (Dyer and Singh, 1998). The ground for networks of alliances and joint ventures emerging is that a diverse set of cooperations provides a firm access to a broader knowledge base, which it potentially can tap into (Mitchell and Singh, 1996). For example, exemplar to Japanese 'Alliance Capitalism' (Gerlach, 1992), Toyota and its suppliers cooperate in a diverse network to learn from each other and about new industry trends. The main parameters of knowledge integration in external networks, as listed in Table 2.3, are discussed in the next section.

Main parameter	Relevance to knowledge integration and organization
Learning races	Races between partnering firms trying to outlearn and integrate more knowledge obtained from the other
Competition	Competitive forces between actors may entail ulterior motives and prevent effective knowledge integration
Governance mode	Different situations of interorganizational knowledge integration require different modes of governance to effectuate knowledge integration

Table 2.3: Main parameters of external networks

Main parameters. Accounts have emerged that the Japanese are more successful in reaping the benefits from external networks than, for example, US firms, partly because of their history in external networks. On the basis of case studies of 11 firms, Hamel (1991) portrayed the US-Japanese situation as US companies believing they are 'masters' and Japanese companies behaving as 'students', but by acting as 'students' they proved to be the 'masters' in reaping benefits from external networks. However, two studies have disconfirmed this. In their study covering the entire set of US-Japanese alliances in operation since 1980, Hennart, Roehl and Zietlow (1999) found no support for Hamel's (1991) thesis that Japanese firms are better learners than their US partners. Adopting the thesis that such learning race behavior would be reflected in changes in the equity stakes by the Japanese, they found that this was not the case. Similarly, Mowery,

Oxley and Silverman (1996) found no evidence that Japanese firms were better learners in strategic alliances.

Alliance duration is one indicator of alliance success, but if the purpose of an alliance is internalizing the partner's knowledge, longevity may not be the right indicator (Hamel, 1991). Learning in external networks is fraught with competitive motivations (Gnyawali and Madhavan, 2001). Mowery, Oxley and Silverman (1996) found that knowledge transfers between network partners would be higher when they share a common knowledge base, as this increased the capacity to absorb knowledge (see also, Lane and Lubatkin, 1998). However, they also found that competition moderates this relationship, since firms operating in industries with the same primary SIC tended to transfer less knowledge among each other.

Competition may also result in learning races. Learning races do contribute to the extent to which firms can reap private benefits from an alliance. Khanna, Gulati and Nohria (1998) and Khanna (1998) have argued that learning races and the ability to internalize knowledge is dependent on the relative scope of the partnering firms and the alliance. The more the scope of the alliance overlaps with the scope of the firms involved, the more common benefits would accrue to both firms. Overlap in scope increases overlap in knowledge bases, and thus increases relative absorptive capacity (Lane and Lubatkin, 1998; Kumar and Nti, 1998), allowing both firms to internalize knowledge. When the scope does not overlap, private benefits would accrue to the partnering firm, since knowledge outside the scope of the alliance has only use to the focal firm.

Hamel (1991) found that learning outcomes were dependent on the intent of a firm, the transparencies of the partners, and the receptivities of the partners. Intent refers to the initial propensity of firms to learn through their collaborations. Transparency refers to the openness of each partner. Receptivity denotes the capacity to learn, and closely relates to absorptive capacity (Cohen and Levinthal, 1990; Lane and Lubatkin, 1998). From this perspective, private benefits accruing to a firm would be high when that firm's intent is high, whereas the partner's is low; when the transparency of that firm is low, whereas the partner's is high; and when the focal firm's receptivity is high, and the partner's is low.

In a study covering the alliances of 147 MNCs, Simonin (1999) found that ambiguity has a significant negative impact on knowledge transfer. He also found that the level of ambiguity is positively related the tacitness of knowledge (see also, Hansen, 1999), and complexity as to the interrelatedness of technologies, routines, individuals and resources. Cultural and organizational distance between partner firms was found to increase the ambiguity associated with interpartner

learning (see also, Szulanski, 1996). Simonin also found that higher levels of previous experience with the knowledge were negatively associated with ambiguity. As mentioned, higher levels of prior knowledge increases absorptive capacity.

Further, Simonin (1999) found that the effects of tacitness and ambiguity were independent of alliance duration, but that the effects of complexity and experience disappeared for older alliances and that the effect of cultural and organizational distance disappeared for younger alliances. Partners in older alliances may be more adapted to each other so that complexity and lack of previous experience are less problematic to knowledge transfer. Partners in older alliances may also have developed partner-specific collaborative knowledge (cf. Dyer and Singh, 1998; Kumar and Nti, 1998) that enables them to overcome issues of complexity and lack of previous experience. Simonin showed that collaborative knowledge contributed to knowledge transfer in alliances, but did not examine the independent effects of collaborative knowledge and alliance duration. Partners in younger alliances may be subject to a cultural adjustment curve that was seen by the partners as necessary to overcome before the alliance was initiated.

Distinct interdependencies and complexities inherent in tasks lead to coordination costs in external networks (Gulati and Singh, 1998). External networks are essentially incomplete contracts with the risk of opportunistic behavior and knowledge leakage emerging (Baum, Calabrese and Silverman, 2000). Therefore, firms use different governance structures for their alliances (Grandori and Soda, 1995), which are differentiated by the amount of hierarchical controls (Dyer and Singh, 1998). When appropriation or opportunistic behavior is an issue, firms were found to use joint ventures and other equity-based arrangements as the interorganizational governance mode (Balakrishnan and Koza, 1993; Baum, Calabrese and Silverman, 2000). Dyer and Singh (1998) argue that effective governance can also occur through third-party enforcement or self-enforcement, either formally through hostages (Williamson, 1985) or informally through trust and reputation (Granovetter, 1985; Gulati, 1995b). For example, Kale, Singh and Perlmutter (2000) found that the development relational capital based on mutual trust creates a basis for knowledge transfer, and restricts opportunistic behavior. Thus, as in studies of social networks, as an alternative to the price mechanism of markets and the authority or control mechanism of hierarchies, norm-based coordination in which trust plays a central role was found crucial in external networks (Bradach and Eccles, 1989).

Knowledge in internal networks

Being the first strain of research on networks that originated in the management field, internal network research centers on network organization as a form of organizing alternative to, for example, functional and multidivisional organization forms (Hedlund, 1994; Nohria and Ghoshal, 1997). When firms enter into external networks, little or no change takes place as to internal organization. Hierarchical logics and routines of organizing, such as those of the functional and multidivisional organization (Chandler, 1962; Williamson, 1975), remain unimpaired and prevent firms from deploying knowledge acquired externally as ambitiously internally (Ghoshal and Bartlett, 1997).

Since 'knowledge is a resource that is difficult to accumulate at the corporate level ... [and] those with the specialized knowledge and expertise most vital to the company's competitiveness are usually located far away from the corporate headquarters' (Bartlett and Ghoshal, 1993: 32), these developments have triggered the emergence of an alternate corporate model. This model marks 'the selective infusion of market mechanisms into hierarchy and hierarchy into markets' (Zenger and Hesterly, 1997: 210). That is to say, alongside a large reliance on external networks, this corporate model relies on intraorganizational or internal networks to foster knowledge creation and integration inside a firm's boundaries.

Research on this corporate model has developed most notably in the field of International Business to understand how MNCs can benefit from their distributed knowledge stocks, and has received a wide variety of labels. For example, it has been labeled alternatively boundaryless organization (Ashkenas et al., 1995), cellular form (Miles et al., 1997), cluster organization (Mills, 1991), differentiated network (Nohria and Ghoshal, 1997), federalist organization (Handy, 1991), information age organization (Mendelson and Pillai, 1999), integrated network (Ghoshal and Bartlett, 1997), internal market (Halal, 1994), lateral organization (Joyce, McGee and Slocum, 1997), metanational corporation (Doz, Santos and Williamson, 2001), modular form (Galunic and Eisenhardt, 2001), post-industrial organization (Huber, 1984), and simply internal network or network organization (Miles and Snow, 1994). For the mnemonics of 'New' and 'Novel'—as the successor to the multidivisional M-form—others have more generally labeled this corporate model the N-form corporation (Hedlund, 1994). Owing to the N-form's network characteristics, 'N' could also stand for 'Network' (Ferlie and Pettigrew, 1996; Hedlund, 1996; Nohria, 1996; Perrone, 1997).

Most of the research on internal networks can be traced to the literature on new forms of organizing, since many new forms of organizing share common

features that resemble network characteristics. This is not to say that internal networks are truly 'new' forms of organizing. Burns and Stalker (1961) already compared the characteristics of organic systems of management, which illustrate close resemblance to internal networks. Likewise, Thompson (1965) was early to report that bureaucracies are moving in the direction of looser structures, decentralization, project organization, and freer communication to foster innovation. Finally, Hedberg, Nystrom and Starbuck (1976) laid down the foundations of self-designing organizations, showing close resemblance to internal networks.

Despite these early accounts of alternative forms of organizing, theoretical development is still underdeveloped. Still, the number of firms experimenting with internal network forms of organizing is progressing (Pettigrew, Massini and Numagami, 2000). Empirical studies of internal networks, however, are largely limited to case studies of firms that seem to have been the first experimenting with internal network forms of organizing (Ghoshal and Bartlett, 1997; Pettigrew and Fenton, 2000). Further insights gained on how internal networks facilitate internal knowledge transfer and creation has mostly emerged from studies explicitly examining knowledge creation and transfer (e.g. Grant, 1996; Kogut and Zander, 1992; Szulanski, 1996; Zander and Kogut, 1995).

To capitalize on this ability and to benefit from the flexibility (Volberda, 1998), self-renewal and organic growth that are argued to accrue from internal networks (Hedberg, Nystrom and Starbuck, 1976), a firm has to change a multitude of characteristics. Since internal networks are characterized by a different organization structure and different organizational processes, the main parameters that influence knowledge integration in internal networks can be grouped under these two banners (see Table 2.4). They are discussed below.

Main parameter	Relevance to knowledge integration and organization
Organizational structure	- Network of dispersed and differentiated, but interdependent organizational units - Operational and strategic decentralization
Organizational processes	- Management roles changing and built on trust, focus on middle management - Knowledge flow configuration in which horizontal knowledge flows supplant and supplement vertical ones.

Table 2.4: Main parameters of internal networks

Main parameters. Nohria and Ghoshal (1997: 208) argue that a differentiated network's advantage is its 'ability to create new value through the accumulation, transfer, and integration of different kinds of knowledge, resources, and capabilities across its dispersed organizational units'. To that end, the structure of internal networks embraces a dense network of dispersed, differentiated but interdependent organizational units with operational and strategic responsibility. Units are not only dispersed and differentiated in terms of geography, but, more fundamentally, in terms of resources, capabilities, activities, and knowledge. Since knowledge is purposefully retained at lower levels, the decentralization of decision rights allow for the collocation of those rights with knowledge (Doz, Santos and Williamson, 2001). Units are allowed to make operational and strategic decisions based on knowledge and other resources localized to, for example, geographical areas, markets, technologies, or certain problems.

Differentiation requires, however, integration (Lawrence and Lorsch, 1967). Knowledge required but not available at a unit must be made available there if the unit, and thus the firm, is to capitalize on emerging opportunities. A particular role in this respect is granted to teams and other temporal constellations of different people from varying organizational levels and units (Hedlund, 1994). In this way, interdependencies between units emerge, which are not only sequential and pooled, but include reciprocal and team-based types of interdependence (Thompson, 1967; Van de Ven, Delbecq and Koenig, 1976). These types of interdependencies enable resources and activities to be integrated among units without the interference of the corporate hierarchy (cf. Lawrence and Lorsch, 1967). Figure 2.2 illustrates a stereotypical internal network.

Hedlund (1994) has labeled such a structure a heterarchy, which is based on the principles of multiplication and combination rather than on the principle of division so characteristic of hierarchies. In that vein, in a posthumous paper, Hedlund (1999) argues that while hierarchies are systems built on the notion of decomposability (Simon, 1945), internal networks are nearly recomposable systems. The presence of heterarchy is not to say, however, that hierarchical organization has disappeared in internal networks. Hierarchy remains indispensable to reach certain decisions quickly, resolve disputes, motivate allegiance to the internal network's mission and objectives, and to control activities of exploitation (Powell, 1990; Quinn, Anderson and Finkelstein, 1996). In a study of a business transitioning into an internal network, Van den Bosch and Van Wijk (1999) illustrated how a firm may move from a hierarchical form towards an internal network form, and that, although the number of

organizational layers decreased, hierarchy remains existent and necessary. Nonaka and Takeuchi (1995) have captured this duality of structure in their 'hypertext organization' model, which consists of a business-system layer that closely resembles a hierarchy, a project-system layer where people meet in teams and projects, and a knowledge base layer where the knowledge of the entire organization resides. Studying two new biotechnology firms, Liebeskind et al. (1996) also found that hierarchy is still important in learning organizations, however with a support structure for both internal and external linkages, instead of a control and command structure.

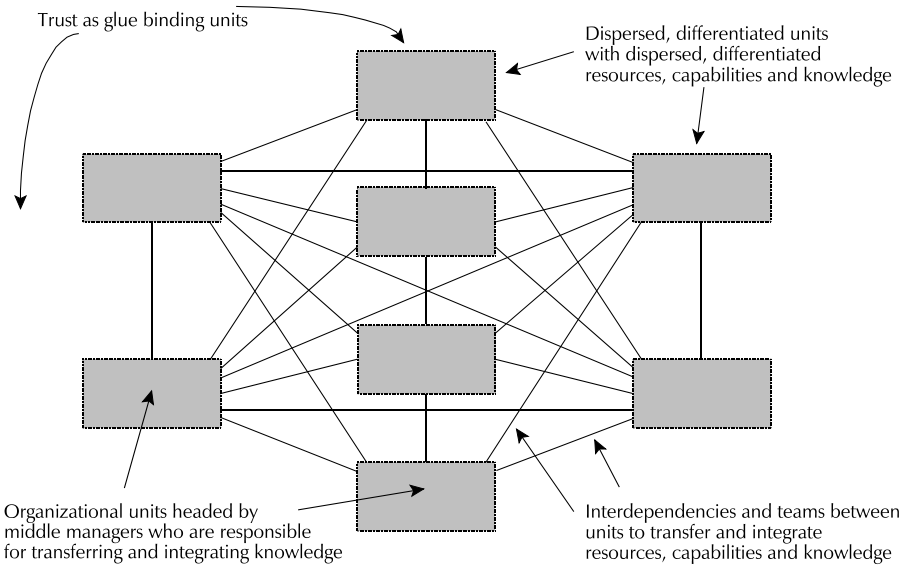


Figure 2.2: Stereotypical internal network (based on Ghoshal and Bartlett, 1997)

The shifting role of hierarchy recurs in the management processes of an internal network. Changing the formal organization only will not give rise to heterarchy, but subtler changes in management are required as well to effectuate interdependencies among organizational units (Hedlund, 1986; 1994). In line with Burns and Stalker's (1961: 121) study of the organic organization in which 'a network structure of control, authority, and communication' is present, several

scholars have recently pointed out that internal networks require a different management philosophy compared to traditional forms (e.g. Ghoshal and Bartlett, 1997; Miles and Snow, 1994). This change of management philosophy resembles that of stewardship theory in which managers are conceived as stewards 'whose behavior is ordered such that pro-organizational, collectivist behaviors have higher utility than individualistic, self–serving behaviors' (Davis, Schoorman and Donaldson, 1997: 24), rather than supposedly economically rational agents of the sort found in conventional organization forms (Ghoshal and Moran, 1996; Miles and Creed, 1995).

Instead of monitoring and commanding, executive managers in internal networks are architects, catalysts and facilitators of network processes (Hedlund, 1994). They are responsible for creating a shared context and vision for long term development and organic growth (Bartlett and Ghoshal, 1993). In multiple case studies, Ghoshal and Bartlett (1997) found that executives facilitate the *leveraging* of resources by institutionalizing common norms and values that breed a culture of trust, reciprocity and collaboration instead of *allocating* resources based on formal control mechanisms (see also Powell, 1990). Senior managers in internal networks are horizontal knowledge brokers 'linking and leveraging the company's widely distributed resources and capabilities', rather than vertical information brokers (Bartlett and Ghoshal, 1993: 33). To substantiate the structural interdependencies that underlie integration, middle managers also need to create and maintain *trust* among organizational members by behaving as coaches and supporting the initiatives taken by front-line managers (see Figure 2.2). Rather than being restricted by decisions made at higher levels in the hierarchy, front-line managers in internal networks were found to pursue the opportunities that emerge in the environment, and generate and update knowledge as necessary (Bartlett and Ghoshal, 1993).

These organizational structures and processes provide internal networks with a knowledge integration and organization capacity that gives internal networks the unique capacity to take advantage of a distributed and dispersed knowledge structure (Doz, Santos and Williamson, 2001) and differentiates it from other organization forms (Hedlund, 1994; Van Wijk and Van den Bosch, 1998).

The integration of knowledge across organizational units concerns knowledge flows contributing to the development of stocks of knowledge retained at organizational units (Dierickx and Cool, 1989). Knowledge transfer and integration processes may be promoted by both vertical and horizontal knowledge flows (cf. Aoki, 1986). In more traditional forms of organizing, knowledge integration is

preserved by hierarchy, where knowledge flows are primarily vertical and unidirectional between headquarters and divisions, business units, and operating units. As Burns and Stalker (1961: 5–6) observed, in mechanistic organizations 'interaction with management tends to be vertical … with information flowing up through a succession of filters, and decisions and instructions flowing downwards through a succession of amplifiers', whereas in organic organizations 'interaction runs laterally as much as vertically … [where] communication between people of different ranks tends to resemble lateral consultation rather than vertical command'. Therefore, contingent upon the degree of hierarchy remaining present, in internal networks vertical knowledge flows are either supplanted or supplemented by *horizontal, multidirectional knowledge flows* to preserve knowledge integration and the embeddedness of the units in the organization (Hedlund, 1994; Quinn, Anderson, and Finkelstein, 1996). In that vein, Van Wijk and Van den Bosch (1998) forwarded a metric, the HV ratio, which is the ratio of horizontal knowledge flows to vertical ones, as an indicator of organization form in use. What is more, horizontal knowledge flows in traditional organization forms are less frequent and moreover largely informal. In internal networks on the other hand these knowledge flows may be informal, but are also largely formalized (Ghoshal and Bartlett, 1997).

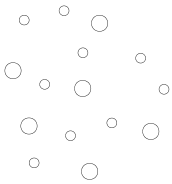
Network research: Individual streams or coherent body?

Does the development of research on knowledge and networks under three banners portrayed in Table 2.1 entail that they are mutually exclusive? As can be observed in the previous discussion, streams of network research have already been used to develop another. This applies especially to those that are grounded in social network analysis, since the concepts used in social network analysis have general application to all kinds of organizations, including internal and external networks. Moving beyond the exogenous rationales for entering into alliances and establishing joint ventures that characterize so many studies on external networks, most notably, social network analysis has been instrumental to explain endogenous aspects of external network formation (Gulati 1998; Gulati and Gargiulo, 1999) and benefits of external networks (Dyer and Singh, 1998). Most recently, social network analysis has also been employed to understand intraorganizational linkage formation (Tsai, 2000), and benefits (Tsai and Ghoshal, 1998).

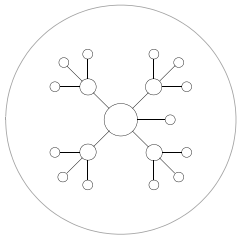
To illustrate how social networks permeate various sorts of organizational forms and governance modes and how social network analysis informs their

analysis, Figure 2.3 portrays six different organizational arrangements from a social network perspective. To underscore from where most network research originated, the market-hierarchy dichotomy, Figures 2.3a and 2.3b illustrate a pure market and a pure hierarchy respectively viewed from a social network perspective. Figure 2.3a is a pure market in which the only coordinating mechanism is the price mechanism; neither informal, nor formal relationships are present. Figure 2.3b illustrates a hierarchical organization in the purest sense. Four units or divisions are formally coordinated by headquarters, and each unit or division coordinates a next set of units, businesses or divisions. Figures 2.3c and 2.3d introduce social networks in both arrangements in the shape of informal relationships between actors. Figure 2.3c portrays the presence of social relationships between firms in a market (Granovetter, 1985), whereas Figure 2.3d shows the presence of informal social relationships in a hierarchical organization (Barnard, 1938). Finally, Figures 2.3e and 2.3f portray an external network and an internal network through a social network lens. In Figure 2.3e, informal social relationships remain to exist, and may provide the basis for a firm to enter in external networks in the future (Gulati, 1995a; 1998), but formal relations have been established between various firms in which not price but trust is the main coordinating mechanism (Bradach and Eccles, 1989). In Figure 2.3f, an internal network is illustrated in which units cooperate with each other not only informally but formally (cf. Ghoshal and Bartlett, 1997).

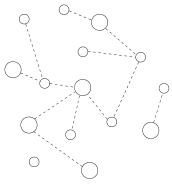
More in general, concepts used in one stream of inquiry can be used to develop another. For example, for many studies in interorganizational networks, the level of analysis is adjustable to the intraorganizational level without consequences for the insights obtained from the study. For example, Lane and Lubatkin (1998) argue since absorptive capacity is relative and explains learning in interorganizational networks, but could also explain intraorganizational learning processes between units. Indeed, absorptive capacity has been found important to learning and knowledge transfer in social (Ahuja, 2000b; Tsai, 2001), external (Cohen and Levinthal, 1990; Dyer and Singh, 1998) and internal interfaces (Gupta and Govindarajan, 2000; Szulanski, 1996). Others (e.g. Jones, Hesterly and Borgatti, 1998) have contributed to developing more general network theories. In certain cases, however, the level of analysis entails implications. Part of this is the result of different contexts in which networks manifest themselves. For example, external networks are generally influenced by competitive forces between firms, which are less likely to play a crucial role or may even be absent in social and internal networks.



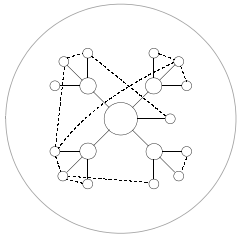
(a) pure market



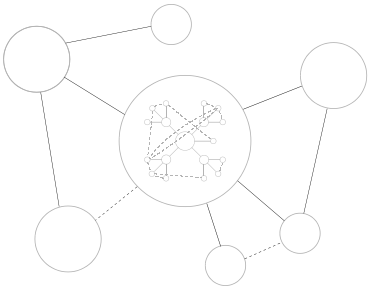
(b) pure hierarchy



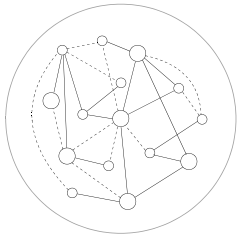
(c) market with informal relations



(d) hierarchy with informal relations



(e) external network



(f) internal network

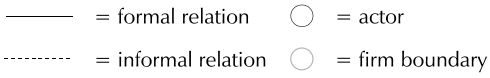


Figure 2.3: Various organizational arrangements from a social network perspective

Given that every organization is essentially a social network (Lincoln, 1982), that firms listed on *Fortune*'s top 500 had on average 24 joint ventures in operation over the period 1978–1992 (Nohria, 1996), and that the proportion of firms experimenting with internal networks seems to be rising (Pettigrew, Massini and Numagami, 2000), firms, too, are likely to be involved in a variety of networks simultaneously. By way of illustration, combining Figures 2.3a through 2.3f, in Figure 2.4 it is portrayed that an organization can be involved in all three types of networks and that they operate in coexistence. In the center of the figure is the focal firm, firm A, which itself is an internal network. Firm A has an alliance set up with Firm B, a hierarchical organization, which is illustrated in that the formal network is star-shaped with a couple of informal linkages. This alliance has come into existence because an employee working at unit A_1 of firm A was acquainted with a manager working for unit B_1 of firm B, and obtained knowledge of firm B's capabilities, which proved to be complementary to firm A's capabilities. The knowledge obtained from this social network was communicated to the headquarters of firm A, HQ_A, which initiated the alliance.

A similar social relationship was present between unit A_2 of firm A and unit B_2 of firm B. In this case, it led to an alliance between unit A_2 of firm A with unit C_1 of firm C. The alliance was only established between the units of the respective firms, since the domain of the alliance was limited to the domains of the units and unit C_1 appeared to possess knowledge that was valuable to unit A_2, the information of which was obtained via the informal relationship between unit A_2 and unit B_2. Finally, the informal relationship between unit A_3 of firm A with unit D_1 of competing firm D resulted in the initiation of a joint venture between firm A and firm E. Unit D_1 had a close relationship with unit E_1, which in turn was on a friendly basis with a person in the headquarters of firm A, HQ_A. This set of relationships allowed knowledge about the capabilities of firm A and firm E to flow through the social network, and resulted in a joint venture in which knowledge and resources were pooled to develop a new product. In that vein, firm A found itself in social networks, external networks, and internal networks, and the presence of one, at times, led to the creation of another.

NETWORKS, KNOWLEDGE AND PERFORMANCE

Since networks and knowledge are employed in environments that put a premium on exploration rather than exploitation (March, 1991; 1995), studies examining the performance implications of knowledge and networks have mainly used innovation-based or product development performance measures. Others

have used survival and growth rates as performance measures. Most of these studies have found positive performance implications.

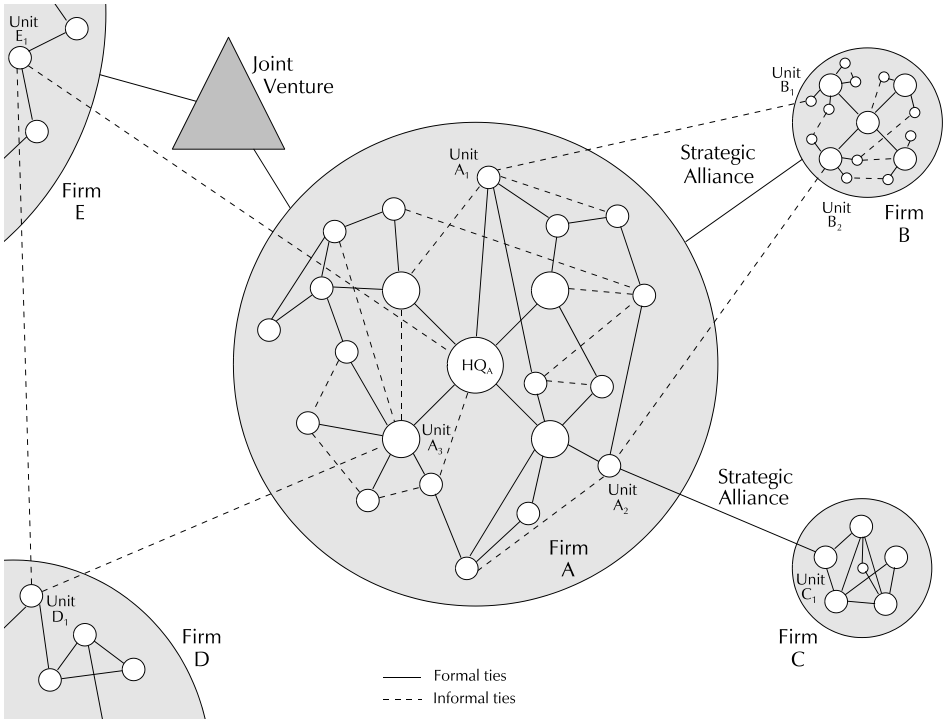


Figure 2.4: Three types of networks in action

In congruence with Powell, Koput and Smith-Doerr's (1996) finding that the locus of innovation in high-technology industries lies often within the alliance, in a study of the hospital software systems industry, Mitchell and Singh (1996) found that, in general, collaborating firms were less likely to shut down than independent firms. However, they also found that, following a sudden environmental shock, firms with collaborative partnerships for activities central to the shock were more likely to shut down, while firms with collaborative partnerships for activities that do not pertain and are therefore less affected by the shock were more likely to survive. In related studies Singh (1997) and Singh and Mitchell (1996) found that chances of firm survival were increased if a focal firm continued to build alliances with firms after existing partners shut down, or when

new partnerships were formed by those partners. In that vein, interfirm collaboration appeared to contribute to survival at one time, but inhibited the ability to adapt to environmental circumstances at another time. As they argue, 'businesses that are able to work closely with current partners while at the same time identifying possible new partners are likely to succeed in an industry marked by ongoing technological change' (Singh and Mitchell, 1996: 112).

Likewise, corroborating the findings of Baum and Oliver (1992), in a study of the Canadian biotechnology industry, Baum, Calabrese and Silverman (2000) found that startups can enhance performance by entering into alliances and by configuring them into a network through which access to diverse information and capabilities is provided. In this study, performance was measured by innovation-based measures which seemed crucial to increased survival rates in high-technology industries. Similar findings were found by Deeds and Hill (1996), Hagedoorn and Schakenraad (1994), and Stuart (2000). In contrast, with financial performance measures as the dependent variable, results are different. Using sales growth as indicator of performance, in a study of 137 Korean technological start-ups, Lee, Lee and Pennings (2002) found that external networks only contribute to performance when a firm has strong internal capabilities and a strong entrepreneurial orientation in place.

In reference to the 'paradox of embeddedness', which denotes the trade-off between maintaining cohesive and diverse ties at the same time (Gargiulo and Benassi, 2000; Uzzi, 1997), a related finding has been found in social network analysis. Uzzi (1996b) found that in stable environments increased embeddedness decreased failure rates, as it makes interaction more extensive and allows for transfer of fine-grained, complex knowledge, which in turn fosters innovation and survival. In more turbulent environments, however, where selection processes operate with greater force, Uzzi (1996b) found that a firm is more likely to survive if it has a diverse set of ties to a variety of partners. Powell et al. (1999) also found that social networks and collaborations increased organizational returns in the innovation-driven bio-technology industry. However, they also found that 'there are decreasing returns to network experience … [because of] the liabilities of being too embedded in social relations' (1999: 151). Similarly, Rowley, Behrens and Krackhardt (2000) examined the combined role of structural and relational embeddedness—measured by network density and tie strength, respectively—on performance in exploitation and exploration favoring environments. They found that network density was negatively related to firm performance in exploitation-favoring environments, but that strong ties have a positive influence on

performance in such environments. They also found that an increasing number of weak ties of a firm contributes to performance in environments demanding exploration. No support was found, however, for their hypothesis that strong ties are negatively related to firm performance in an environmental context favoring exploration. In light of Hansen's (1999) study, these findings underscore the presence of a trade-off between managing weak and strong ties. Hansen argues that innovation is mainly brought about by complex knowledge, but found that transferring such knowledge is benefitted by strong ties. The studies above found that strong ties are most effective in stable environments, whereas environments rewarding innovation tend to be turbulent. However, the results are mixed. In contrast to the studies above, the studies of Ahuja, (2000a), Kraatz (1998) and Walker, Kogut and Shan (1997) indicate that strong ties are more likely to allow a firm to survive in turbulent environments, as they are information-rich and foster innovation. At any rate, weak ties are easier to establish and therefore broaden the knowledge base a firm can tap into. Although establishing strong ties is more difficult, they allow a firm to transfer deep knowledge. As such, firms are required to continually form both weak and strong relationships with diverse partners as it allows them to maintain access to both a broad and deep knowledge base.

In a study of an internal network, Tsai (2001) found that a central network position providing access to diverse set of knowledge and the presence of absorptive capacity increased not only innovative but financial performance. Likewise, Hoopes and Postrel (1999) found that shared knowledge brought about by cross-functional meetings, teams and participation by boundary-spanning individuals increased product development performance. In case a firm experienced 'glitches', defined as cases in which shared knowledge is absent, it incurred excess costs. On the basis of that finding, Hoopes and Postrel (1999) submitted that the optimal amount of shared knowledge is determined by offsetting the cost of sharing knowledge against the cost of glitches.

KNOWLEDGE OF NETWORKS

The study of knowledge and networks is not limited to how knowledge manifests itself in networks. Networks themselves may be considered knowledge as well. In the context of external networks, following Lyles (1988), Kale and Singh (1999) advanced that firms can develop an 'alliance capability' which facilitates the formation and use of alliances. From a similar learning perspective, Gulati (1999) found that greater network alliance formation capabilities increase

the chance that firms enter into alliance in the future (see also, Amburgey, Dacin and Singh, 1996; Dyer and Singh, 1998).

Next to facilitating alliance and network formation, these alliance capabilities also facilitate learning and knowledge integration in external networks. On the basis of a longitudinal case study, Lorenzoni and Lipparini (1999) proposed that the capability to interact with other firms improves learning and knowledge access and transfer. In a study of 147 MNCs, Simonin (1999) found that collaborative knowledge mitigated the negative effects of knowledge complexity, as well as cultural and organizational distance on learning. In other words, alliance capabilities and interorganizational routines may overcome barriers in interorganizational knowledge transfer. In their study of alliances in the manufacturing sector, Anand and Khanna (2000) found support for the same hypotheses in relation to joint venturing. As such, the presence of alliance capabilities facilitates both the formation of new alliances and the transfer of knowledge via alliances.

Additionally, Anand and Khanna (2000) found that firms learn to create more value as experience in joint venturing and alliances accumulated. In a study of 1000 randomly selected firms, Simonin (1997) found a similar result in that collaborative know-how allowed firms to reap greater benefits from their collaborations. In congruence with earlier studies (e.g. Inkpen, 1995), Simonin's study also illustrates that a direct link between past experience in alliances and joint ventures and performance in new collaborations is not present. The experience is only beneficial when it is internalized and shared throughout the organization before it contributes to performance. In a study of 81 biotech and pharmaceutical firms, on the other hand, Zollo, Reuer and Singh (2002) found no support for their hypotheses that the presence of general and technology-specific interorganizational routines increases performance, but found a strong positive relationship between firm-specific interorganizational routines and performance. This result is consistent with the case study findings of Lyles (1988), who found that experience in collaborating is especially crucial in developing collaborative know-how that is tailored to specific firms.

Kale and Singh (1999) found that such 'alliance capabilities' are determined, among other things, by a firm's internal knowledge sharing process, in which experiences of previous alliances can be shared. As such, the sharing of knowledge that networks facilitate, at the same time facilitates the development of new networks. In that vein, besides the view that knowledge manifests itself *in* networks, the view has emerged recognizing that networks must be considered

essentially *as* knowledge. As Kogut, Shan and Walker (1993: 77) argue, 'knowledge consists ... also of the know-how regarding cooperation. Information of the network consists of identifying who will cooperate and who has what capabilities'. Adopting that view, in a later paper, Kogut argues that a 'network is itself knowledge, not in the sense of providing access to distributed information and capabilities, but in representing a form of coordination guided by enduring principles of organization' (2000: 407), and that 'because they are the outcome of generative rules of coordination, networks constitute capabilities that augment the value of firms' (Kogut, 2000: 423). Therefore, grounded in the notion that capabilities are formed by knowledge (Grant, 1996a), the social construction of a network is also an expression of knowledge.

CONCLUSION

This chapter indicated that research into knowledge and networks has made substantial progress the past decade. It also showed, however, that this research has developed under three banners: social networks, external networks and internal networks. Although the current study focuses on internal networks, the question arises how research from the other two lines can complement and inform research on internal networks. With minor exceptions, research under these various banners has generally forwarded different but complementary main parameters of how knowledge is organized and integrated. Therefore, the main parameters concerning knowledge integration and organization in social and external networks may prove valuable in explaining knowledge integration and organization in internal networks.

From the theoretical overview provided in this chapter it appeared that internal networks foster the integration of knowledge integration between organizational actors. Since innovation rests for a large and important part on the combination of different kinds of knowledge, especially internal networks' facilitation of the integration of knowledge between organizational units is crucial. In internal networks, knowledge integration is facilitated by alternative organization structures and processes. Structural elements that have changed in internal networks is that the structure of an internal network consists of dispersed and differentiated but interdependent units with operational and strategic responsibilities. Processual elements of internal networks

Since the thrust of social network analysis is that every organization is a social network, social network analysis is effectively used by researchers to understand knowledge organization and integration between and within firms. Similarly,

firms can also effectively use the social networks of individual employees to disseminate and integrate knowledge. The main finding of social network analysis relevant to the present study is that weak ties provide an effective mechanism to search for knowledge, and that strong ties between various units are necessary to integrate complex, tacit knowledge (Hansen, 1999; 2002). In other words, to facilitate the integration of knowledge across units, both formal and informal ties in both vertical and horizontal interunit relations are necessary.

External networks have been established as a governance mode to gain access to knowledge unavailable within a firm's boundaries, or to pool the knowledge bases of the focal and other firms together. Two issues from this line of research are relevant for the current study. First, competition between firms may lead to learning races between the firms. Second, firms partnering to gain access to new knowledge may do so because their knowledge bases complement each other. In addition, recent studies (e.g. Lane and Lubatkin, 1998) have indicated that when similarities and complementarities in, for example, organization structure, organization processes and organization cognition are present, the integration of knowledge is fostered. Since firms as actors in external networks can conceptually be substituted by organizational units as actors in internal networks, competition and complementarities in knowledge and the determinants of knowledge integration may play an important role in internal networks as well.

An increasing number of studies is focusing on alliance capabilities (Kale and Singh, 1999), interorganizational routines (Zollo, Reuer and Singh, 2002), collaborative know-how (Simonin, 1999), and other sorts of networking knowledge, suggesting that networks themselves are knowledge too (Kogut, 2000). This validates further that the three research streams are not mutually exclusive. Firms that have developed a capability to collaborate with partners in external networks are likely able to deploy that capability internally as well. Similarly, individuals with strong social networking skills are likely to able to apply that both in internal and external contexts. Therefore, concepts and variables used under one research banner can often be used under other banners as well, often at no cost and sometimes at the cost of only minor alterations. In the next chapter, the determinants of knowledge organization are heeded with the parameters of social, external and internal networks raised in this chapter as input.

ENDNOTES

[1] Two alternative uses of the term 'network' exist that confound its meaning, but are beyond the scope of this chapter. First, by mentioning 'networks' in economics, scholars often refer themselves to 'network economies' or 'network externalities', which are present when goods interface with other goods, entailing conversion, consumption and imitation effects. Of these especially imitation effects impact on knowledge-related considerations, as they occur when mimetic behavior brought about by interfirm information flows drives firms to imitation (Majumdar and Venkataraman, 1998). Second, when considering the implementation of networks, often reference is made to information technology networks that link computers throughout an organization. While these networks certainly contribute to the sharing of information and knowledge within and across firms, and even contribute to the development of a 'network firm' (Antonelli, 1988), they go completely by on richer face-to-face communications, which are essential to network organization (Nohria and Eccles, 1992). As will be elaborated in chapter 3, rather than constituting network organization, information technology networks are *determinants* of knowledge integration.

CHAPTER 3

Knowledge Integration

Corporate and Business level Determinants

The emergence of internal networks has resulted in an increasing number of studies examining this alternative form of organizing, and how it facilitates the organization and integration of knowledge. However, as indicated in the preceding chapter, it is still largely conceptual (Daft and Lewin, 1993; Hedlund, 1986; 1994, 1999; Miles and Snow, 1994; Quinn, Anderson and Finkelstein, 1996; Zenger and Hesterly, 1997) and case study work (Ashkenas et al., 1995; Bartlett and Ghoshal, 1993; Ghoshal and Bartlett, 1997; Malnight, 1996; Pettigrew and Fenton, 2000) that dominates the field. Formal tests of how networks foster knowledge integration within firms have been conducted mainly in the context of social networks (Hansen, 1999; 2002; Tsai, 2000; 2001; 2002; Tsai and Ghoshal, 1998) and multinational corporations (Birkinshaw, Morrison and Hulland, 1995; Gupta and Govindarajan, 2000; Kogut and Zander, 1993; Nohria and Ghoshal, 1997; Zander and Kogut, 1995). In addition, these studies have hardly addressed corporate-level determinants and mainly considered business-level determinants of knowledge integration. In this chapter, therefore, hypotheses are developed on what corporate-level elements influence knowledge integration in internal networks.

Determining how internal networks foster the integration of knowledge from the corporate-level can be established by considering how organizational elements characteristic of internal networks foster knowledge integration. In the previous chapter, how internal networks differ from other organization forms has been addressed by considering organizational structures and organizational processes. In this chapter, too, both structural and processual determinants are addressed, which are typically corporate-level phenomena, and are argued to have changed in internal networks. In that vein, structural elements addressed are the number of organizational levels, decentralization, product vs. project-based structures, and

diversification. Processual elements that are examined in this chapter are information technology and human resource practices.

Organization forms are, however, also systemic entities. Change of organization form is more than a change in a single organizational element, or more than change in structure alone. Instead, when firms change their form of organizing, due to the systemic character of organization forms, a wide variety of organizational elements are being changed, ranging from structural to processual to cultural elements (Bartlett and Ghoshal, 1989). Almeida, Song and Grant (2002) argue that changes in exactly these three realms are necessary to support knowledge integration. It is, therefore, important to consider the systemics or complementarities between organizational elements (cf. Milgrom and Roberts, 1990; 1995; Rivkin, 2000; Siggelkow, 2001; 2002) in determining knowledge organization.

As argued above, many studies have been conducted considering business-level determinants of knowledge integration. These studies have, however, generally not been conducted in internal networks, but in multinational corporations (e.g. Birkinshaw, Morrison and Hulland, 1995; Ghoshal, Korine and Szulanski, 1994; Gupta and Govindarajan, 1993; Lamont et al., 2000; Nohria and Ghoshal, 1997). Although multinational corporations are moving to network-based forms (Malnight, 1996), considering business-level elements remains important to understand knowledge integration. In many studies, absorptive capacity was found to be a crucial determinant of knowledge integration (Gupta and Govindarajan, 1999; Nobel and Birkinshaw, 1998; Szulanski, 1996). Initially, the capacity to absorb knowledge has been identified as a crucial capability of firms for external appropriation and integration of knowledge (Cohen and Levinthal, 1989, 1990, 1994). However, for internal transfer and integration of knowledge among units, too, absorptive capacity is crucial. For example, Szulanski (1996) found that a lack of absorptive capacity with a receiving unit was the most important barrier to internal transfer and integration of knowledge. The study by Gupta and Govindarajan (2000) also indicated that absorptive capacity plays an important role in knowledge transfers between headquarters and subunits as well as among subunits in MNCs.

In this chapter, therefore, hypotheses are developed not only as to how corporate-level elements but as to how business-level elements foster knowledge organization. In the following section, hypotheses are developed as to how corporate-level elements affect knowledge organization. Then, hypotheses are developed as to how complementarities between those corporate-level elements

influence knowledge organization. In the next section, the performance implications of the corporate-level attributes are examined. The business-level elements of knowledge organization center on the role of absorptive capacity and are considered in the following section. Here the role of internal networks' knowledge flow configuration on the development of absorptive capacity, rather than its dependence on absorptive capacity alone, is considered. Finally, conclusions are drawn.

CORPORATE-LEVEL DETERMINANTS OF KNOWLEDGE INTEGRATION

As mentioned in chapter two, internal networks are differentiated from other organization forms by particular organization structures and processes. In this section hypotheses are developed regarding determinants of knowledge integration falling within these categories at the corporate level. An overview of the hypotheses is given in Table 3.1.

Determinant	**Hypothesis**	
Organizational structure		
Organizational levels	H1	As the number of organizational levels increases, knowledge integration will decrease
Decentralization	H2	As the degree of decentralization increases, knowledge integration will increase
Corporate headquarters	H3	As the size of corporate headquarters increases, knowledge integration will decrease
Product-based structures	H4a	The more organizations make use of product-based structures, the less knowledge integration will take place
Project-based structures	H4b	The more organizations make use of project-based structures, the more knowledge integration will take place
Diversification	H5	As the relatedness between divisions and businesses increases, knowledge integration will increase
Organizational processes		
Information technology	H6	As the use of information technology increases, knowledge integration will increase
Human resource practices	H7	As the use of new human resource practices increases, knowledge integration will increase

Table 3.1: Corporate-level hypotheses

Organization structure

An important determinant of knowledge integration is organization structure (Jensen and Meckling, 1992; Mendelson and Pillai, 1999; Teece, 2001). As Mendelson and Pillai (1999) argue, organizational structure is closely tied to and dependent on knowledge flows; a change in the latter spurs the search for a new optimum in the former. As pioneering firms have been replacing their corporate models with other forms of organizing to foster knowledge integration, many structural attributes had to change along to ensure effective operation (Ashkenas et al., 1995). Typical corporate *structural attributes* that are argued to have changed are strong reductions in the number of hierarchical levels, increased emphasis on decentralization, different roles for corporate headquarters, greater reliance on project-based as opposed to product-based structures, and less diversification and more focus (Hedlund,1994).

Organizational levels. One of the most important reasons hierarchy has come to be the dominant, taken-for-granted logic of organizing is because of it ability to reduce equivocality (Daft and Lengel, 1984). In that conception, hierarchy has traditionally been considered one of the mechanisms facilitating knowledge integration (Daft and Lengel, 1984; Galbraith, 1973; Grant, 1996a; Williamson, 1975). Actions taken by lower level managers must be authorized first by higher level managers. As one moves up a hierarchy, each level in the hierarchy has more knowledge about wider organizational issues that qualifies it to apply rules that lower levels cannot apply (cf. Shumway et al., 1975). Knowledge goes through the hierarchy until the 'appropriate' office is reached, at the point where the hierarchies of two units involved unite. At those higher points in the hierarchy, knowledge is integrated and strategies formed, in turn to be implemented by lower level managers. In this approach, however, knowledge integration in a hierarchy rests upon the assumption of rationality.

This assumption has been subject, however, to considerable debate. Following Simon (1945), it has become a common contention that no individual can know everything, because cognitive limits prevent it from doing so. Many scholars (Hedlund, 1994; Ghoshal and Bartlett, 1995; 1997) have taken up the bounded rationality argument to illustrate that hierarchy restricts the integration of knowledge. First, because the function of a hierarchy is the reduction of equivocality, knowledge gets also filtered and condensed as it moves up and down the hierarchy. Only knowledge that is considered crucial is supposed to reach higher levels in the corporate hierarchy. Therefore, its integration can only be

suboptimal. Second, as higher level managers stand further away from the reality of day-to-day business, it is difficult, if not entirely impossible due to rationality constraints, to assess what knowledge is crucial (Nonaka, 1994; Thompson, 1967).

Further, knowledge integration through a hierarchy is hampered due to power and political issues. People are less likely to transfer knowledge upward if it likely to be harmful (Hall, 1996; Pfeffer, 1998). While that knowledge may nevertheless be important to a firm, higher level managers then cannot integrate it. As the number of hierarchical levels increases, such processes are likely to become more prevalent.

Evidence suggests that one of the first things many firms did when dissociating themselves from hierarchical structures and adopting different modes of organizing was delayering (Cascio, 1993; Floyd and Wooldridge, 1996). By diminishing the number of organizational layers costs resulting from having extensive layers of middle management could be reduced. At the same time, the speed of decision-making could be increased (Freeman and Cameron, 1993; Geroski and Gregg, 1994). Both reduced costs and increased speed allow for more efficient and effective knowledge integration to occur. When issues are of strategic interest requiring executives need to intervene selectively, the chain of command is shorter allowing (dis)approvals on propositions made to executives to come more quickly. In summary,

Hypothesis 1: *The higher the number of hierarchical levels in a firm, the less knowledge integration will take place.*

Decentralization. Decentralization (Vancil, 1978) and its counterpart centralization (Pugh et al., 1968) are other structural correlates that recently have been subject to debate in theories of new organizational forms. When the multidivisional structure started to replace the functional structure as the main mode or organization in the twenties and thirties, firms also decentralized operations from the corporate to the divisional level (Chandler, 1962). Many commentators of new organization forms argue that the degree of decentralization has moved even beyond the levels that characterized multidivisional corporations. Ferlie and Pettigrew (1996b) also note that the current trend is towards decentralization. This development is clearly illustrated by, for example, Ghoshal and Bartlett (1997) who report that the responsibility to take action has shifted from top to middle management. By increasing the degree of decentralization, lower-level managers will feel themselves more accountable for the success of the

firm. Strategic decentralization changes incentives and managers' orientation towards profits and investments, as they become the ones responsible for achieving satisfactory results (Ghoshal and Bartlett, 1997; Pfeffer, 1998). By corollary, as new opportunities and demands emerge, they are also likely to be searching for knowledge themselves, and integrate that with the existing knowledge base. Because employees at lower levels in the organization are given discretion to decide what is best for their organization unit in certain circumstances, knowledge integration across large numbers of autonomous units becomes a new priority. Further, because of their closer involvement in day-to-day business, lower-level managers also know market demands better, providing them with a better opportunity to integrate the knowledge required for the situation. In that vein, decision rights come to be co-located with the knowledge necessary to make the decisions (Doz and Santos, 1997; Grant, 1996a). As a result,

Hypothesis 2: *As the degree of decentralization increases, knowledge integration will increase*.

Corporate headquarters. Especially in the corporate strategy literature, it has become evident that multiunit firms start experimenting with a different role of corporate headquarters in creating interunit links. Whereas empirical studies used to emphasize a proactive role of corporate headquarters in actively seeking interunit links (e.g. Goold, Campbell and Alexander, 1995), recent studies signal a facilitatory role of corporate headquarters in fostering self-organizing process to capture synergies (Brown and Eisenhardt, 1998), to share knowledge, and to recombine resources and product markets (Galunic and Eisenhardt, 1996; 2001). This pattern also recurred in the studies of Holmström and Roberts 1998) at Asea Brown Boveri and British Petroleum. They found that both companies 'see the opportunity to learn and share information effectively as key to their competitive advantage, and [therefore] both operate with extremely lean headquarters that are too small to play a central, direct role in transferring knowledge across units. (1998: 91). Similarly, in a case study of the Danish hearing-aid company Oticon A/S, Ravasi and Verona (2001) found that many activities traditionally carried out by headquarters were performed lower in the organization. As a consequence, these studies submit that corporate headquarters has a less central role in knowledge integration and organization.

From studies examining the shifting role of management in internal network forms of organizing, too, it appears that corporate headquarters has a different

role. The control and monitoring function of executives in internal network forms of organizing is argued to be replaced by a coaching and architectural role (Hedlund, 1994). Executives are not expected to devise grand strategies and allocate resources, but instill a vision that serves as an umbrella for middle managers who leverage resources at their own discretion (Bartlett and Ghoshal, 1993). This shift of responsibilities from top to middle management has consequences for the role and size of corporate headquarters. As managerial responsibilities to take action move down the hierarchy, less need is present for a substantial staff located at corporate headquarters (Ferlie and Pettigrew, 1996b; Quinn, Anderson and Finkelstein, 1996). As knowledge is transferred from node to node, from unit to unit, and from division to division without intervention of the corporate chain of command, there is no need to have a large corporate headquarters. This leads to

Hypothesis 3: *As the size of corporate headquarters decreases, knowledge integration will increase*.

Product vs. project-based structure. Another feature of organization structure is a firm's adherence to product-based or project-based structures. The decomposition of corporations into various divisions and businesses for separate products has consequences for knowledge integration (Eisenmann and Bower, 2000). By establishing divisions for different products, corporations also divide knowledge that by corollary becomes more specialized. Since learning is cumulative, this specialization increases over time. To integrate knowledge bases, however, a common knowledge between divisions, in the shape of shared language, terminology, concepts and frames of reference, is an important facilitator (Buckley and Carter, 2000; Cohen and Levinthal, 1990). Since divisions and businesses become specialized over time, this common language among divisions is likely to erode or less likely to develop, which is detrimental to knowledge integration. As such,

Hypothesis 4a: *The more organizations make use of product-based structures, the less knowledge integration will take place*.

In the past decade, however, many firms have introduced project-based structures, allowing employees from different divisions and organizational units to work together. In that vein, different types of knowledge from different

knowledge domains can be integrated. An example of a project-based structure can be found in Nonaka's (1994) 'hypertext organization'. The hypertext organization consists of three layers: a business system layer where the formal hierarchy resides, a project layer where projects reside, and a knowledge layer where all knowledge created is accumulated. In this type of organization employees move from the formal layer to the project layer to work on something important to current conditions. Through this project layer, where employees from different divisions can interact, they are able to integrate and create knowledge, which subsequently is accumulated in the knowledge layer. When the task is finished, employees move back to the formal business system layer. Similarly, in internal networks the permanent structures of employees that characterize the M-form are abandoned and 'varying constellations of actors' incorporated in which employees link up and work together to integrate their knowledge as the 'natural mechanism' (Hedlund, 1994: 83). A similar pattern was observed by Ravasi and Verona (2001) in their case study at Oticon. They found that part of the reduction in the role of corporate headquarters involved the establishment of projects taking over headquarters' activities and responsibilities and facilitating the integration of specialized knowledge. In summary,

Hypothesis 4b: *The more organizations make use of project-based structures, the more knowledge integration will take place*.

Diversification. The new competitive landscape has also put organizational boundaries under pressure. Especially in the context of the increasing number of mergers and acquisitions that many firms have pursued recently to acquire new knowledge necessary to develop new products and processes across a variety of industries (Capron, 1999), high on the strategic agendas of corporate executives is the structural decision as to how many divisions and business a firm should operate, how diversified they should be, and how knowledge should be integrated across them.

At first sight, this development appears to contradict with the observations of Hoskisson and Hitt (1994) and Hedlund (1994), who argue that in order to integrate knowledge effectively firms should downscope and focus on a limited set of operations. Still, downscoping, restructuring and divestiture activities have been on the rise within the business community. Many firms have been retreating to their core business while outsourcing peripheral activities (Hoskisson and Hitt, 1994; Prahalad and Hamel, 1990; Quinn, 1992; Volberda, 1996; 1998). In the

meantime, the reliance on strategic alliances established for learning and acquiring new knowledge has been rising (Koza and Lewin, 1998).

Hedlund (1994) argues that establishing focus in a firm will lead to economies of depth allowing a firm to capitalize on its knowledge and create it more effectively through its integration. As a "diversified firm cannot internalize, at the corporate level, processes into a tacit organizational reservoir of routines", for effective knowledge integration to occur firms are required to focus rather than to diversify. Therefore "*economies of depth* are heavily involved in knowledge transformation processes, [in which] 'depth' refers to the experience and involvement in an area necessary to be able to generate new knowledge, and ... to benefit from knowledge in related fields" (Hedlund, 1994: 85; original emphasis). As it easier to learn new things in domains in which knowledge is already present—Cohen and Levinthal (1990) refer to this as absorptive capacity—knowledge integration in narrow domains is more likely than in broad domains.

In light of diversification, this is akin to Gupta and Govindarajan's (1986) finding that the ability of firms to share resources is dependent on the relatedness between divisions and businesses. The relatedness of businesses and divisions influences the absence or presence of common knowledge across them (cf. Cohen and Levinthal, 1990; Gupta and Govindarajan, 1986). As divisions' relatedness in terms of products, technologies and processes increases, the likelihood of having overlapping knowledge bases increases, fostering the integration of knowledge. Summarizing,

Hypothesis 5: *As the relatedness between businesses and divisions increases, knowledge integration will increase*.

Organization processes

Several scholars (e.g. Brown and Eisenhardt, 1998; Ghoshal and Bartlett, 1997) argue that while structure may remain important, organizational processes essentially define how knowledge is integrated within a firm. Two of the most important corporate *processual attributes* available to corporations to link divisions, businesses and units are information technology and human resource practices (Hedlund, 1994; Whittington et al., 1999).

Information technology. In the past decade, firms have witnessed enormous advances in Information Technology. By the mid-nineties, over forty per cent of

new capital equipment investment was spent on information technology (Hitt and Brynjolfsson, 1996). With the rise of the Internet in recent years, this has likely only increased. While Lucas (2002) believes that the digital revolution created by the internet and e-commerce will have a profound impact on strategy and organization, his analysis suggests that the internet and e-commerce alone will not necessarily enable a firm to gain a competitive advantage. It is the way in which these technologies are used that will contribute to the generation of competitive advantage as they enable firms to leverage other resources and strengths. Similar comments have been about corporate-wide information technology networks. With the rise of Internet, email, corporate-wide Intranets, and software packages such as IBM's Lotus Notes and K-Station, and Hummingbird's Fulcrum PC Docs, information technology has also moved from the 'back office' to all production functions. With the information technology function, corporations are given new opportunities not only to change ways in which products and services are offered to customers, but to enhance knowledge sharing and integration within their firms.

In contrast to the general belief installed by the popular press, the implementation of these IT networks does not constitute a knowledge strategy by itself (Almeida, Song and Grant, 2002; Nohria and Eccles, 1992). Information technology is a platform through which knowledge and information can be transferred and shared throughout the organization. On the other hand, context-specific, tacit knowledge can only be shared at considerable cost through face-to-face contacts or the physical movement of at least one of the individuals exchanging knowledge. These limitations of information technology are clearly illustrated in a study of Eliasson (1996), in which was evident that even the big ICT companies, such as IBM, who should be in a privileged position in developing IT networks, could not transfer every piece of knowledge through such systems, and that face-to-face contacts and apprenticeships remain important (cf. Nonaka and Takeuchi, 1995). In that vein, discussing how networks can be conceptualized, Baker (1992) makes a distinction between 'thin' and 'thick' networks. In the former, a network is taken as an information systems network, in which the major part of knowledge integrated is explicit. In the latter, however, a network is seen as a network organization in the richest sense of the word, in which both information technology systems and face-to-face contacts provide the links between units, and, with that, facilitate the integration of both 'thin' explicit and 'thick', context-rich tacit knowledge (see also, Argote, 1999).

Information technology can, however, contribute to the transfer of knowledge

in three ways. First, because codifiable, explicit knowledge can be converted into binary language and therefore by nature fed into IT systems, it can be transferred through IT systems at much less cost. Second, IT networks enable fast communication through which knowledge can be located at much less cost. This coalesces with findings in social network theory. In studies of social networks it has been found that while weak ties enable the search for new knowledge and the transfer of non-complex knowledge, strong ties facilitate the transfer of complex knowledge (Hansen, 1999; 2002). In a study of the B-2 stealth bomber, Argyres (1999) found that information technology systems facilitate coordination, and when fully implemented may even substitute for trust and social networks as coordination mechanisms. A similar finding has been found by Kumar, Van Dissel and Bielli, 1998 in a study of the failure of the interorganizational collaboration Sprintel.

Third, information technology systems largely eliminate the physical, spatial and temporal limitations of communication and transferring knowledge (Brown and Duguid, 1998), and therefore decrease the cost and difficulty of transferring knowledge over longer distances and time spans. Firms employing information technology tend to increase the number of information flows while reducing the number of human actors involved in transmission (Huber, 1990). Brynjolfsson (1994), Hitt and Brynjolfsson (1996), and Huber (1990) also argued that information technology alters the location of information and knowledge, allowing knowledge integration to occur more effectively and efficiently. Thus,

Hypothesis 6: *As the use of information technology systems increases, knowledge integration will increase*.

Human resource practices. Besides hierarchy, firms make use of myriad coordination mechanisms that facilitate the integration of knowledge in both 'thin' and 'thick' networks. Examples of such coordination mechanisms are new human resource practices such as internal labor markets, teams, managerial development events, and networks among employees and organizational units within a firm (Ichniowski, Shaw and Prennushi, 1997). Hoopes and Postrel (1999) found that boundary spanning individuals, cross-functional teams, and meetings foster the presence of a knowledge base shared by individuals, and so increased product development performance. In their absence, a shared knowledge base was more difficult to build so that firms experienced 'glitches' faster, which incur excess costs and decreased performance. Zahra and Nielsen (2002) found that the use of

internal human resources was valuable in the development of new products, new patents and radically new products, as well as the commercialization of the technologies underlying these products and patents.

In their in-depth case study, Ravasi and Verona (2001) found that mobility of employees, as part of the 'structurally ambiguous' organizing process of Oticon, strongly supported Oticon's ability to integrate knowledge. Pfeffer and Cohen (1984) found moderate support for the relationship that internal labor markets are to be found in firms where firm-specific skills and knowledge are required. By using internal labor markets as a coordination mechanism, firms enable employees to work in different locations through which they learn new things, and with that can integrate that new knowledge with the knowledge that they already possess (Lam, 2000).

A similar argument applies to teams. Teams bring together employees from various organizational units, departments, and divisions to work on a particular operation, which could be the development of a new product or service, or the search for a solution to a problem. In that vein, different kinds of knowledge from people with distinct specializations can be integrated. For example, Nonaka and Hedlund (1993) found that Japanese firms were able to reduce the introduction time of new cars by allowing employees from R&D, production and marketing to team up. In that way, not only production time could be lessened, but new concepts could be developed by integrating the knowledge of the various department employees, and European and American counterparts be outperformed.

Another means through which knowledge comes to be integrated is through the social networks of employees within a firm (Burt, 1997; Liebeskind et al., 1996; Nahapiet and Ghoshal, 1998). Kogut and Zander (1996: 503) argue that 'a firm be understood as a social community specializing in the speed and efficiency in the creation and transfer of knowledge'. Through their social networks, employees are able to interact and communicate with other people informally, allowing to share knowledge and integrate that in their existing knowledge base. Social and intellectual capital coevolve (Nahapiet and Ghoshal, 1998), and by so doing underpin the advantage firms bear over markets. As social networking in a corporation increases, more avenues for integrating knowledge will become present. Summarizing,

Hypothesis 7: *As the use of human resource practices increases, knowledge integration will increase*.

COMPLEMENTARITIES

The hypotheses developed thus far centered on the effects of corporate elements shaping knowledge integration independent of the effects of other elements. From the preceding discussion, two sets of elements can be discerned. First, determinants were introduced that, ceteris paribus, likely restrict knowledge integration: hierarchical layers, size of corporate headquarters, product-based structures, and diversification. Second, determinants were distinguished that, ceteris paribus, likely enable knowledge integration: decentralization, project-based structures, information technologies, and human resource practices. In this section, hypotheses on complementarities between these elements are developed, as listed in Table 3.2.

Determinants	**Hypothesis**	
System I: Project-based structures Human resource practices Information technology Decentralization	H8	The systemic effect on knowledge integration of adopting project-based structures, human resource practices, information technology and decentralization will be higher than their individual effects
System IIa: Product-based structures System I	H9a	The effect of product-based structures on knowledge integration will become more positive as complementarities with project-based structures, human resource practices, information technology and decentralization increase
System, IIb: Organizational levels System I	H9b	The effect of the number of organizational layers on knowledge integration will become more positive as complementarities with project-based structures, human resource practices, information technology and decentralization increase
System IIc: Diversification System I	H9c	The effect of relatedness between divisions and businesses on knowledge integration will become more positive as complementarities with project-based structures, human resource practices, information technology and decentralization increase
Systems I, IIa, IIb, IIc	H10	The effect of complementarities between corporate elements in shaping knowledge integration will be higher for high performing firms than for low performing firms

Table 3.2: Corporate-level hypotheses: systemic effects

The hypotheses developed in the previous section were largely based on case study research of early adopters of internal network forms of organizing (e.g.

Ashkenas et al., 1995; Bartlett and Ghoshal, 1993; Ghoshal and Bartlett, 1997). Effects on knowledge integration were hypothesized of elements that this literature typically forwards as characteristic of internal networks. A broad range of literature suggests, however, that organization forms are integrated sets of elements (e.g. Holmström and Milgrom, 1994; Lawrence and Lorsch, 1967; Leavitt, 1965; Miller and Friesen, 1984; Tushman and Romanelli, 1985). For example, Scott (1996: 46) argues that in Max Weber's (1924) "ideal type" bureaucracy 'each element operates not in isolation but as part of a system of elements that, in combination, are expected to provide more effective and efficient administration'. Similarly, Williamson (1991: 271) argues that organizational forms require 'a syndrome of attributes that bear a supporting relation to one another' and submits that many organization forms 'never arise, or quickly die out, because they combine inconsistent features'.

To Hedlund (1994), Miles and Snow (1994) and Ghoshal and Bartlett (1997), too, the elements characterizing internal networks operate in close relation and are essentially systemic. As Bartlett and Ghoshal (1989) argue to explain that organization change is more than change in formal structure alone, organization form moves beyond the anatomy of structure and includes the physiology of processes and the psychology of culture.

Comparing systems of mass production and modern manufacturing, Milgrom and Roberts (1990; 1995) capture organizational systemics in the notion of complementarities. They argue that complementarities exist when 'the marginal returns to one variable are increasing in the levels of the other variables' (1995: 181). In other words, activities are complements when doing more of one activity increases the return to doing more of other activities. Strong empirical support for the gains that complementarities bring has been found in human resource practices. For example, Ichniowski, Prennushi and Shaw (1997) found that the systemic adoption of human resource practices provided firms with productivity enhancements that the adoption of individual human resource practices was unable to provide. Similarly, Laursen (2002) found that human resource practices indigenous to innovative forms of organizing are more effective in influencing innovation performance when applied together than when applied alone.

The notion of complementarities can also be applied to the context of internal networks in fostering knowledge integration and organization. As firms enact a strategy to enhance knowledge integration, changes in other organizational elements are likely to be required as well (De Boer, Van den Bosch and Volberda, 1999; Lewin, Long and Carroll, 1999; Volberda, 1998). For example, Argote (1999:

181) argues that 'face-to-face methods of communication such as meetings and conferences can be fruitfully supplemented by electronic means once a relationship is established, … [so that] a multiplex approach to knowledge transfer is likely to be most effective'. Likewise, the case studies of Almeida, Song and Grant (2002: 159) suggest that the challenges of organizing knowledge 'extend beyond the creation of international information systems, to the design of organizational structures, systems and culture capable of supporting knowledge building'. In the context of this study, this suggests that the systemic adoption of corporate attributes is more likely to result in enhanced knowledge integration than the adoption of individual corporate elements. Consistent with Milgrom and Robert's (1990; 1995) comparison of mass production and modern manufacturing, when applied to the elements that ceteris paribus enable knowledge integration, this leads to

Hypothesis 8: *The systemic effect of adopting project-based structures, human resource practices, information technology and decentralization concurrently on knowledge integration will be higher than their individual effects*.

A general theme across the case studies reported in a volume by Pettigrew and Fenton (2000) and across those studied by Whittington and Mayer (1997) is, however, that in innovative forms of organizing certain elements are introduced to facilitate knowledge integration, but that, at the same time, more traditional elements, such as those restricting knowledge integration individually, have to remain in existence to capitalize on knowledge integration. In other words, firms adopting internal networks seem to continue using hierarchies and product-based structures, but overlay such corporate attributes with knowledge integration enabling elements, such as decentralization, project-based structures, information technologies, and new human resource practices.

This observation recurs in the distinction made by Hill, Hitt and Hoskisson (1992) and Hoskisson, Hill and Kim (1993) between competitive and cooperative M-forms. Whereas interdivisional integration is kept minimal in the former, in the latter it is emphasized (see also Chandler, 1990; Eisenmann and Bower, 2000). In that way, for example, product-based structures and diversification allow a firm to have a diverse set of knowledge, while the other attributes allow it to pool that knowledge together and integrate it. In the same vein, Zenger (2002) and Zenger and Hesterly (1997) argue that in hybrid organization forms, or team-based

organizations, hierarchy is infused with market governance. In a later paper, Zenger argues that 'the distinctive bundle of complementary attributes termed hierarchy is ideally configured to govern mass production of a stable set of goods and services, … [whereas] team-based organizational forms are arguably better suited to environments demanding more rapid change' (2003: 83).

This suggests that firms characterized by product-based structures, hierarchies and high degrees of diversification may overcome the detrimental effects of these attributes by 'overlaying' or complementing them with a project-based structure, high degrees of new human resource practices, information technologies, and decentralization. Thus,

Hypothesis 9a: *The effect of product-based structures on knowledge integration will become positive as complementarities with project-based structures, human resource practices, information technology and decentralization increase*.

Hypothesis 9b: *The effect of the number of hierarchical levels on knowledge integration will become positive as complementarities with project-based structures, human resource practices, information technology and decentralization increase*.

Hypothesis 9c: *The effect of relatedness between divisions and businesses on knowledge integration will become more positive as complementarities with project-based structures, human resource practices, information technology and decentralization increase*.

Complementarities, Knowledge Integration and Performance

One of the research questions addressed in this study concerns also how internal network forms of organizing, through their facilitating role in knowledge integration and organization, contribute to performance. Originally, Milgrom and Roberts (1990) introduced the notion of complementarities to explain performance differences among firms and their organization forms. In their comparison of mass production and modern manufacturing systems they found that complementarities between elements indeed increase performance. Later studies have confirmed this finding. For example, Whittington et al. (1999) found that systemic change provided firms with performance enhancements above those achieved through piecemeal change. Similarly, consistent with configurational

theory (Miller and Friesen, 1984), Doty, Glick and Huber (1993) found that firms with specific configurations of traits or elements were more effective or higher performing. Milgrom and Robert's (1990) study indicated, however, that complementarities only increased performance when they formed part of either mass production or modern manufacturing systems. In the words of Zenger (2002), no violation in the pattern of complementarities should be present; elements forming an essential part of mass manufacturing but implemented in a modern manufacturing system violate the pattern of complementarities.

Influenced by complexity theories being applied in the fields of strategic management and organization theory, others have also argued that systems of tightly interconnected activities contribute to creating and sustaining competitive advantage (Rivkin, 2000) and to survival (Levinthal, 1997). Recently, however, Rivkin and Siggelkow (2003) reached the conclusion that firms face a duality between search and stability in coupling elements of organizational design. On the basis of their agent-based simulation model, they hypothesize that 'organizations that couple design elements that foster search with elements that promote stability will be more successful than those that rely exclusively on one set of elements or the other' (2003: 308). Similarly, Romme (1996) argues that teams contribute to the exploration of knowledge, while hierarchy is necessary for the exploitation of that knowledge. Based on the argument that both exploration and exploitation are required for both current and future performance (Levinthal and March, 1993), he argues that the optimum on the hierarchy–team continuum lies in the middle.

If the argument is taken that the presence of complementarities will lead to enhanced performance, and that knowledge integration is conducted with the purpose to enhance performance (Conner and Prahalad, 1996), it follows that the effect of complementarities between the elements heeded above will be higher for high performers than for low performers. In summary,

Hypothesis 10: *The effect of complementarities between corporate elements in shaping knowledge integration will be higher for high performing firms than for low performing firms*.

BUSINESS-LEVEL DETERMINANTS: ABSORPTIVE CAPACITY

Many studies have been conducted considering business-level determinants of knowledge integration, especially in multinational corporations (e.g. Birkinshaw, Morrison and Hulland, 1995; Ghoshal, Korine and Szulanski, 1994; Gupta and Govindarajan, 1993; Lamont et al., 2000; Nohria and Ghoshal, 1997).

In many of those studies, absorptive capacity was found to be a crucial determinant of knowledge integration (Gupta and Govindarajan, 2000; Nobel and Birkinshaw, 1998; Szulanski, 1996). Initially, the capacity to absorb knowledge has been identified as a crucial capability of firms for external appropriation and integration of knowledge (Cohen and Levinthal, 1989; 1990; 1994). However, for internal transfer and integration of knowledge among units, too, absorptive capacity is found to be crucial. For example, in a study of internal transfer of best-practices, Szulanski (1996) found that a lack of absorptive capacity with a receiving unit was the most important barrier to internal transfer and integration of knowledge. The study by Gupta and Govindarajan (2000) also indicated that absorptive capacity plays an important role in knowledge transfers between headquarters and subunits as well as among subunits in MNCs.

Since internal network forms of organizing rely on knowledge integration among dispersed and differentiated units, absorptive capacity is especially important to internal networks (Van den Bosch, Volberda and De Boer, 1999). To facilitate knowledge integration among subunits, absorptive capacity with the receiving unit is necessary. Since, as will be elaborated in the sections to follow, absorptive capacity is dependent on prior knowledge endowments, however, the use of absorptive capacity will contribute to its future development. A unit or firm using its capacity to absorb knowledge increases its knowledge endowment, and therefore its absorptive capacity for later in point in time. Since in internal networks management have been found to create the context for organic growth (Ghoshal and Bartlett, 1997), and complementarities between organizational elements influencing knowledge integration have been argued to contribute to that (Zenger, 2002), absorptive capacity is likely to contribute to such growth. In this section, the hypotheses listed in Table 3.3 are developed.

Determinant	**Hypothesis**	
Vertical knowledge flows	H11a	As vertical knowledge flows become more prevalent, the depth of absorptive capacity will increase
Horizontal knowledge flows	H11b	As horizontal knowledge flows become more prevalent, the breadth of absorptive capacity will increase
Depth of absorptive capacity	H12a	As the depth dimension of absorptive capacity increases, the degree of exploration over exploitation will decrease
Breadth of absorptive capacity	H12b	As the breadth dimension of absorptive capacity increases, the degree of exploration over exploitation will increase

Table 3.3: Business-level hypotheses: absorptive capacity

In their seminal papers, Cohen and Levinthal define absorptive capacity as the 'ability to identify, assimilate, and exploit knowledge from the environment' (1989: 589; 1990). Advancing it as a firm-level construct, they argue that this ability is largely dependent on a firm's prior knowledge endowments. Akin to individuals, firms that have developed a knowledge base in a certain domain experience less difficulty learning from the external environment in that domain or a domain close to it than firms lacking this knowledge. Several empirical studies have been conducted that support this notion and its significance to learning and innovation (Ahuja, 2000b; Cockburn and Henderson, 1998; Lane and Lubatkin, 1998; Lyles and Salk, 1996; Mowery, Oxley and Silverman, 1996; Pennings and Harianto, 1992; Pisano, 1994; Powell, Koput and Smith-Doerr, 1996; Shane, 2000; Stuart, 1998; Tsai, 2001; Van den Bosch, Volberda and De Boer, 1999).

Most studies centering on the importance of absorptive capacity to learning and innovation have focused, however, on its outcomes. Far less is known about the aspects shaping absorptive capacity (Van den Bosch, Van Wijk and Volberda, 2003). Since absorptive capacity is resultant from prior knowledge, Cohen and Levinthal (1990) point out that it can be deduced that a firm's absorptive capacity equals the sum of the absorptive capacities of a firm's individual employees. They also contend, however, that aspects that are 'distinctly organizational' shape a firm's absorptive capacity beyond the sum of employees' individual absorptive capacities (p. 131). Yet, with few exceptions (e.g. Lane and Lubatkin, 1998; Van den Bosch, Volberda and De Boer, 1999), understanding of the organizational determinants of absorptive capacity remains limited (Zahra and Geroge, 2002).

Although their data precluded them from empirically testing the role of such organizational aspects, Cohen and Levinthal (1990: 131) argue specifically that a firm's absorptive capacity depends on 'transfers of knowledge across and within subunits'. In many studies, knowledge transfers and communications among subunits have been found to enhance exploration and innovation by themselves as they expedite the combination and creation of knowledge across the organization (Burns and Stalker, 1961; Ghoshal, Korine and Szulanski, 1994; Kusunoki, Nonaka and Nagata, 1998; Lawrence and Lorsch, 1967; Rogers, 1983; Tsai and Ghoshal, 1998; Zander and Kogut, 1995). To date, however, no studies have been performed as to how knowledge transfers contribute to absorptive capacity, and how absorptive capacity associates with innovative performance as the outcome of this relation.

Szulanski's (1996) study on the transfer of best practices among the units of

an organization indicated that a lack of absorptive capacity with the recipient of the best practice is the most important cause of best practices and knowledge not being transferred. However, absorptive capacity is not only crucial on the receiving end. Since absorptive capacity is dependent on prior knowledge endowments and thus on prior learning (Cohen and Levinthal, 1990), lack of absorptive capacity will not only hamper current knowledge transfer, but will hinder further the development absorptive capacity on the future.

Since the development of absorptive capacity takes place not at the corporate level but by individuals, groups, and units at the business level, studying how knowledge transfers in internal networks contribute to the development of absorptive capacity is essentially a business-level phenomenon. When a firm learns from another firm, this is generally done by individuals or units. These actors form the interface of the firm with its environment (Cohen and Levinthal, 1990). The same actors can transfer knowledge to and from other individuals and units within the firm, and so use and develop absorptive capacity at the same time. The development of that absorptive capacity will determine the absorptive capacity of a firm, since it is the sam individuals that act on behalf of the firm in exchanging knowledge with actors in the external environment. Next to the performance implications of transferring knowledge, therefore, knowledge transfer will contribute to the development of absorptive capacity, which can be used for future knowledge transfers.

During the past decade, research into both absorptive capacity and internal knowledge transfers has made significant progress. Despite Cohen and Levinthal's (1990) claim that knowledge transfers across subunits contribute to a firm's absorptive capacity, however, subsequent studies of absorptive capacity have been silent about the role of knowledge transfers. Likewise, studies of intraorganizational knowledge transfers by and large have neglected the importance of absorptive capacity. Instead, research studying knowledge transfers within firms has clustered most notably around studies of how organizations use and increase horizontal knowledge flows in MNCs (e.g. Gupta and Govindarajan, 2000; Nobel and Birkinshaw, 1998), and by the adoption of new organization forms (e.g. Ghoshal and Bartlett, 1997; Hedlund, 1994).

A couple of studies have examined the facilitatory role of absorptive capacity in intraorganizational knowledge transfer. For example, Szulanski (1996) found that a lack of absorptive capacity was the most important barrier to the transfer of best practices in a firm. Similarly, in a study of MNCs, Gupta and Govindarajan (2000) found that absorptive capacity facilitates the flow of knowledge into a

subsidiary. Others have centered on how absorptive capacity fosters learning and knowledge transfers in interorganizational collaborations and networks (Ahuja, 2000b; Lane and Lubatkin, 1998; Mowery, Oxley and Silverman, 1996; Powell, Koput and Smith-Doerr, 1996; Stuart, 1998; Tsai, 2001). With that, studies have focused on the benefits that absorptive capacity brings to a firm in intraorganizational and interorganizational knowledge transfer and learning.

Research into what brings about absorptive capacity in a firm is far less developed. Lane and Lubatkin (1998) found that besides similarity of knowledge bases, similarities of organization structure and similarities of compensation practices between two firms in an interorganizational learning dyad fostered absorptive capacity. Based on two case studies, Van den Bosch et al. (1999) illustrated that organization form and the combinative capabilities in use by a firm influenced absorptive capacity. They argued that the presence of absorptive capacity will be different in firms with distinct organization forms. Further, they proposed that systems and socialization capabilities are likely to increase the efficiency of knowledge absorption, whereas coordination capabilities are prone to increases in the scope and flexibility of knowledge absorption.

Absorptive capacity: two dimensions

Building on theories of the transfer of learning and memory development by individuals (Ellis, 1965; Hilgard and Bower, 1975; Singley and Anderson, 1989), Cohen and Levinthal (1990: 128) argue that absorptive capacity 'is largely a function of the level of prior related knowledge'. Firms experience less difficulty in accumulating and using new knowledge when the knowledge being absorbed is similar or relates to the stock of knowledge already present in a firm, than when this related stock of knowledge is not in place. In that vein, Shane (2000) found that the ability of entrepreneurs to learn and discover new opportunities improved as prior experience was higher. Similarly, Pennings and Harianto (1992) found endorsement for the influence of absorptive capacity in a study of the adoption of video banking by commercial banks. They found that the propensity of banks to adopt video banking was largely determined by cumulative experience with information systems rather than by asset investments in such systems.

In the context of interorganizational networks, many studies have also shown that the ability to absorb knowledge from partners increases with the knowledge overlap or relative knowledge base of partners (Lane and Lubatkin, 1998; Mowery, Oxley and Silverman, 1996; Stuart, 1998). In the hypothetical case that two firms or units share exactly the same knowledge base, there is nothing to learn;

knowledge is completely common to both firms or both units. In contrast, when two firms or units have knowledge bases that are precluded from any overlap at all, the necessary background to learn from each other is absent; knowledge is completely diverse to both. In that vein, Marengo (1998: 227) argued that 'organizations whose members share a perfectly homogenous knowledge base do not face any "cognitive" obstacles to effective coordination, but are likely to present little scope for learning and adaptation, as mutual learning is not possible … [whereas] diversity of knowledge allows such learning but makes coordination more problematic'. Hence, absorptive capacity is relative, depending on the knowledge bases of the actors involved (Dyer and Singh, 1998; Lane and Lubatkin, 1998; Khanna, 1998; Kumar and Nti, 1998). Cohen and Levinthal (1990: 134; see also, Prat, 1996) argue that 'the ideal knowledge structure ... should reflect only partially overlapping knowledge complemented by non-overlapping diverse knowledge'. While on the one hand some commonality of knowledge is required among firms learning from each other to enable the absorption of knowledge in a specific domain, some diversity is necessary to absorb knowledge in new domains on the other. Excessive dominance by one or the other will be dysfunctional.

A derivation of the distinction between commonality and diversity of knowledge is that between deep and broad knowledge (Nass, 1994; Wang and Tunzelmann, 2000; Zahra, Ireland and Hitt, 2000). Deep knowledge is associated with specialist knowledge and sophistication of a subject, generally causing its domain to be narrow. Broad knowledge is related to generalist knowledge and a range of subject areas, commonly causing its domain to be shallow. Consequently, depth and breadth of knowledge condition whether knowledge will be common or diverse. Investments in the breadth of knowledge determine the extent to which knowledge will be overlapping or not with a potential learning partner, because it increases the prospect that knowledge will relate to what is already known. Investments in deep knowledge, on the other hand, are required to increase learning performance and to allow a firm to learn about more complex matters (Cohen and Levinthal, 1990; Lane and Lubatkin, 1998). Therefore, dealing with the matter of developing absorptive capacity, firms can alter the trade-off between commonality and diversity of knowledge by investing in deep or broad knowledge (Cohen and Levinthal, 1990; Marengo, 1998; Prat, 1996).

Since absorptive capacity is dependent on levels of prior related knowledge, the distinction between the depth and breadth of knowledge calls forth similar dimensions of absorptive capacity. Depth of absorptive capacity facilitates the

absorption of new, additional knowledge in a domain in which knowledge is already present, and allows a firm to absorb knowledge of more complex and elaborate matters. Since deep knowledge gains from specialization (Cohen and Levinthal, 1990; Leonard-Barton, 1995), depth of absorptive capacity is also likely to increase with the degree of specialization in a firm. Since specialization fosters rationalization and routinization (Scott, 1996), depth of absorptive capacity may also increase the efficiency and decrease the cost of absorbing knowledge (cf. Henderson and Cockburn, 1996; Van den Bosch, Volberda and De Boer, 1999). On the other hand, breadth of absorptive capacity fosters the absorption of new knowledge in domains other than but related to what is currently known, gaining from generalization and scope. In this vein, depth and breadth of absorptive capacity closely relate to Grant's (1996a) notions of efficiency and scope of knowledge integration respectively.

Knowledge flow configuration and absorptive capacity

Besides its manifestation in an organization's interface with the environment, Cohen and Levinthal (1990: 131–132) argue specifically that absorptive capacity 'also depends on transfers of knowledge across and within subunits that may be quite removed from the original point of entry'. They illustrate their point on the basis of a gatekeeper's function, which forms the link a firm occupies with its environment. Absorptive capacity is 'not only a function of the gatekeeper's capabilities but also on the expertise of those individuals to whom the gatekeeper is transmitting the information' (Cohen and Levinthal, 1990: 132). A gatekeeper can forward any potentially valuable incoming information and knowledge to other employees who have a relevant knowledge base to deal with the matter. Similarly, employees can forward the necessary knowledge and information to the gatekeeper. In that vein, communications and transfers of knowledge enable a firm to leverage absorptive capacity throughout the firm.

Transfers of knowledge generally commence with the individual. As Imai, Nonaka and Takeuchi (1985: 360) stress, knowledge accumulated 'at the individual level is transferred to other divisions or to subsequent projects within the organization and becomes institutionalized over time' (see also Nonaka, 1994). However, this process of institutionalization does not occur through flows or transfers of knowledge across subunits alone. Besides horizontal or lateral flows of knowledge across subunits, a firm's configuration of knowledge flows also consists of vertical flows of knowledge that proceed along the hierarchy (Hedlund, 1994; Imai, Nonaka and Takeuchi, 1985). The same configuration can be applied

to a firm's communication structure (Allen, 1977; Blair, Roberts and McKechnie, 1985; Simpson, 1959).

In the studies of both Aoki (1986) and Imai, Nonaka and Takeuchi (1985), the information structures and knowledge flow configurations of Japanese and US firms have been compared, and concluded that they differ substantially. Whereas the information and knowledge structures in US companies were found to be largely vertical, in Japanese companies they appeared mainly horizontal. Studying product development processes, Imai, Nonaka and Takeuchi (1985: 372) found that in the US '[m]ost of the learning is done by an elite group of technical people ... within a narrow area of specialization'. In Japan, on the other hand, employees are assigned to teams and 'encouraged to become generalists by interacting with each other' (p. 372). They refer to these two kinds of learning as 'learning in depth' and 'learning in breadth' respectively.

Another useful distinction in determining the effect of a firm's knowledge flow configuration on absorptive capacity is the scope of knowledge transfer (Winter and Szulanksi, 2001). Through vertical knowledge flows, knowledge is likely to be confined to the vertical chain of departments employees are working in. Since departments in the vertical chain of a firm's hierarchy are generally decompositions of the department in the next higher level (March and Simon, 1958), knowledge will be limited to that area in which these departments specialize. In other words, vertical knowledge transfers are more likely to be of narrow scope (Winter and Szulanski, 2001). As a result, the relevant knowledge base will be more specialized and deeper (cf. Levinthal and March, 1993). Through horizontal knowledge flows, employees are able to interact with employees from other units and other functional departments, broadening the relevant knowledge base. As a consequence, the scope of horizontal knowledge transfers is more likely to be broad, as the chance that they create or greatly modify the organizational setting of the receiving unit is larger (Winter and Szulanski, 2001). Horizontal knowledge flows enable knowledge integration as they increase the embeddedness of organizational units in the firm (Hedlund, 1994; Tsai, 2001). Summarizing,

Hypothesis (11a): *As vertical knowledge flows become more prevalent, the depth of absorptive capacity will increase*.

Hypothesis (11b): *As horizontal knowledge flows become more prevalent, the breadth of absorptive capacity will increase*.

Absorptive capacity and exploration vs. exploitation

In many studies (e.g. Cohen and Levinthal, 1989, 1990; Pennings and Harianto, 1992; Pisano, 1994; Powell, Koput and Smith-Doerr, 1996), it has been found that absorptive capacity increases a firm's ability to innovate. An alternative way to look at innovation is by considering exploration and exploitation (March, 1991). When adaptation calls for increased innovation, exploration is crucial (March, 1995; McGrath, 2001). However, 'an organization is to engage in sufficient exploitation to ensure current viability and, at the same time, to devote enough energy to exploration to ensure its future viability' (Levinthal and March, 1993: 105). As it associates with innovation, exploration relates to long-term performance. In order to perform well in the short-run, however, firms must also devote resources to exploitation. March (1991) points out that both are necessary, but compete for scarce resources. Therefore, if one aspires to consider the whole set of possible outcomes for a firm, exploration is best studied in conjunction with exploitation.

Levinthal and March (1993) argue that the propensity of exploitation to eradicate exploration is the result of two learning mechanisms that organizations generally use to learn from experience: simplification and specialization. They argue that 'learning processes seek to simplify experience, to minimize interactions and to restrict effects to the spatial and temporal neighborhood of actions' (p. 97). Simplification is often achieved by departmentalization through which an organization's structure is decomposed into several parts that mitigate interaction effects in learning (March and Simon, 1958). But, 'learning processes tend to focus attention and narrow competence' as well (Levinthal and March, 1993: 97). When a firm strengthens its competence in a certain practice by learning, and thus specializes, the process of finding a new competence is likely to be impeded (see also, Leonard-Barton, 1995). In that vein, both learning mechanisms are conducive to increases in the depth of absorptive capacity, constituting examples of exploitative learning that eliminate variety and choice (Boisot, 1998).

Exploratory learning, on the other hand, generates variety (Boisot, 1998). For example, Cohen and Levinthal (1990: 133; see also, Schumpeter, 1934) argue that 'interactions across individuals who each possess diverse and different knowledge structures will augment the organization's capacity for making novel linkages and associations—innovating'. In this connection, they point at the Japanese practice of rotating employees across functions to deliberately create a knowledge overlap, so as to foster innovation (see also Imai, Nonaka and Takeuchi, 1985). Cohen and

Malerba (2001) found that the breadth effect of R&D activities, and the diversity it creates is one of the chief causes of technological progress at the industry level too. Further, in a study of mergers and acquisitions, Ahuja and Katila (2001) found an inverted-U relationship between the relatedness of firm knowledge bases and post-merger innovative output. When no overlap or excessive overlap exists between the knowledge bases of two merging firms, no innovative benefits may be reaped from merging. Overlap of knowledge is determined by whether the knowledge base upon which absorptive capacity is built is deep or broad. No or excessive overlap is likely when deep knowledge is involved, leading to less innovation and the exploitation of what is already known. Breadth of absorptive capacity is more likely to lead to partial overlap, and results in higher exploration. Therefore,

Hypothesis (12a): *As the depth dimension of absorptive capacity increases, the degree of exploration over exploitation will decrease*.

Hypothesis (12b): *As the breadth dimension of absorptive capacity increases, the degree of exploration over exploitation will increase*.

CONCLUSION

In this chapter, it was shown that a substantial number of organizational elements operating at the corporate level contribute to shaping knowledge organization. In that vein, it has been postulated that delayering, decreasing headquarter size, increasing levels of decentralization, increasing use of project-based structures while decreasing use of product-based structures and increasing the relatedness between divisions are important structural elements fostering knowledge organization. Similarly, important processual elements facilitating knowledge organization are information technology and human resource practices.

Since the adoption of organization forms entails changes in a wide spectrum of elements, meaning that organization forms are systemic in character, it has also been argued that complementarities or systemics between individual elements are present in shaping knowledge integration. To that end, in concordance with arguments of Milgrom and Roberts (1990; 1995), it has been hypothesized that the marginal benefit in knowledge organization of adopting one corporate-level element may increase with the concurrent adoption of other elements. Changes in sets of corporate-level elements are likely to influence knowledge organization more than changes in individual elements. In internal networks, however,

elements typically characterizing more traditional organization forms are maintained due to heritage and to pursue the benefits of exploitation, specifically product-based structures, a certain degree of hierarchy and a certain degree of diversification. Although these traditional elements individually were hypothesized to decrease knowledge organization, it was hypothesized that the concurrent adoption of "new" corporate-level elements while maintaining traditional ones increased knowledge organization over and above the concurrent adoption of those elements that individually foster knowledge organization. Finally, it was hypothesized that complementarities between corporate-level elements increase performance.

At the business level, this chapter focused on the role of absorptive capacity. Earlier studies have indicated that absorptive capacity is the most prominent determinant of knowledge transfer (e.g. Szulanski, 1996). Here, the facilitating role of absorptive capacity has been extended to how knowledge transfers contribute to absorptive capacity. On the one hand, absorptive capacity is required for knowledge transfer to take place in the beginning (Cohen and Levinthal, 1990). But since absorptive capacity is dependent on prior knowledge endowments, and learning therefore contributes to absorptive capacity, knowledge transfer also contributes to absorptive capacity rather than being dependent on it alone. To that end, a distinction has been made between depth and breadth of absorptive capacity. It has been hypothesized that vertical knowledge flows contribute to depth of absorptive capacity, whereas horizontal knowledge flows contribute to breadth of absorptive capacity. Depth of absorptive capacity, in turn, has been hypothesized to contribute to exploitation, whereas breadth of absorptive capacity has hypothesized to contribute to exploration. Since internal networks largely rely on horizontal knowledge transfers, from this perspective it could be argued that the self-reinforcing cycle of knowledge transfers and absorptive capacity contributes to internal networks' ability to transfer knowledge and innovate.

In the next chapter, the research method for testing the hypotheses postulated in the current chapter is elaborated.

CHAPTER 4
Research Design

The preceding chapters indicated that, although the field of study is strongly progressing, understanding of knowledge integration and organization in internal networks is limited both in scale and scope. Pettigrew and Fenton (2000) argue that research on internal networks still lacks an overarching theory. Although a substantial number of case studies of organizations with internal network forms of organizing have been conducted, most are cross-sectional and, moreover, do not focus exclusively on knowledge-related matters. As a consequence the study of knowledge integration and organization in internal networks is both biased in research method and scarce in generalizable empirical evidence, and has left the field with a variety of research approaches still to be pursued. In this study therefore, both ideographic and nomothetic research approaches were pursued to further understand knowledge integration in internal networks.

Given the state of the field, ideographic research that places knowledge central to study and considers the dynamics involved over time is invaluable to uncover the details of knowledge integration in internal networks. However, the present study also sought to unravel generalizable empirical evidence. As indicated in the literature review, networks influence internal organization at multiple levels. To that end, in the preceding chapter hypotheses were developed as to how corporate-level and business-level elements indigenous to internal networks shape knowledge integration. Therefore, the current study pivoted on a multi-method, multi-level research design, which was carried out to a large extent as part of the INNFORM research program, an international collaboration of researchers coordinated from Warwick Business School in the United Kingdom with participators from universities in France, Japan, Netherlands, Spain, Sweden, Switzerland and the United States (Pettigrew, 1997b; Pettigrew, Whittington and Conyon, 1995; Pettigrew and Fenton, 2000).

Consistent with these matters, two research approaches in three research settings were followed in the present study. First, case studies at multiple levels of analysis were conducted at Rabobank Group covering the period 1988–1998. Apart from seeking corroboration for aspects that appeared crucial in the literature review, the case study sought to find new and emerging patterns that have not been described in the literature. Also, since case study research on internal networks has remained largely cross-sectional, a longitudinal research approach was adopted, allowing for the uncovering of causal patterns of how firms change organizational elements to influence knowledge integration and organization. Second, a questionnaire was developed and administered to the CEOs of the top 4500 companies in Europe, Japan and the United States. Results from the cross-company questionnaire were used to map corporate change and to test the hypotheses relating to determinants of knowledge organization at the corporate level. Third, a questionnaire was developed and administered to all employees of Spectrum, a facilitatory business unit of Rabobank operating as an internal network. The results from this questionnaire were employed to test the hypotheses of business-level determinants of knowledge organization. How the three studies tie together and in which chapters they appear, is given in Table 4.1.

Research method	**Unit of analysis**	**Level of analysis**	**Chapter**
Case study	Rabobank - group - local member banks - business unit Spectrum	 - corporate - business	Chapter 5
Questionnaire	4500 companies in Europe, Japan and the US	- corporate	Chapter 6 Chapter 7
Questionnaire	units in Rabobank business unit Spectrum	- business	Chapter 8

Table 4.1: Levels of analysis and research methods

The chapter is organized as follows. In second section, details on the research method used for the case study analysis are presented. Next, specifics on the questionnaire administered the top European, Japanese and US companies are given. Then, the questionnaire administered in Spectrum addressing the business-level is heeded. Finally, the ways in which the three methods add up and were triangulated are discussed.

CASE STUDY METHOD

Since little is known yet about the transitional and evolutionary processes involved in moving towards internal networks, the effects of their organizational structures and processes on knowledge organization in particular, the case study methodology was believed an appropriate method for current purposes. The case study methodology has been suggested as an appropriate method for examining in-depth phenomena of organizations in their real-life context. Case studies allow researchers to infer causal relations and to grasp holistic patterns in their real setting (Miles and Huberman, 1994; Numagami, 1998; Yin, 1984). In that vein, it serves the purpose of exploring contemporary issues, and of developing and expanding theory (Eisenhardt, 1989).

To bring time and dynamics centrally into the analysis (Kimberly, 1976; Pettigrew, 1992; 1997b), the methodology employed in this chapter resembles a longitudinal case study. Longitudinal studies facilitates the detection of causality, the inference of data on processes, understanding of organizational change, and the inclusion of contextual constraints (Kimberly, 1976). Adopting a methodology as advocated by Pettigrew (1990), we were in search of (1) embedding the case across a number of levels of analysis, (2) temporally interconnecting events, (3) explaining action in its context, and (4) linking process to outcome. In that capacity, the research method is on all fours with the contextualist research tradition in which an event or phenomenon is investigated 'in its setting'; that is, not only the socio–economic, political and business context, but the intraorganizational context were of concern (Pettigrew, 1985).

Research setting and design

The financial services industry was believed to be a promising field to perform the case study analysis. Over the past years, the international financial services industry has become a highly volatile field world-wide (e.g. Crane and Bodie, 1996; Flier et al, 2001; Van der Heijden and Bernaert, 1994). Therefore, many international banks have started to reconsider the modes of organizing they employ, and have started experimenting with new forms of organizing. One notable example is US–based Banc One, which has become a stereotypical example of replicating knowledge and best practices (Winter and Szulanski, 2001).

The case study in this study was carried out at Rabobank Group, a Dutch multinational financial services corporation employing about 44,000 people, which instigated in 1988 a corporate–wide transition towards a new mode of

organizing. Therefore, the period covered in the case study was 1988–1998. The third financial services corporation in the Netherlands behind competitors ABN–AMRO Bank and Internationale Nederlanden Group (ING), Rabobank ranked 225th in terms of total revenues and 42nd in terms of total assets on Fortune's Global 500 of 2001. Owing to its expertise of the agricultural, health care and food industries, Rabobank is even the second largest player in these industries in many foreign countries such as Australia and the United States. Rabobank listed 29th in terms of total revenues in the global financial industry rankings (*Fortune*, July 22, 2002). Moreover, at the time of the research, Rabobank was the only financial institution in the Netherlands and one among the 20+ in the global financial industry accredited the AAA-rating for credit liability by US rating companies Moody's and Standard & Poor's.

Yin (1984) argues that a case study design can be either holistic or embedded. In spite of the holistic view that was maintained as a requirement for longitudinal case study research (Pettigrew, 1990), we employed an embedded case study design embodying three units of analysis, as illustrated in Figure 4.1. First, the corporate level was analyzed by considering the transition of Rabobank at the Group level. Second, the business level was addressed by heeding the change process of the local member banks through which domestic clients are served. Third, the business level was also considered by analyzing the operation as an internal network of a facilitatory business unit called Spectrum.

Since Rabobank Group was undergoing a corporate-wide transition towards an internal network form of organizing, the corporate level constitutes the first unit of analysis. Although Rabobank experienced a corporate–wide change journey, different parts within Rabobank Group at distinct departure points and found themselves in distinct phases of change. Besides that distinct phases of change could indicate different change trajectories, another rationale for adding two units of analysis was to provide for the depth the corporate level of analysis could not provide. The local member banks and the facilitatory business unit, each in a different phase of development, were therefore framed within two separate units of analysis. Since the two embedded units were in different phases of transition—the local member banks starting off to become an internal network, while Rabofacet–Spectrum is experiencing the challenges involved in being an internal network—they were prone to provide comparative data.

While these two embedded units of analysis allowed for a closer look at transition processes to internal networks, the corporate unit of analysis was chosen to explore the questions involved in managing differential paces of change.

The two embedded units of analysis focused on changes in organization structure, management and organizational processes during transition, their effect on knowledge organization, and the barriers and supporting factors involved in integrating knowledge and moving towards an internal network. In that vein, the two units of analysis at the business level were contextually embedded in the corporate level, the first unit of analysis. Although the history of Rabobank is narrated to further improve on the contextualist character of the case study (cf. Pettigrew, 1985), the major focus is on *the period 1988–98*. This period covers the entire change process from the start through the achievements made by Rabobank Group (see also, Van den Bosch and Van Wijk, 1999; Van Wijk and Van den Bosch, 2000).

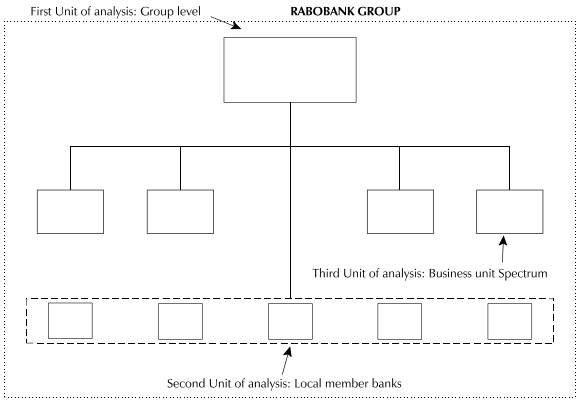


Figure 4.1: Embedded case study design in Rabobank

Data collection

Data was obtained by a total of 40 semi-structured pro forma interviews in the period 1996–98, as listed in Table 4.2. At the Group level, 7 interviews were conducted with managers and members of the Strategy department at the central organization Rabobank Nederland in 1996. The strategy department was one of the prominent players during the change process. In conjunction with Rabobank's top management, many aspects of the change process emerged in that group, providing an excellent setting to uncover details of the change process at the

corporate level and the interrelationships between the change journeys of different parts within Rabobank.

In that same year, interviews were held with 18 general managers directing local banks to gain insight into processes of change and the management of knowledge in particular at the local member banks. As local member banks differed in size—the largest local bank reported total assets exceeding € 1 billion, while the balance sheet total of the smallest local bank amounted to approximately € 20 million—general managers were approached so that the size distribution of the banks they directed was proportionate to that of the entire population of local banks.

Interviewed persons	**Number of interviews**
Group level: Rabobank Group	
Members of the Strategy Department	7
Business level: Local member banks	
General managers heading local banks	18
Business level: Spectrum	
Business unit manager Management team members Clustercoordinators / Project managers	168
Total	40

Table 4.2: Interviews

Data on the process of change and knowledge processes at Spectrum was obtained by interviewing 15 members in the period 1997–98, ranging from the business unit manager and (former) Management Team members (N=7) to clustercoordinators and project managers (N=8). Being responsible for a larger group of employees, these persons were most involved in both changes at Spectrum and daily operations. Additionally, a substantial number of informal talks with employees throughout the organization proved to be of value.

Interviews were structured to provide for focus, reliability and increased validity (Yin, 1984), as they allow for repetition and more objective views. However, structured interviews forego on the opportunity 'to let people speak for themselves' in the shaping of our perceptions (Starbuck, 1993: 887; Eisenhardt, 1989). Therefore, it was chosen to have semi-structured interviews, in which

questions could be repeated across interviewees, but at the same time allowed interviewees to move beyond those questions so as to gain insight into certain issues not considered at the outset and to allow certain idiosyncracies to emerge.

Interviews were written up and during each interview side notes were made. These write-ups were used to analyze the case and search for patterns within the case. These patterns were extracted for each level in the embedded case so that cross-case comparisons could be made, as well as reliability and validity could be increased (cf. Eisenhardt, 1989). Since the cases were part of an embedded case study design, juxtaposing the cases generated insight fom multiple levels and angles. At all levels of analysis, the data obtained from the interviews was supplemented by (1) public information sources, such as generic and company–specific magazines and Annual Reports, and (2) private information sources, such as internal memos and archival data to increase the validity of the data (Pettigrew, 1990; Yin, 1984).

CORPORATE-LEVEL QUESTIONNAIRE

To map patterns of change in knowledge integration as well as in the elements shaping it, and to test hypotheses (1) through (10) postulated in chapter 3 (see Tables 3.1 and 3.2), a questionnaire was administered as part of the INNFORM program to the Chief Executive Officers of the top 2000 companies in Continental Europe, the top 1500 companies in Japan and the top 1000 companies in the United States (see Appendix A). Earlier studies using this questionnaire include Pettigrew, Massini and Numagami (2000) and Whittington et al. (1999). Selection of the top slices of the population of firms in each region was based on total assets, which was obtained from various sources, such as CD Europe, Worldscope and Thomson Financial.

Sample selection

In drawing the initial sample, three selection criteria were used. First, the sampling distribution of the various countries had to be grossly proportionate to home-country Gross Domestic Product (GDP). For the Continental European sample, firms based in Austria, Belgium, Denmark, Finland, France, Germany, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden and Switzerland were included. That is, in the initial sample firms from most member countries of the European Union in Continental Europe including Switzerland, typically Western European firms, were included. In that vein, including the US and Japan the initial sample included 4500 companies located in 16 different

countries. The second selection criterion used was that firms had to have at least 500 employees on the payroll. By selecting the largest companies from the three economically most active regions in the world, the bulk of economic activity would be covered. The third selection criterion was that all firms in the sample had to independent, non-governmental, domestically owned organizations. The rationale for excluding from the initial sample firms dependent on others as well as subsidiaries of both domestic and foreign firms was that corporate level phenomena were sought for. The ground for excluding governmental organizations was that these are in general organized differently and do not contribute directly to economic activity.

Questionnaire instrument

The development and administration of the questionnaire was conducted as part of the INNFORM research program. For the major part, the questionnaire was constructed around five-point Likert-type scales. Respondents were asked to indicate the presence or influence of certain organizational characteristics and practices in the firms they worked for in 1996. A value of '1' was generally associated with 'no influence', whereas a value of '5' generally implied 'large influence'.

An initial version of the questionnaire was tested with a substantial group of executive MBA students with a variety of backgrounds. After making the necessary refinements, a second version was piloted to a sub-sample of the population of firms subject to analysis. Then the questionnaires were translated into the native languages for each of the sub-samples. Except for firms in the Dutch and Scandinavian samples, which received English copies, each firm received a copy in the native language of the country it was located in. Native translators were used to translate the questionnaires. After translation, the questionnaires were translated back by a different set of translators, and checked for consistency by the research team. Due to the fact that in some countries more than one language is spoken, Belgian firms received English and French copies of the questionnaire, while Swiss firms received German, French and Italian copies of the questionnaire. The choice which one to fill out was left with the respondents.

The final administration of the questionnaire was conducted in three waves. All questionnaire copies sent out to the CEOs of the firms in the sample were accompanied by a return envelope. The firms that had not responded after three weeks were sent a second copy of the questionnaire as a reminder. If firms still

refrained form responding after yet another three weeks, they were phoned with the request to cooperate. If they were not willing to cooperate, they were asked for their motivation not to do so. It appeared that the majority of non-responders were either too busy, or had competing questionnaires to fill out.

Of the 4500 questionnaires administered, 596 usable responses were received, representing an overall response rate of 13.2 percent. Considering that research targeted at senior executives typically elicits response rates between 10 and 12 percent (Hambrick, Geletkanycz and Frederickson, 1993), and that cross-nation surveys generally tend to decrease response rates because of the inherent difficulties involved (Peng and Luo, 2000), this response rate was considered respectable. The total number of responses from the Continental European sample amounted to 260 questionnaires, equaling a response rate of 13 percent. This response rate was comparable to other European studies of organization change (e.g. Ezzamel, Lilley and Wilmott, 1996). Within the Continental European sample, the response rate of Spanish firms was highest with 22.4 percent. Considering the proportionate distribution of firms over countries based on home-country GDP, 26.5 percent of the firms were German, and 16.9 percent were Spanish. No other European country accounted for more than 15 percent of the responses. The response rate of the Japanese sample amounted to 257 responses, equaling a response rate of 17.1 percent, whereas the response rate of the US sample amounted to 7.9 percent.

As mentioned above, the questionnaires were sent to the CEOs of the firms in the sample. The responses indicated that 23.1 percent of the returned questionnaires were indeed filled out by the CEO, whereas 45.7 percent of the questionnaires were filled out by an executive other than the chief executive, notably executives in charge of personnel and human resources. For the remaining 31.2 percent of the questionnaires that were returned the function of the respondent could not be established.

BUSINESS-LEVEL QUESTIONNAIRE

To test hypotheses (11) and (12), relating to the business level, a questionnaire was administered at Spectrum, a facilitating business unit of the Dutch multinational financial services firm Rabobank Group (see Appendix B). The business unit Spectrum was founded in 1992 with the aim to explore new and emerging opportunities for Rabobank as a proactive response to the turbulence in the financial industry. To that end, Spectrum had grown into one of the most important innovators within Rabobank, providing products and services that were

often new to the financial services industry. These products and services were mainly used in or sold through other organizational units and related to new advisory and developmental activities in, among other things, knowledge management, information technology systems, bank infrastructure, internet, and test centers. Starting off with 30 employees in 1992, by the end 1998 Spectrum had 260 regular employees.

Sample selection

The rationale for choosing this setting was that, at the outset, Spectrum's structure consisted of 6 Areas of Attention with 29 clusters residing within them. Both specialist and generalist clusters were present, the employees of which could communicate and learn from each other to their discretion, both within and across clusters. The number of clusters as well as their foci were held flexible with the purpose to serve market and organizational demands in the best way possible. When different kinds of expertise were needed, teams were established consisting of employees of different clusters. In case the expertise required was not readily available within the organization, this was remedied by enlisting people from partnerships with other firms and business units, or by hiring external part-time employees.

Since absorptive capacity was important to Spectrum not only to allow for the absorption of external knowledge, but to facilitate internal communications and learning processes, the setting was instrumental in establishing face validity of the constructs. Also, both horizontal and vertical knowledge transfers were used to feed both specialist and generalist units within Spectrum with knowledge. Finally, knowledge was used for the development of radically new products and processes, as well as the exploitation and gradual improvement of existing ones.

Questionnaire instrument

With minor exceptions, the questionnaire was anchored around five-point Likert-type scales. Generally, respondents were either asked to indicate the presence or influence of certain organizational characteristics and practices in the clusters and areas of attention they worked for, or were asked to indicate to what extent they agreed to a certain statement relating to Spectrum. A value of '1' was generally associated with 'no influence' or 'completely disagree', whereas a value of '5' generally implied 'large influence' or 'completely agree'. In order to develop the questionnaire instrument, the 15 extensive semi-structured interviews that were held as part of the case study with members of Spectrum's management

team, cluster coordinators, and other employees were used as input. In addition, 3 meetings were held with members of Spectrum's Management Team and cluster coordinators specifically to develop and improve the questionnaire. Then, to mitigate measurement error resulting from the questionnaire, that version was pilot tested before the final questionnaire was administered to all 260 employees.

To increase the response rate, the questionnaire was issued twice with a three week interval. After those two waves, telephone call reminders was conducted in which potential respondents were queried whether they would still be willing to fill out the questionnaire. If so, the potential respondent was mailed an additional copy of the questionnaire with the request to return it within two weeks. A return envelope was enclosed with all questionnaires so that the respondents could mail the questionnaires directly back to the research team. On every occasion, it was communicated to the respondents that the questionnaire would be treated confidentially. Upon completion, 6 questionnaires were returned blank, whereas 100 usable responses were obtained, reflecting an effective response rate of 38.5 percent.

Sampling bias

To establish whether sampling bias was present in the sample two tests were performed. First, the distribution of the respondents over different organizational levels, different locations, and different clusters was compared with that of the population. Chi-square tests indicated that the distribution of respondents in the sample was not significantly different from the distribution in the population at $p < 0.05$. Second, the same variables were used to compare the responses from the questionnaires that were mailed to the respondents in the first mailing round with those received after the telephone call reminders. The *F*-statistics obtained from analyses of variance indicated that for none of the variables the responses from the first and second round were significantly different at $p < 0.05$. On the basis of both these findings, it could be concluded that no systematic response bias was present.

TRIANGULATION

The aim of empirical research is either to expand current theory or to test hypotheses derived from current theory. Important considerations when choosing a proper method for the purpose at hand are the validity and reliability of constructs and measures. As argued above, the present study employs a qualitative and a quantitative approach. Both case study research and

questionnaires were used. To improve the strength of the main conclusions that can be drawn from all methods, triangulation is an important issue (Denzin, 1978; Flick, 1992; Jick, 1983).

Following Denzin's (1978) classic distinctions, three types of triangulation relevant to this study can be discerned. The first is data source triangulation, which has three subtypes: time, space and person. That is, data should be collected at a variety of times, in different locations and from a range of persons and collectivities. The second is investigator triangulation, that is, using multiple rather than single observers of the same object. Finally, the third, methodological triangulation has two subtypes: within-method and between-method triangulation. Within-method triangulation is achieved by using, for example, in a questionnaire, a combination of attitude scales, forced choice items and open ended questions. Between-method triangulation involves the use of various methods, and is generally considered to be the most important (Jick, 1983).

These three types of triangulation were all pursued in this study. Data source triangulation was made possible in conducting the case study through interviewing multiple respondents at different times and different parts in the organization about similar phenomena. Data source triangulation was also facilitated in the questionnaires where primary data directly from the questionnaire was compared and supplemented with other sources providing the same or at least similar data. Investigator triangulation was not directly made possible in the current study. However, since the study was conducted as part of the INNFORM research program, where the inputs of multiple investigators and researchers led to the development of the case study format and the construction of the corporate-level questionnaire, triangulation was facilitated. Finally, method triangulation was made possible by using both qualitative and quantitative research methodologies, as well as by having multiple scales and questioning formats in both the corporate-level and business-level questionnaires.

CONCLUSION

The multi-method, multi-level research design described above allowed for the uncovering knowledge integration and organization in internal networks at multiple levels of analysis. The case study at Rabobank incorporated the corporate and business levels of analysis, and allowed for a detailed analysis of the changes in organization structures and processes necessary to influence knowledge integration. It also served as input for the construction of the two questionnaires. The questionnaire developed as part of the INNFORM program served to unravel

determinants of knowledge integration at the corporate level. The questionnaire administered at the Rabobank business unit Spectrum was deployed to test the hypotheses on how absorptive capacity operates in internal networks, by testing how it is determined by knowledge flow configuration, and determines innovative performance. By means of these various research approaches, and the ability to triangulate the results emerging from them, the study aimed to gain additional insight into how internal networks operate in influencing knowledge integration and organization.

CHAPTER 5

Transition Process to an Internal Network and its Effect on Knowledge Integration

An Embedded Case Study at Rabobank Group

This chapter aims to provide new empirical insights into the developmental process of internal network forms of organizing by means of a longitudinal case study conducted at Rabobank Group (see also, Van den Bosch and Van Wijk, 1999). It assesses the corporate-wide transition of Rabobank Group, a Dutch–based multinational financial services corporation, towards an internal network form of organizing over the period 1988–1998. In line with the research question, the case study focused particularly on how changes in organization structure and organization processes, as well as in the complementarities among them, influenced the integration and organization of knowledge and how these contributed to performance at Rabobank.

To illustrate the intricacies involved in changing into an internal network form of organizing, the case study was framed along the line of an embedded case study design with three units of analysis at different levels of analysis. Consistent with the research approach of this study and the literature on corporate strategy, which signals a shift from a controlling and monitoring role of corporate headquarters to a role in which corporate headquarters facilitates self-organizing processes of business, both the corporate and business level were considered. Addressing the corporate level, the first unit of analysis concerned the transition process of Rabobank Group. Besides Rabobank's drivers for change, the pace, scope and depth of the change process towards internal network forms of organizing are analyzed for different units within Rabobank. Analyzing the transition process from the corporate level, the case study paid attention in particular to the differential paces of change of various units and divisions, and the bipolarities in structure that emerged as a result of these different paces. Both hierarchical and internal network forms emerged at corporate level and at various units.

The second and third unit of analysis are constituted by two organizational units of the group that pursued different change trajectories to describe in depth the challenges involved in changing into internal networks. As the second unit of analysis, the local member banks were amidst the change process towards an internal network form of organizing. This analysis describes how the change trajectory of the local member banks was influenced by organization structure and processes acting as barriers of knowledge integration among local member banks. The third unit of analysis involved a longitudinal analysis of a facilitatory business unit, Spectrum, which was created as an internal network and functioned as a template for creating internal networks in other parts of the Rabobank organization. Considering its initial creation and its subsequent transition into and evolution as an internal network, this analysis pays attention to both supporting and inhibiting determinants of knowledge integration emerging from organization structure and organization processes.

The remainder of this chapter is structured as follows. In the second section, a historical overview of Rabobank and its evolution during its 100-year existence is provided. In the section to follow, the corporate-wide transition process of Rabobank at the corporate level is analyzed. Then, the transition process of the local member banks is considered. In the next section, the evolution of the facilitatory business unit Spectrum is analyzed. With regard to all three units of analysis attention will be paid to drivers for change, content and process sequencing, depth and pace of change, barriers, and the consequences of adopting an internal network. The chapter concludes with a summary of the main findings.

RABOBANK GROUP: HISTORICAL OVERVIEW

A cooperative, Rabobank celebrated its 100-year existence in 1998. Although the name 'Rabobank' was adopted only in 1972, the financial services corporation traces its origins back to 1898 when 46 local agricultural credit cooperatives spread throughout the Netherlands were merged into two credit federations, Raiffeisenbank and Boerenleenbank. Simultaneous to the merger, each of the two credit federations decided in conjunction to establish a central organization. The local Boards also decided that the central organization was not to be positioned on top of the chain of command, and that the banks, as cooperatives, should remain operating as a decentralized organizations. This meant that local banks were completely autonomous and self-responsible for their actions. The central bank acted only as an advisor and supported the local credit institutions in case such needs were present.[3]

In the first 60 to 70 years of the twentieth century, societal developments led Rabobank to change the way in which it had traditionally operated. Increases in the number of local banks to a maximum of 1324 in 1955, the inclusion of non-agricultural customers to the customer base, the inclusion of the small and medium sized enterprise (SME) and large enterprise sectors into the client base, as well as further diversification of the branch made customers more heterogeneous. To increase adaptive ability of the banks to deal with these changed circumstances, it was decided in 1972 to unite Raiffeisenbank and Boerenleenbank into one organization: Rabobank. In 1980, the year in which the first international Rabobank subsidiary was opened, the name of the central organization was changed into 'Rabobank Nederland'. In the first century of its existence, Rabobank Group has thus evolved from a domestic agricultural bank serving farmers with savings and loans products to a high-tech multinational financial corporation offering the gamut of financial products and services to a broad range of customers. Still, the bank has continued to operate as a cooperative during all those years.

During the last decade, financial performance of Rabobank has improved steadily (see Figure 5.1). In the period 1988–1998, most finanvial performance measures increased by approximately factor 2.5. Total assets have increased from € 73,320 million to € 249,718 million. Respectively, total income and operating expenses have increased from € 2,202 million and € 1,444 million in 1988 to € 5,832 and € 4,099 million in 1998. Net profits have risen from € 353 million in 1988 to € 936 million in 1998. When compensated for yearly consumer price indices, these performance figures still have more than doubled in the period 1988–1998.

Rabobank's domestic and international growth is also reflected in the development of the number of employees, international subsidiaries, and local banks in the last decade, as displayed in Figure 5.2. Although a small decrease took place in the period 1992–1995, the number of employees increased from 33,200 in 1988 to 49,465 in 1998. Of these, the central organization, Rabobank Nederland, had 5401 employees on the payroll in 1988 and 10239 in 1998, marking an increase of, respectively, 16.2 percent to 20.7 percent of total workforce. In the same period, Rabobank also extended its international presence with the number of international subsidiaries increasing markedly from 24 to 150. The number of domestic local banks, on the contrary, has almost halved from 906 to 445 in the period 1988–1998, mainly resulting from a restructuring process in which smaller banks were merged into larger ones. In that way, the average

number of employees per local bank increased from 30.0 in 1988 to 51.4 in 1995 to 77.7 in 1998. Together with the international expansion, the concentration process of merging local banks into larger units was an integral part of the change journey towards a new form of organizing that Rabobank instigated in 1988.

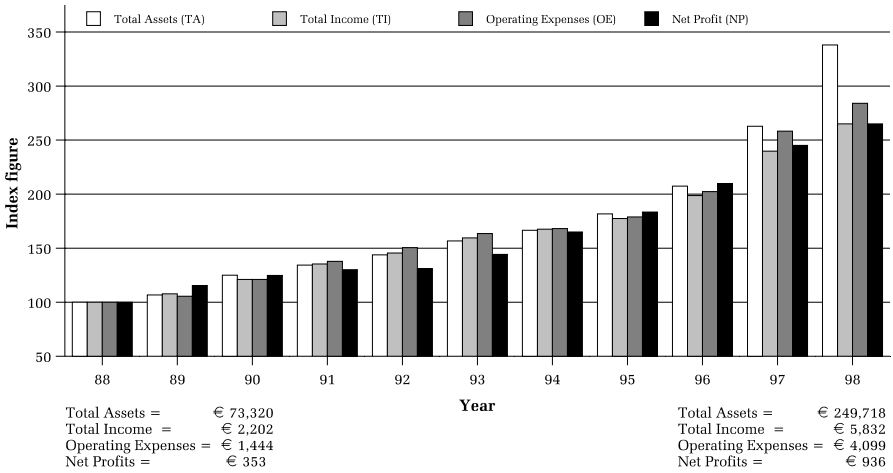


Figure 5.1: Performance index figures Rabobank Group, 1988–1998 (1988 = 100) (source: Annual reports)

THE CHANGE JOURNEY OF RABOBANK GROUP: CORPORATE-LEVEL

The cooperative identity that Rabobank Group adheres to has always been a strong intraorganizational contextual variable that guided the development of Rabobank. Since the cooperative principle entails that Rabobank's assets are furnished by its member clients (see footnote 1) and that Rabobank maintains a strong foothold in society in general, this has resulted in a culture in which the client is placed centrally. At Rabobank, everything starts with the client. As Rabobank's CEO stressed in 1996, Rabobank's strategy is that it 'unremittingly seeks to link-up with the changed and changing societal circumstances' (Wijffels, 1996). Because local banks are responsible for their actions at both the strategic and operational level, most market knowledge is retained at the local banks. As a result, in contrast to Rabobank's competitors who rely on the corporate

hierarchy, Rabobank's the local member banks can create a competitive edge through continuous assessment of what clients expect from their bank.

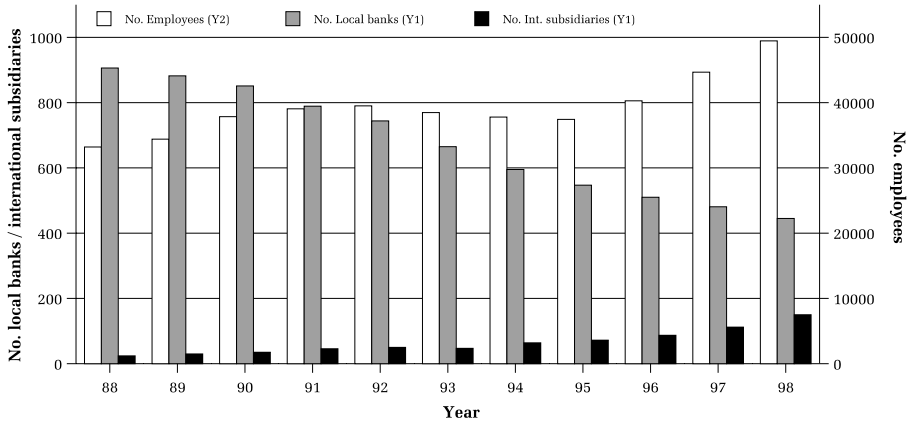


Figure 5.2: Number of employees, local banks and international subsidiaries of Rabobank Group, 1988-1998 (Source: Annual and Social reports)

In the earlier years when the mass market for products prevailed, it was difficult for Rabobank to differentiate itself from its main competitors. But in the late seventies and eighties, demanding customers, corporate clients in particular, started to ask for more integrated financial products that, also because of legislative changes, could provide tax benefits. Consequently, banks were compelled to bring All-Finanz or Universal Life Products to the market. These products are characterized by the combination of previously separately offered products, such as insurances, mortgages, savings, investments and loans.

This development led to an industry-wide concentration movement in which some of Rabobank's competitors merged, others followed an acquisition trajectory, but most did both. Whereas Algemene Bank Nederland (ABN) merged with Amsterdam–Rotterdam Bank (AMRO bank) to form ABN-AMRO Bank and remained in the banking industry, Nationale Middenstandsbank (NMB) merged with insurer Nationale Nederlanden (NN) to form the banking-insurance combination Internationale Nederlanden Groep (ING). The latter also acquired Postbank in 1992, formerly known as Rijkspostspaarbank, which was Rabobank's main rival in the first half of the twentieth century. These two financial conglomerates that emerged from the concentration wave have continued to be

Rabobank's main competitors since the mid-eighties.

To implement its strategy, Rabobank also took part in this concentration wave by acquiring cooperative insurer Interpolis in 1990, and after a collaboration of 7 years, global top 10 investment banker Robeco in 1997. In addition, Rabobank entered the large cooperative alliance network UNICO, comprising Austrian RZB, Belgian CERA, German DG Bank, Italian ICCREA, Finnish OKO Bank and Swedish Förenings bank, to provide its international clients with tailored products and services. In this *external network* Rabobank became the nodal bank together with French-based Credit Agricole, with which it started to cooperate in 1990, and with total revenues of $35,668 million listed 107th and with total assets of $501,535 million listed 22nd on Fortune's Global 500 in 1998 (*Fortune*, July 22, 2002). These developments formed an integral part of Rabobank's change journey.

Drivers for change at Rabobank

The blurring boundaries in the financial services sector have challenged financial institutions to change and integrate their products and services. Although Rabobank's traditional competitor Postbank maintained its focus on selling mass products, Rabobank's competitors ABN-AMRO and ING pursued, in the words of a member of Rabobank's strategy staff, 'a strategy tied to the extended product function'. These competitors offered a broad range of products and services, and aimed to integrate them basically by 'taking them off the shelves and combine them'.

Since 'Rabobank could not entirely live up to the environmental dynamics in those years' according to the same member of Rabobank's strategy staff, these developments stimulated Rabobank to move even further. It was felt that only by means of a leapfrogging strategy Rabobank could differentiate itself from its competitors. As the CEO of Rabobank, Herman Wijffels, commented on Rabobank's transformation, because of the individualization of society 'the turn that had to be made … is the transformation towards the capacity function … [where] client wishes constitute the full guiding principle, [and] the bank possesses the expertise to fulfill these' (1996). Based upon this strategy, Rabobank aimed to be a fully customer-driven organization, and to offer clients fully tailored products, rather than the semi-tailored products that result from integrating products off the shelves. However, this strategy required that Rabobank adopted a new mode of organizing, one in which knowledge could be more easily integrated and used.

Apart from this strategic intent, a second and related driver made Rabobank

adopt a new form of organizing. Besides dealing with environmental dynamics impinging upon Rabobank, Rabobank has undertaken this corporate-wide change process to revitalize the cooperative identity of Rabobank Group. As Rabobank's central organization Rabobank Nederland grew both in size and influence due to the mergers and acquisitions in the mid and late eighties, Rabobank Group, just like its competitors, came to resemble more a large hierarchy instead of the decentralized organization it used to be ever since Rabobank's founding in 1898. As a result of this gradual evolution to a centralized organization, many organizational units began to complain that 'Rabobank Nederland does not know what happens in the localities lower down the hierarchy. I say hierarchy, but that is what it seems to be right now, because at the same time, corporate headquarters increasingly begins to impose its strategies upon the local member banks, thereby diminishing their autonomy', as a local bank general manager commented. In addition, partly because of the strong role of Rabobank Nederland, the local units themselves did not know where and with whom to find appropriate knowledge.

The complaints were not put aside and given attention by Rabobank Nederland. The central organization, too, considered inappropriate the hierarchical organization form that had gradually emerged to implement Rabobank's new strategy. As the CEO explained,

> The hierarchical, pyramidal structure, with its tendency to uniformity, belongs to the past. The present era demands differentiation and specification, and with that, units with a large degree of autonomy. They have to serve the market and clients in a differentiated fashion. Adapting to client needs forces to lay responsibilities on the level where contacts with the clients occur. … Traditional organization concepts start from concentration of knowledge at the top, to be directed downwards via the hierarchy. Owing to the distribution of knowledge, it has become impossible and unnecessary to manage organizations from the top. An inversion of that organizing principle is necessary. Basically, the pyramid has been inversed upside-down. But that is not a stable organization form. Hence, it is better to think in terms of *the network concept*. The organization as a system of relations between people, who collectively want to realize a shared idea. … Central to the network concept is that all cells, call them expertise centers, in the network have their own responsibility. One cannot speak of subordination, but of mutual service rendering based on equivalence. It is a living organism, in which every cell performs its own function, without getting formalized instructions. The core notions of a network are "working together" and "environmental awareness". Only by realizing that your behavior also bears effects on other cells in the system, you will come to good choices (Wijffels, 1996; italics added).

As environmental turbulence increased in the shape of the individualization of society, increasing concentration of the financial industry, developments in Information Technology and further development of All-finanz products, top

management began to see the necessity of restructuring in 1988. Furthermore, as Rabobank needed to broaden its scope through the further inclusion of corporate clients to remain competitive vis-a-vis its major rivals ABN-AMRO and ING, 'a regrouping of tasks, competences, and responsibilities' (Annual Report, 1988) was in order. It was felt that less emphasis should be laid upon the local member banks, traditionally the mainstays of Rabobank, while other units at Rabobank should receive more attention to serve corporate clients more effectively. After first discussions in 1988, the two or three years thereafter provided the Executive Board with sufficient support to move towards a new form of organizing.

According to its CEO, Rabobank's transition was largely the result of 'the changes "on the outside" [that took] place quicker than ever.' However, Rabobank's CEO still accredits the largest part of the change to an *internal driver*, as he talks about the 'line of fracture' that constituted the start of the transition process Rabobank was about to undergo:

> For we operate on the basis of continuity, there was no external factor, such as a merger, a privatization, or an introduction on the stock exchange, that symbolized the line of fracture. In the shape of a new style, we deliberately created and symbolized such a line of fracture, and as such marked the transition from a product-driven towards a customer-driven organization (Wijffels, 1996).

The new style Rabobank attempted to adopt involved two important complications, however. First, although Rabobank aimed to be customer-driven, it could not abolish selling mass products, for there was still a large market for such products in the form of standard mortgages, savings, loans, and so forth. As mentioned above by Rabobank's CEO, such products can only be exploited by means of the economies of scale a hierarchical organization generates. Thus, Rabobank needed to maintain at least some of its hierarchical form to preserve the exploitation of mass products, while it needed to introduce an internal network-based form or organizing to preserve the exploration of new, client-tailored products in line with market demand. Second, in 1988 Rabobank was made up of three major divisions: Wholesale Banking, Support Services and Member Banks (see Figure 5.3). These three divisions were so differentiated in terms of customers they served and type of products they offered that they could not be part of the same network to integrate the knowledge and resources they built upon. Whereas the Wholesale Banking division served corporate and international clients, and Support Services mainly supplied organizational units within Rabobank with the services required to perform tasks, the Member Banks division served domestic

clients. All these clients demanded different products, so that the units serving them maintained different types of knowledge.

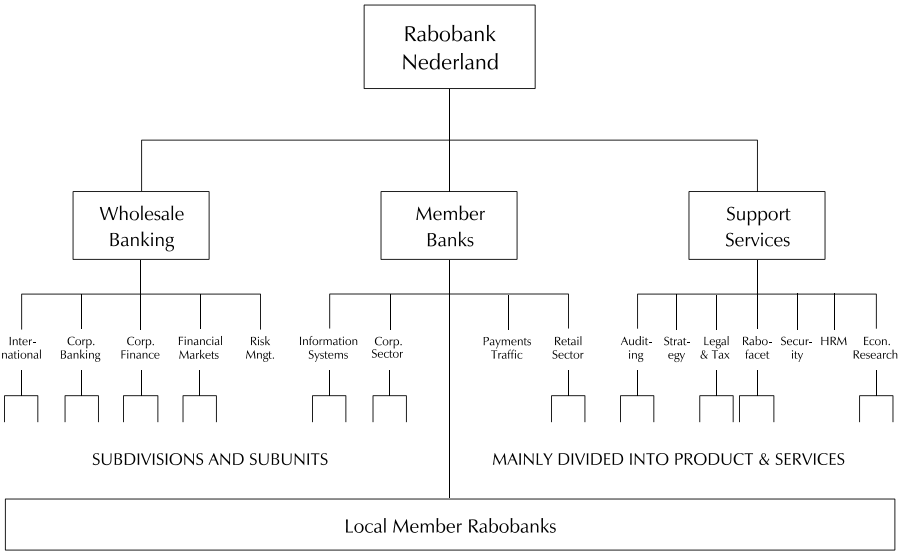


Figure 5.3: Organizational structure Rabobank Group 1988 (source: Annual report)

Scope of Rabobank Group's Change Journey

Although the corporate level transition process started off in 1988, the change journeys of distinct divisions had their own year of departure, either because they were not prepared yet to undergo such an encompassing change in 1988, or because they were included in Rabobank Group after 1988, such as insurer Interpolis and investment banker Robeco, acquired in 1990 and 1997 respectively. Before 1996, these acquisitions were normally included in the corporate hierarchy in a fourth division (as in Figure 5.3). As of 1996, each acquired company, previously combined in the same division, formed a separate division, so that synergies between divisions were easier to establish.

Reflected in that the Annual Report did not contain an organization chart in that particular year, the year in which Rabobank's corporate structure underwent the largest change was in 1996. Figure 5.4 depicts the structure of Rabobank in

1998, which resulted from the major change in 1996, with eight major divisions created during the corporate level transition. Comparing Figures 5.3 and 5.4, it is clear that Rabobank Group became less centralized as part of the transition over the period 1988–1998. The number of organizational layers was reduced so that vertical lines became shorter and market responsiveness increased. This reduction entailed, however, that the number of divisions increased. Each division or unit obtained more discretion to make both operational and strategic decisions. The Member Banks Support division, which advises and helps local member banks as their daily business routine, was moved from a line to a staff position in 1996, in an attempt to make it easier for local member banks to consult other local member banks and other organizational units directly instead of through this unit.

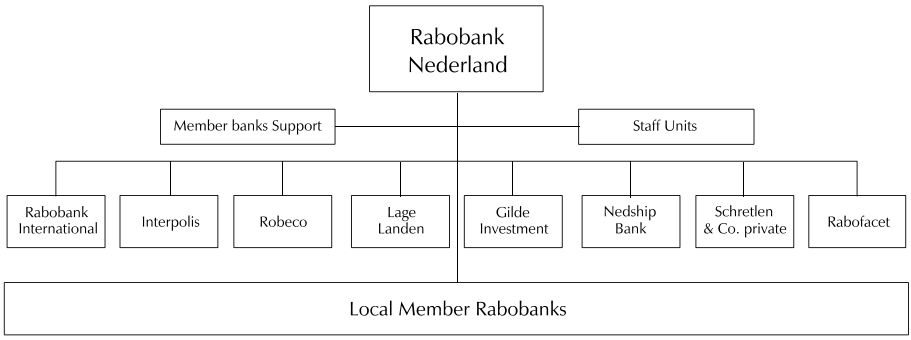


Figure 5.4: Organizational structure Rabobank Group 1998 (source: Annual report)

The Annual Report of 1999 contains the structure of Rabobank that was the outcome of the 1988–1998 transition process. Although the structure of Rabobank in 1999 was basically not different from its structure in 1998, as illustrated in Figure 5.5, Rabobank's structure has come to constitute an internal network. The difference lies mainly in looking from above instead of from the side. With the corporate center acting as headquarters, and with multiple divisions, hierarchy is still present in the structure of Rabobank. However, the structure illustrated in Figure 5.5 denotes that synergies and collaboration between units and divisions is searched for, underscoring that processes are more important than structures in internal networks forms of organizing.

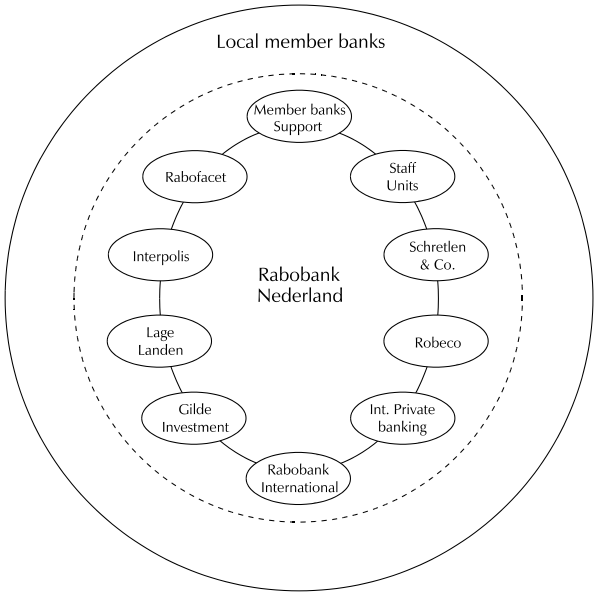


Figure 5.5: Organizational structure Rabobank Group 1999 (source: Annual report)

Differential paces of change

Because Rabobank consisted of many divisions and units that each served different products for different clients, each division and unit pursued a different change process at distinct paces. Of all the divisions and other organizational units, Spectrum was the first to initiate an internal network. In line with the demand for knowledge for Rabobank's new strategy, Spectrum was deliberately created in 1992 as an internal network with the aim to provide Rabobank Group and its units with cutting-edge knowledge mainly in Information Technology.

As a facilitatory business unit, Spectrum was positioned in the facilitatory division Rabofacet. In addition to providing knowledge to other parts of Rabobank, during the 1992–1998 change period described below, Spectrum constituted a learning platform from which other divisions and units within Rabobank Group could learn. The fact that Spectrum served as a template did not prevent problems with other Rabobank units from occurring, however. As a Spectrum Management Team member clearly illustrated,

> 'Spectrum operates in the hierarchy of Rabobank Group. Sometimes you face tremendous walls. For example, at one point in time we started visiting local member banks to see what they could use in terms of information technology systems ... to see what best practices they could use. But to implement and coordinate these systems you need others from the rest of Rabobank. Since Rabobank has a hierarchy, these things can take a long time. But you still need that hierarchy. Otherwise it will not become a formal Rabobank product. But then other units from Rabobank hear about our visits to local member banks, and say: "it cannot be that you guys do things we are already doing, and it also cannot be that you guys do things we are not doing". Obviously you have a problem here.'

Since Spectrum worked together with other units within Rabofacet, this applied in particular to other units that were part of Rabofacet.

Because of these matters and the success of Spectrum, Rabofacet as well as other organizational units underwent the change towards an internal network form of organizing in 1996 as part of the corporate-wide transition. Rabofacet went from being a hierarchy with two divisions, each commanding several units, to a flatter organizational structure with 14 business units, in order to facilitate collaboration between its units. Rabobank International's change program towards an internal network form of organizing also commenced in 1996, the year in which Wholesale Banking, traditionally serving international clients, was renamed into Rabobank International. In 1998, Rabobank International has even started to capitalize on its organizational form by publicly advertising in national magazines and on national television that because of the network structure they adopted, clients of, for example, the office in Sydney or London can benefit from knowledge generated in the office in Hong Kong.

The transition of the local member banks was preceded by two change programs: FOCUS and EDLB. The corporate change program FOCUS was instigated to increase customer-responsiveness at Rabobank, by establishing two different business templates, one for standard and one for tailored products, along which customers with different demands were to be served. The local bank change program EDLB (Efficiency Drive Local Banks) was instigated to increase the efficiency of local banks by sharing the best practices of some high-performing local banks. Furthermore, in 1991 an internal labor market was started off to abolish the regional recruitment procedure that had been in place, and to benefit from the knowledge employees had gained working in different parts of Rabobank. In the context of the two corporate change programs FOCUS and EDLB, the successive change journeys at the local member banks and the Support division were based on what was called Vision '98. As an extension to FOCUS, this program was initiated in 1995 as the new organizational vision with the formal

incorporation of a new banking style and a new corporate logo that changed Rabobank's position in the financial services industry to further the change process at Rabobank towards an internal network form of organizing. Nevertheless, the actual change process at the local member banks started in 1997–8. In 1998, the Member Banks Support division initiated a development towards a 'flexible network organization'.

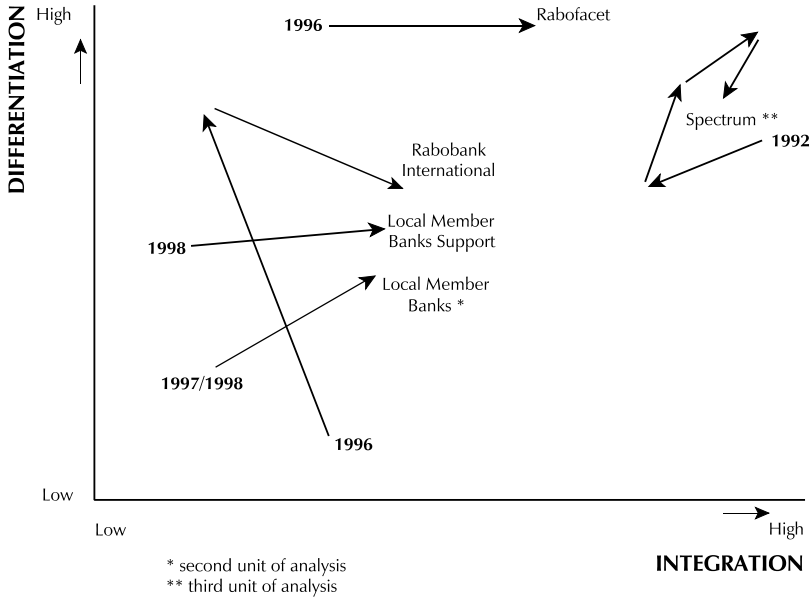


Figure 5.6: Differential paces of change of five parts of Rabobank Group (solid lines represent followed change processes)

Figure 5.6 tentatively illustrates the phenomenon of differential paces of change at five parts of Rabobank, by relating the chan0ge process of each of these organizational parts in terms of organizational differentiation and integration, horizontal integration in particular. As mentioned above, two of these five parts, the local member banks and the business unit Spectrum, relate to units to be discussed separately below. As will be elaborated below, except for their size and markets served, local member banks were much alike. As a result, most local banks offered similar products based on similar knowledge bases. Therefore, the degree of differentiation between banks was relatively low. At the same time,

since they operated largely autonomously without consultation of other local banks, the local banks were not tightly integrated on a horizontal basis. This is reflected in Figure 5.6: the starting point of the change process is in the left corner below. Therefore, the change process of the local member banks, starting in 1997–1998, was initiated to increase the local banks' position on both dimensions. The knowledge stocks of local member banks were more differentiated. Increasing horizontal knowledge flows should preserve the integration of their knowledge stocks.

Rabofacet's change process, starting in 1996, was intended to increase the integration of its already differentiated business units by increasing the collaboration between them. Also starting in 1996, Rabobank International's change process was a trajectory in which the differentiation of the international subsidiaries increased, followed by a process to increase the integration of these subsidiaries by emphasizing the knowledge sharing between them. Since 1996, Rabobank International has been systematically implementing a knowledge-driven strategy with a focus on customers and a focus on sectors that 'put firmly in place a networked approach which brings together all available expertise within the Rabobank Group'. The Member banks Support division was less horizontally integrated, partly due to its functional structure. In 1998, in this division a change process was started towards a 'flexible network organization' to increase the degree of integration in the unit. Finally, as mentioned above and as will be elaborated below, Spectrum was created with the intent of developing an internal network from which other units within Rabobank Group could learn on how to network. Notwithstanding the minor shifts that took place as a result of the problems associated with evolution and high-growth it faced, Spectrum has always been differentiated while being integrated. These change processes illustrate clearly (1) that differential paces of change occurred by design, but even more so, were needed since different units performed tasks requiring different forms of organizing, and (2) that since units and served different products and services to different markets both traditional and innovative elements of forms of organizing co-exist.

THE TRANSITION OF THE LOCAL MEMBER BANKS: BUSINESS-LEVEL

The second unit of analysis deals with the local member banks, which serve domestic clients with the products offered by Rabobank. The analysis focuses particularly on the knowledge process characteristics of the local banks to describe the degree to which the local banks constitute an internal network. The

three themes of organizational structure, organizational processes and knowledge processes guide the analysis.

Organizational structure

In line with the cooperative principle, in almost all of the interviews, the general managers stressed that each local bank is largely autonomous. Although the central organization involves itself in affairs that are best handled by a central actor or those that are of concern for the entire organization to keep it on track, both operational and strategic matters are almost completely at the discretion of the local units. That is, within the confines of the industry Rabobank is operating in, what the name and label Rabobank stands for as well as what it portends to be, and with regard to the products and services offered, local units act upon local circumstances using their own resources, and with these may adopt whatever practice to serve its clients.

The interviews also indicated that differences exist among local bank managers as to the commonality of this consent. An important cause of this is that the central organization develops most products and services to be distributed through the local banks. Moreover, a few of the general managers felt that the central organization involved itself more in their local units than it did in others. By corollary, they argued that the local banks they lead are dependent on the central organization rather than on themselves and other local banks, and that the central organization exerts a role too profound to call Rabobank a network organization. At the other extreme, a few of the general managers experienced that their local units operated in a 'market with the name Rabobank pinned on it.' That is, they felt they were loners in a 'market' where local units, rather than collaborating, competed with each other to gain the interest of the best clients.

Despite the autonomy of the local units, some linkages exist between local banks in the form of management meetings, seminars, national and regional consultative structures, interpersonal social networks and Information Technology networks. In the interviews it was revealed, however, that these mechanisms are generally not extensively used, only when matters ask for it. Local banks make no use of more extensive means of collaboration, such as teams of employees originating from different local banks.

Organizational processes

Managers and employees at different levels within the local banks all have different responsibilities as for both the creation of knowledge within the local

bank they work for and the sharing of knowledge with other organizational units of Rabobank. Differences in responsibility for the creation of knowledge within local banks are not significant across general management, supervisory management and employees. The specific roles exercised at each level vary substantially, though. As a general manager illustrated this in an interview, 'my role is more one of making sure that knowledge gets created and used properly, whereas the supervisory managers and, even more, the employees are the ones who must do it. They are most closely to our clients.'

As for the sharing of knowledge across local banks, in interviews general managers argued it is important, but does not take place extensively. Since general managers generally have longer tenure and therefore know more people in Rabobank, it appeared they have first responsibility regarding their local units, and are usually the ones who participate in seminars and meetings. As one of the general managers mentioned, the person in such a position 'is the one designate for the sharing of knowledge with colleagues.' Heavy responsibility for sharing knowledge with other local units is put on the general managers. The role of supervisory management, and even more for employees, is limited in that they hardly participate in events that transcend the boundaries of local banks.

Knowledge processes and flows

In Figure 5.7, the two types of knowledge flows that occur in the local member bank setting are depicted: (1) vertical knowledge flows from the central organization Rabobank Nederland and affiliated subsidiaries to the local banks, and (2) horizontal knowledge flows between the local member banks. The interviews revealed that flows of knowledge at Rabobank are primarily *vertical and uni-directional* in the sense that the central organization or one of its affiliated subsidiaries is the main source of new knowledge for the local banks. Horizontal knowledge flows between local banks are less important.

The interviews made clear that the general managers of the local banks tend to perceive the central organization as 'thinking for them,' and that most knowledge is retained at and obtained from this central point. It appeared that most local banks rely on knowledge obtained from the central organization. Examples are advisors of the central organization, products and services, seminars or company documents. The central organization and affiliated subsidiaries invent and develop the core and related products and services respectively. These products and services are distributed via the local units. Local market knowledge, however, is mostly created and obtained within the local bank itself.

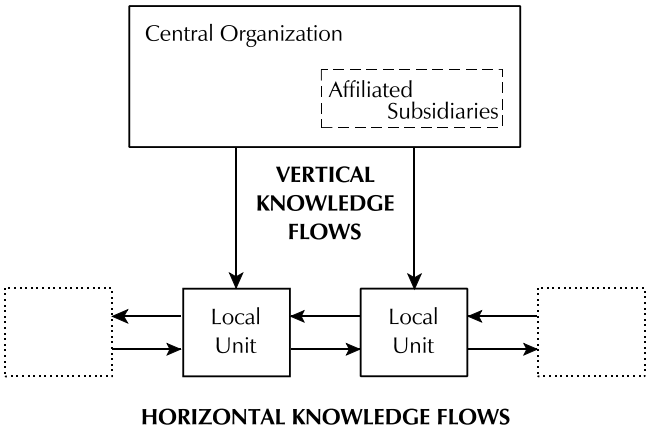


Figure 5.7: Knowledge flows in the local member bank setting

In line with this finding, a manager at the central organization observed, for example, that Rabobank 'focuses increasingly on systems'. Consequently, the locally embedded distinction between two different local banks in two different geographic areas was becoming blurred in the sense that the local banks in that way are 'nothing more than an interface between client and system', making cooperation and knowledge sharing between them unnecessary.

Corroborative evidence: facilitating and inhibiting mechanisms

Despite the change journey, within the local member banks the mechanisms for sharing knowledge have remained primarily vertically oriented and relate particularly to the transfer of explicit knowledge. The interviews indicate that these 'vertical' mechanisms coordinated by the central organization include seminars, documents and notes, and the use of advisors of the central organization to help local units comply with the wishes of the client at the local site when the matter is too complex to be locally organized. These mechanisms facilitate the vertical transfer of explicit knowledge; mechanisms for the horizontal dissemination of tacit knowledge are not widely used.

Although viable for sharing knowledge horizontally, the formation of cross-functional and interunit teams, and the transfer of employees and management between local banks were among the less frequently used instruments for horizontal knowledge sharing. The 'horizontal' mechanisms of management conferences and informal talks are more popular, but are not used to intentionally share knowledge. In the interviews, general managers generally concurred on that *horizontal knowledge sharing* is inhibited to the degree that each local bank, partly because of its relative autonomy, is perceived by its management to be a separate organization rather than a unit serving the entire organization of Rabobank Group.

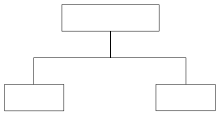
To a large extent, the local banks compete with each other within the organization. Furthermore, the Boards of local banks were made of local inhabitants, who did not have an interest in that their local bank shared knowledge with other local banks. This was reflected in the fact that when, for example, the owner of a home appliances shop was on the Board of a local bank, and the owner of a competing shop was on another local bank's Board, they both had an interest in not sharing knowledge. Therefore, local banks are not always receptive to each other. Obviously, this restricts sharing knowledge between local banks. Another barrier to the horizontal spread of knowledge is the observation revealed in an interview that many units do not know what they know, and moreover, do not know where to find the appropriate knowledge. To a large extent, apparently, Rabobank's local banks were not transparent enough to effectively and efficiently share knowledge.

SPECTRUM CHANGING OVER THE PERIOD 1992–1998: BUSINESS-LEVEL

As mentioned above, Spectrum is a business unit within Rabofacet, the facilitatory division within Rabobank (see Figures 5.3 and 5.4), created to provide Rabobank Group with cutting-edge knowledge in particular in the area of Information Technology (IT) in order to ameliorate Rabobank's competitive position. As with the embedded case study of the local member banks, changes in structure, processes and knowledge flows guide the analysis of Spectrum's transition in the period 1992–1998.

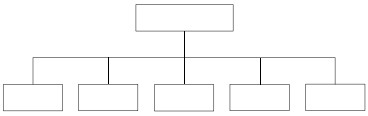
Structural transition of Spectrum

The structure of Spectrum underwent substantial changes in its short history, which are illustrated in Figure 5.8. The major transition occurred in 1994–1995 when the previous way of organizing was completely recast. At its founding in 1992, Spectrum employed 30 people and was organized along two explorative



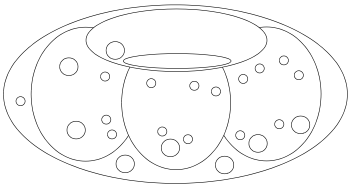
1992

30 employees
2 Product Units



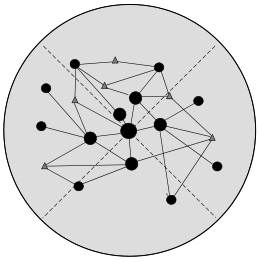
1993

60 employees
5 Product Units



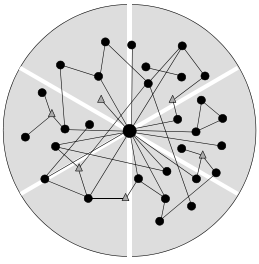
1994–1995

100 employees > 120 employees
3 Areas of Attention
15 Product Clusters



1996

220 employees
4 Areas of Attention
13 Clusters



1997–1998

350 employees > 550 employees
6 Areas of Attention
29 Clusters

● = Management Team
● = Clusters
▲ = Projects

Figure 5.8: Spectrum's transition process towards an internal network: 1992–1998

Product Units (PUs) that stood in close relation to each other. Shortly after its founding, Spectrum obtained a number of groups of Information Technology experts from other parts of Rabobank and incorporated them as three new PUs in the existing organizational structure. With the inclusion of these three PUs, the number of employees increased from 30 to 60 employees. This increase in organizational size triggered a process of compartementalization. This process was strongly visualized also by cultural differences in terms of organizational dress. As a Management Team member observed, 'People in one Product Unit wear T-shirts, whereas people in another wear suits. This illustrates the difference in culture between the Product Units, and the resulting lack of communication and knowledge sharing between them.'

As these developments inhibited the creation and sharing of knowledge horizontally across PUs, as illustrated in Figure 5.8, in 1994–1995 the structure of Spectrum was completely conceived anew by Spectrum's management team to regain the internal network structure and the explorative focus of the years right after founding. The five PUs were abolished, and instead three 'Areas of Attention' (AoA) were conceived to change the rhetoric used in Spectrum. Partly because the number of employees increased to approximately one hundred, each AoA housed a variable number of interdependent, fluid 'clusters' to retain, as the Business Unit manager of Spectrum referred to it, 'the subtlety of small groups.' The number of clusters in an AoA was deliberately variable so that Spectrum could tailor to client demand and technological advancements. In one period of time, there could be five clusters, whereas in a subsequent period there could be three or eight clusters, possibly with entirely different names.

By the end of 1996, the number of employees had increased to 220. As in the previous period, there was only one formal management layer. The number of organizational layers, however, has increased with one with the establishment of projects and teams cutting across clusters and AoAs to ease collaboration. Although the increase in number of employees led to tighter time schedules, in particular on behalf of the managers, and, moreover, to an additional AoA, the way of organizing remained intact. This way of organizing remained the same in the period 1997–1998. However, as the number of employees has increased by then to approximately 350 people, partly because of the inflow of people from another business unit of Rabobank, the total number of AoAs has increased to six, and the number of clusters has increased as well.

Transition of organizational processes in Spectrum

The structural transition process of Spectrum towards an internal network had also implications for organizational processes. In particular, the increase in employees had a substantial impact on the managerial function in that the 'spans of control' of managers increased rapidly over time. During the main transition period in 1994–1995, an extra layer of coordinating personnel was added to free up the management team as the latter were not longer in the position to oversee the activities of all employees in the AoAs they led. These clustercoordinators were not appointed formal management positions with the appropriate management tasks (e.g. execution of performance appraisals, authority to sign for contracts of more than 5,000 dollars); rather, they came to be, as the BU-manager of Spectrum called them, 'the 'functional feeders' of Spectrum, and their task was limited to overseeing and leading the activities in the clusters in order that the goals of Spectrum were adhered to. In addition, they also served an important role in establishing new linkages across clusters and AoAs. Thus, although there were three *organizational layers* (management team - clustercoordinators - employees), there was only one formal *management layer*.

In 1996, the number of organizational layers has increased by one with the establishment of project managers heading the projects and teams of persons from different clusters and AoAs. These project managers worked for one of the clusters participating in the project, and if the project was traversing AoA boundaries they originated from the Management Team. As the number of employees increased from approximately 220 to approximately 350 over the period 1996-8, the time constraints of managers had substantially increased. As a Management Team member said, 'If I do performance appraisal talks with all the employees, I will be busy for one to two months.' This development has currently led to extensive discussions to lay formal management functions with the clustercoordinators. This discussion has focused, on the one hand, on the issue that the Management Team of Spectrum wants to maintain only one formal layer of management to preserve its flatness and concomitant agility and flexibility; on the other hand, it focused on the awareness that the increasing size of Spectrum requires additional management resources.

In 1998, the Management Team of Spectrum appeared to favor the latter point. As the BU-manager of Spectrum recognized, 'the *way* of organizing matters, no matter what kind of structure you have. The processes are important. ... It's just like an ant hill over here. To me, that is also the way in which we organize things. In that way, people can learn everything from others, as long as they have their

eyes and ears open.' This way of organizing, emphasizing collaboration, communication, informality, and fluidity, has always been an integral part of the vision of Spectrum. Nevertheless, as the Management Team member responsible for IT argued, 'in Spectrum there is both a hierarchical organization and a network organization now. Both formal. ... Before '97 everybody was involved and could interfere in everything. Currently, this no longer the case. More hierarchy has entered the organization. Maybe it is not even more hierarchy, but more formalization; those two things are not the same. For example, there is Peter and John. John may ask Peter for help, or offer Peter a project or job. Formerly, this was common practice. Peter was free to do so. Currently, Peter has to ask the Cluco first.'

All the changes in Spectrum have also occurred under this vision of the BU-manager, who has been with Spectrum since its founding, and is everywhere else in Rabobank recognized as the champion of Spectrum. Almost all changes in the transition process of Spectrum have been the discretion of the BU-manager and the Management Team.

Knowledge flows in transition within Spectrum

Over its seven-year existence, Spectrum has witnessed different developments regarding the incidence of horizontal and vertical knowledge flows. These developments have been both the result and the cause of the managerial and structural changes that took place to reconceptualize the business unit. This process of reconceptualization stems from continuous threats to Spectrum's transition process towards an internal network form. Shortly after its founding, the two PUs stood in close relation to each other and were able to share both explicit and tacit knowledge directly on a horizontal basis, either by face-to-face contacts or via Information Technology systems, across the boundaries of the respective PUs. With the incorporation of another three PUs in 1993, the increasing compartementalization quickly led to progressing differences among the PUs, inhibiting the process of horizontal knowledge sharing across PU boundaries.

The main transition period of 1994–1995 was instigated to reconceptualize the configuration of knowledge flows, and to increase the incidence of horizontal knowledge flows aimed at knowledge creation and sharing. With the rhetorical change of Product Units into Areas of Attention (AoA) and the incorporation of clusters, it was aimed to resuscitate the idea of smallness of Spectrum and, as a result, the sharing of knowledge across boundaries. Clusters remained small in order to ensure that the employees working for the clusters needed to consult each

other in Spectrum to solve their problems; by means of formal routes as well as informal routes, such as, as the Chief Executive called it, 'unintended meetings at the central coffee machine.' As the number of employees increased constantly, however, the AoAs became also 'islands' within Spectrum in terms of knowledge sharing. This doubtlessly led to less innovative efforts by combining knowledge from different AoAs and clusters to generate new products and services.

The incorporation of projects as a structural mechanism was executed in 1996 to ameliorate the transfer of knowledge across boundaries within Spectrum. However, as more employees started working for Spectrum, projects were increasingly established within the confines of the AoAs, not crossing the boundaries of them, in the overall leading to a decrease in the incidence of horizontal knowledge flows. As the Business Unit manager argued, 'as you grow, specialization will increase. As a result, less overlap between people and units will be present, and less knowledge sharing will take place'. The relative increase of vertical knowledge flows as opposed to horizontal ones was also strengthened by the incorporation of a substantial number of employees from another business unit of Rabobank. This other business unit had a hierarchical tradition, which was internalized by its members. As a result, in joining Spectrum these employees witnessed substantial difficulty in adapting to Spectrum's internal network characteristics.

CONCLUSION

Although the process of change at Rabobank was still evolving in 1998, it has become evident that Rabobank Group increased its effectiveness in integrating and organizing knowledge throughout the organization over the period 1988–1998. Rabobank's ability in integrating and organizing knowledge constituted an important driver to introduce internal network forms of organizing. Although strong external pressures were present in the shape of environmental dynamics, the individualization of society, and changes in the nature of products and services offered, the most important driver at Rabobank was an internal one. While its competitors were still mainly offering mass products or 'tailored' them by integrating the different products, Rabobank decided to move further and provide its customers with fully tailored products. As it aimed to differentiate itself from its main competitors by providing fully tailored products to its customers, Rabobank needed a strong capability in integrating and organizing knowledge. The case study indicated that an internal network form of organizing contributed to this aim of improving its ability in integrating and organizing

knowledge as it allowed Rabobank to combine its stocks of knowledge more effectively.

Although the change process took place throughout the entire organization, several internal networks developed concurrently at different paces in distinct divisions and organizational units with different outcomes. All dealing with the heterogeneity a large firm is exposed to, two antecedents to these differential paces of change could be observed. First, the size of Rabobank restricted the development of one large internal network. Second, since different divisions and organizational units served different customers, each requiring different products, mass or tailored, it was required to pursue different change processes for each division or unit. The different requirements in knowledge integration and organization also resulted in bipolarities in structure emerged among the units and divisions to provide customers with the products they demanded. Although an internal network was considered imperative to capitalize on the integration and organization of knowledge so as to develop tailored products requiring the integration of expertise maintained by various units, a hierarchy needed to remain existent for developing mass products. In that vein, the differential paces of change largely contributed to bipolarities in structure.

For the local members banks were amidst the process of change during the study, assessing the consequences of adopting internal network forms of organizing at the local member banks proved valuable since causal relations could be observed directly. It was apparent that because the central organization remained developing the bulk of the products, the local member banks relied heavily on the vertical knowledge flows generated by the central organization. When tailoring products to client needs at the site of the local member bank, local member banks relied on their own knowledge base and integrated that with the knowledge obtained from the central organization, without the consultation of other local member banks and the knowledge stocks these held. Since they are strongly embedded in the local communities they serve and since each local member bank can be considered a separate organization, local member banks' autonomy generally inhibited the sharing of knowledge among banks. Although these mechanisms were employed by the central organization in their interactions with local member banks, transfer of people among banks and the use of teams comprised of people of various banks hardly occurred. In other words, local member banks relied mainly on the integration of vertical knowledge flows rather than horizontal knowledge flows. As a result, many general managers of local banks felt they operated as part of a hierarchy, rather than that they operated as

part of the "network of local banks" it was commonly referred to by corporate headquarters. Consistent with the argument of Van Wijk and Van den Bosch (1998), the ratio of horizontal to vertical knowledge flows appeared to be an effective indicator of organization form in use.

At Spectrum, horizontal knowledge integration occurred on a wide basis. Spectrum's internal network facilitated new combinations of knowledge, vertically but in particular horizontally between units, that led to the exploration of new products and services. One of the most important inhibitors of knowledge integration at Spectrum was its size, which played an important role during the entire evolution of Spectrum. Initiated as a small group of 30 employees in 1992, Spectrum continued to grow as part of its success, so that Spectrum had 120 employees on the payroll in 1994. At that point in time, collaboration was not as evident as it used to be, and knowledge integration began to suffer. As a result, in 1996, Spectrum introduced Areas of Attention and clusters. These areas and clusters employed people with similar forms of expertise enabling the transfer of knowledge among them. In addition to changing the foci of the Areas of Attention and clusters themselves, employees were rotated among them. To maintain integration of knowledge across people with various specializations further, teams were installed as a way to integrate knowledge across clusters and areas of attention. Still, in 1998, Spectrum's size had increased to 350 employees, complicating the integration and organization of knowledge further, and led to the implementation of one formal organizational layer. Although the importance of size has been illustrated by traditional studies (e.g. Pugh et al., 1968), the study at Spectrum underscored again that size is an important factor to consider as it impinges strongly on the development and evolution of internal networks.

Next to the importance of implementing both network and hierarchical forms of organization, all units of analysis were also illustrative of the fact that complementarities are needed between structural and processual attributes of organizations during change, and with that reinforced earlier findings (Starbuck, 1993; Whittington et al., 1999; Zenger, 2002). The case evidence of the local member banks suggests that structural and managerial hierarchies corresponding with traditional organizations inhibit especially horizontal knowledge integration. In that vein, violations of complementarity emerged (Zenger, 2002). Similarly, at Spectrum, it appeared that when horizontal knowledge integration opportunities were threatened, deliberate structural and processual changes took place aimed at restoring these opportunities.

As argued, partly as a result of the organic growth created by an internal

network (cf. Galunic and Eisenhardt, 2001; Hedlund, 1999), the transition process was still evolving in 1998. The concentration process of merging local banks into larger entities continued, resulting in further reduction of the number of local banks serving the domestic market from 445 in 1998 to 369 in 2001. In 1999, as part of further revitalizing Rabobank from a closed credit cooperative into an open cooperative in which virtually every client could become a member, further emphasis was laid on achieving synergies between units and divisions within Rabobank Nederland, between Rabobank Nederland and the local units, and between local units. At Rabobank International, according to the Annual report, a team of members from different subsidiaries, with different specializations and from different organizational levels evaluated Rabobank International's change journey and concluded that since the trajectory was successful Rabobank International should continue in the same way. In that same year, internal networking also enlarged the external networks maintained by Rabobank. An alliance with German DG Bank was established to set the stage for the development of a European network of cooperative banks, so that international clients could be served more effectively and efficiently. In 2001, it was decided to reduce the size of corporate headquarters and to change the services provided by headquarters to local member banks from being supply-driven to being demand-driven to foster local entrepreneurship and diminish the role of corporate headquarters Rabobank Nederland. These changes after the period of investigation indicate that Rabobank has continued to operate successfully as an internal network and increased knowledge integration both internally and externally.

In conclusion, the analysis of the change process towards new forms of organizing in a large corporation revealed that different parts of a corporation may pursue differential paces of change, and became therefore subject to bipolarities in structure. Internal networks were necessary to develop innovative and tailored products and services, whereas a hierarchy proved indispensable in providing mass products to customers. The use of hierarchy, however, appeared to bear important side-effects in terms of the knowledge flow configuration used among the local banks. Complementarities among structural and processual elements were found necessary to influence knowledge integration and organization. In that vein, the differential paces of change of influenced knowledge integration and organization at the business level, and aggregated at the corporate level. In the next chapter, it is examined to what extent the changes in organization structure and processes implemented by Rabobank have been implemented by a wider population of firms in Europe, Japan and the US.

ENDNOTES

[3] Invented by German mayor Friedrich Wilhelm Raiffeisen (1818–1888), the cooperative principle was grounded in the establishment of credit institutions of which farmers became members by depositing their savings and excess financial resources in the form of earnings and profits. Coordinated by representatives chosen from and by the members, these what may currently be called local member banks pooled together financial resources from a many different sources. In turn, when farmers were in short of financial resources in later circumstances, the credit institutions could remedy shortages at lower interest rates than when farmers contacted traders and shopkeepers for financial resources while giving their harvest as security. The profits made are explicitly used to preserve the continuity of the cooperatives, rather than paid out as dividends to stockholders. Another essential part of the cooperative principle is that major decisions are decided upon on the basis of democratic governance; that is, in meetings where associates from both the local banks and the central organization meet to discuss, and occasionally vote for the strategies to be implemented.

CHAPTER 6

Patterns of Change in Organizing for Knowledge Integration

A Comparative Study of Europe, Japan and the US

Extending existing case study work, the case study reported in the previous chapter provided new insights into the issues involved in knowledge integration. It showed that in Rabobank knowledge integration was facilitated in various parts of the organization by changing organizational structures and processes. Extending qualitative studies of knowledge integration in internal networks, the present study also sought to obtain quantitative insight into how firms in a wider population are changing so as to change knowledge integration and organization. In that vein, a question that to date has remained unanswered is to what extent knowledge integration and organization have changed among firms over the globe. In addition, the extent to which firms have changed other organizational elements to facilitate knowledge integration has also remained quantitatively unexplored in previous research. These questions are dealt with empirically in this chapter. In chapter 3, several determinants of knowledge integration at the corporate level were discerned. Patterns of how knowledge integration and its determinants, which are listed in Table 6.1, have changed will be examined.

To illustrate the change patterns, data obtained from the questionnaire that was administered to European, Japanese and US companies as part of the INNFORM research program (Pettigrew, Whittington and Conyon, 1995) was used. Since the questionnaire queried respondents to indicate how their firms could be characterized in terms of several corporate-level elements for two years, changes in those elements could be uncovered. It should be noted here that respondents in Europe and Japan were asked to tick the scales for 1992 and 1996, whereas the US respondents were queried for 1993 and 1997. In addition to uncovering change patterns, the regions covered by the questionnaire also allowed for an examination of how firms from different countries and regions compare to one another. This is the second issue explored empirically in this chapter.

Organizational structures	Organizational levels
	Decentralization
	Product-based structures
	Project-based structures
	Diversification
Organizational processes	Information technology
	Human resource practices

Table 6.1: Determinants of knowledge integration considered

The chapter proceeds as follows. In the next section, general patterns of organizational change emerging from the questionnaire are illustrated. It is shown how firms generally changed their basic structures, decentralization, number of organizational layers, diversification, use of information technology and use of human resource practices. In the third section, considering the same elements used in illustrating general patterns of change, high and low knowledge integrating firms are compared as to the organizational elements they adopted to illustrate how corporate-level elements influence knowledge integration. In the final section, the findings will be discussed and the paper concluded.

GENERAL PATTERNS OF CHANGE OF CORPORATE-LEVEL ELEMENTS

Before the patterns of change and issues involved with firms changing knowledge integration are explored, first general patterns of change among the sample of firms are analyzed. In the following sections, it is described how organizational structures and processes have changed in general among the European, Japanese and US firms in the sample.

The analysis centers on the share of firms that made extensive use of the various organizational structures and processes. As indicated in chapter 4, the questionnaire contained five-point Likert-type scales. When a firm reported a 4 or 5 on those scales for a certain element, it was considered that that element was extensively used by that firm. For both information technology and human resource practices, multiple indicators were present in the questionnaire. The three items indicating use of information technology (information technology strategy, information technology use and electronic data interchange) were averaged to obtain an indicator for the extensive use of information technology. Due to the nature of the questioning in the European and Japanese questionnaires,

the indicator for human resource practices was obtained by flagging those firms that made use of internal labor markets, corporate wide mission building, managerial and professional development teams and internal networks at the same time. In other words, only if a firm reported use of all four practices, was this considered extensive use. The indicator for the US sample was obtained similar to the indicator of information technology; that is, the four items were averaged, and firms scoring 4 or higher were considered extensive users.

Structuring

Table 6.2 indicates the shares of firms that have adopted certain basic organization structures. It is clearly evident that the emphasis on product-based structures generally increased in the period 1992–1996, indicating that the 'traditional' way of organizing is still and even increasing in importance. The share of European firms reporting strong emphasis on product-based structures increased from 53.8 percent in 1992 to 76.2 percent in 1996, while the share of US firms increased at roughly the same levels from 55.9 percent in 1993 to 76.1 percent in 1997.

Determinants	**Europe**			**Japan***			**United States**		
	1992	1996	Δ	1992	1996	Δ	1993	1997	Δ
Product-based structuring	53.8%	76.2%	22.4%	N/A	N/A	-	55.9%	76.1%	20.2%
Functional structuring	54.8%	61.3%	6.5%	N/A	N/A	-	41.8%	43.9%	2.1%
Geographic structuring	48.4%	55.1%	6.7%	N/A	N/A	-	50.0%	52.9%	2.9%
Project-based structuring	16.9%	49.6%	32.7%	24.9%	48.8%	23.9%	15.4%	32.8%	17.4%

* Japanese figures obtained from Pettigrew, Massini and Numagami (2000)

Table 6.2: Organizational structures: general patterns in basic structuring

The use of functional and geographical structures increased as well, however, by far not as much as the use of product-based structures did. With a share of 54.8 percent reporting extensive use in 1992, European companies made use of functional structures to approximately the same degree as product-based structures in 1992. However, that portion only increased to 61.3 percent in 1996, falling short on the levels of product-based structures in that same year. US firms reported significant less use of functional structures and hardly increased their use over the period 1993–1997 (from 41.8% to 43.9%). As indicated in Table 6.2,

the use of structures along the lines of geographic regions exhibited a similar pattern.

Comparing the three 'traditional' structures—product-based, functional and geographic structures— it appears that the share of firms reporting extensive use of product-based structures was highest and increased most in both Europe and the US. Especially in the United States, product-based structures generally appeared to be the dominant structure. In Europe, firms also appeared to rely on functional and geographic structures to a large extent, especially in 1992. By 1996, however, in Europe, too, product-based structures have come to be the dominant organization structure.

As illustrated in Table 6.2, the highest increases were observed for the use of project-based structures. In the United States, 15.4 percent of the firms indicated extensive use of project-based structures in 1993. That percentage increased with 17.4 percent to 32.8 percent in 1997, indicating that the reliance on project-based structures has more than doubled in the period 1993–1997. In Japan, 24.9 percent of the firms indicated that they made extensive use of project-based structures in 1992 already, and that number increased to 48.8 percent in 1996. In Europe, the most substantial increase in the use of project-based structures was observed, with 16.9 percent of the firms reporting extensive use in 1992 and 49.6 percent in 1996. In other words, departing from levels US firms reported in 1992 to levels Japanese firms indicated in 1996, the share of European firms reporting strong reliance on project-based structures has almost tripled in 1992–1996.

Decentralization and organizational layers

The degree to which firms in Europe, Japan and the United States employ decentralized structures increased markedly as well in the period 1992–1996. This applied in particular to firms allowing subunit managers to make decisions regarding operating decisions and less so to those in which subunit managers are allowed to act with more discretion than corporate headquarters in making strategic decisions (see Table 6.3). As regards operational decentralization, Japanese and US firms stand out. The share of Japanese firms indicating that they made extensive use of operational decentralization in 1992 has risen with 8.3 percent to 67.4 percent in 1996. With shares of 55.4 percent in 1993 rising to 66.2 percent in 1997, US companies reported marginally less reliance on operational decentralization than Japanese firms. European companies, on the other hand, lagged behind their Japanese and US counterparts. European firms ended up with levels of operational decentralization in 1996 that Japanese and US companies

roughly reported in 1992.

As regards strategic decentralization a different pattern emerged. Whereas the share of firms reporting extensive use of operational decentralization fell in the range of roughly 50–70 percent, that range was only 10–25 percent for reliance on strategic decentralization. Apparently, discretion in making strategic decisions continued to lie with senior and executive managers in most of the firms. In contrast to the patterns observed for operational decentralization, US firms made more use of strategic decentralization than their Japanese counterparts. European firms reported the highest increase in the use of strategic decentralization. Although the slice of European firms employing strategic decentralization extensively was only 12.9 percent in 1992, that percentage increased to 21.9 percent in 1996. The portion of firms indicating large emphasis on strategic decentralization was smallest in Japan, and with 2.2 percent also increased least.

Determinants	**Europe**			**Japan***			**United States**		
	1992	1996	Δ	1992	1996	Δ	1993	1997	Δ
Operational decentralization	40.7%	61.0%	20.3%	59.1%	67.4%	8.3%	55.4%	66.2%	10.8%
Strategic decentralization	12.9%	21.9%	9.0%	14.6%	16.8%	2.2%	19.2%	24.3%	5.1%
No. of organizational layers	3.5	3.2	-0.3	4.1	4.0	-0.1	4.9	4.5	-0.4

* Japanese figures obtained from Pettigrew, Massini and Numagami (2000)

Table 6.3: Organizational structures: general patterns in decentralization and organizational layers

The increases found in the use of decentralization were not completely reflected in the decreases in the number of organizational layers reported. As illustrated in Table 6.3, in general, the average number of organizational layers has decreased only marginally across the three regions covered in the present study. On average, all firms reported only a marginal reduction in the period 1992/3–1996/7, whereas in European and US firms the average number of organizational layers has decreased with 0.3 and 0.4 layers in the same period. Noteworthy differences were observed, however, between the regions in terms of absolute values. As indicated in Table 2, US firms maintained more organizational layers in both years than European and Japanese firms. Thus, contrary to expectations, in regions were decentralization was generally highest, the number of organizational layers was highest as well.

Diversification and alliances

Evidence for the trend reported extensively in the literature (Cascio, 1993; Hedlund, 1994; Hoskisson and Hitt, 1994) that firms are downscoping and moving back to the core of their business was found in the data as well. Downscoping rests on two main pillars: reductions in the degree of diversification, and increased use of alliances.

As portrayed in Table 6.4, especially European and US firms reported increased relatedness between divisions. With a maximum of 1.5 percent change over the period 1992–1996, Japanese firms appeared not to have changed their degrees of diversification much. Japanese firms were, however, found to be the most focused firms, especially in 1996. The share of Japanese firms operating a single core business, accounting for more than 95 percent of sales, was 35.4 percent in 1996. The share of Japanese firms with a dominant core business, producing 70–94.9 percent of total sales, was 32.3 percent in 1996. The portion of Japanese firms with a wide range of businesses was only 9.1 percent in 1996.

Determinants	**Europe**			**Japan***			**United States**		
	1992	1996	Δ	1992	1996	Δ	1993	1997	Δ
Single core business	34.5%	24.1%	-10.4%	35.9%	35.4%	-0.5%	33.3%	22.1%	-11.2%
Dominant core business	26.9%	33.6%	6.7%	32.7%	32.3%	-0.4%	29.9%	36.4%	6.5%
Set of related businesses	26.9%	29.6%	2.7%	21.8%	23.3%	1.5%	18.2%	29.9%	11.7%
Wide range of businesses	12.3%	12.6%	0.3%	9.5%	9.1%	-0.4%	18.2%	11.7%	-6.5%
>10% of assets in alliances	12.9%	31.1%	18.2%	18.5%	25.0%	6.5%	22.4%	40.3%	17.9%

* Japanese figures obtained from Pettigrew, Massini and Numagami (2000)

Table 6.4: Organizational structures: general patterns in diversification and strategic alliances

European and US firms, on the other hand, appeared to have moved to dominant core businesses and sets of related businesses, moving away from single businesses and wide sets of businesses. In Europe and the US, the share of firms operating a single core business has decreased substantially. At the same time, with an increase of 6.7 percent, the percentage of firms operating a dominant business has increased to comparable degree. The slice of firms with a set of related businesses increased marginally in Europe, but in the US increased from 18.2 percent to 29.9 percent in the period 1993–1997. Also, the share of European firms operating a wide set of businesses has remained more or less stable over the

period 1992–1996. In the US, on the other hand, that share has decreased from 18.2 percent in 1992 to 11.7 percent in 1996.

In summary, Japanese firms appeared to have maintained their degrees of diversification in the period 1992–1996. But considering absolute diversification values, they also appeared to be most focused. Especially in 1996, the share of firms in Japan operating a single core business was substantially higher than that in Europe and the US. With a substantial share of firms apparently moving from a single core business to a dominant business or a set of related businesses and the share of firms with a wide set of businesses remaining constant, European firms appeared to have widened their focus. A similar pattern was observed with US firms. However, US firms were found to be decreasing their reliance on wide sets of businesses as well, typically converging on dominant core businesses and sets of related businesses.

As portrayed in Table 6.4, a similar result was found for the use of strategic alliances. The share of firms with more than 10 percent of their assets deployed in strategic alliances has increased substantially. Despite the Alliance Capitalism in which Japanese firms operate (Gerlach, 1992), the smallest increase was reported by the Japanese firms. Almost one out of five Japanese firms queried reported that they had more than 10 percent of their assets deployed in strategic alliances in 1992. That number increased to one out of four in 1996. The slice of European firms relying on strategic alliances to that extent has increased more substantially with a share of 12.9 percent in 1992 increasing to 31.1 percent in 1996. The highest levels and increases were, however, reported by US firms. The share of US firms reporting that they had more than 10 percent of their deployed in strategic alliances was 22.4 percent in 1992. That share increased with 17.9 percent to 40.3 percent in 1996.

Information technology and human resource practices

The changes that occurred in the use of information technology and human resource practices appeared to be most extensive and remarkable. As illustrated in Table 6.5, firms in the three regions have drastically increased their reliance on information technology, especially in Japan and the US. The share of firms indicating large reliance on information technology increased from 17.5 percent to 76.7 percent in Japan, and from 7.9 percent to 64.5 percent in the US in the period 1992/3–1996/7. Compared to these figures, the 36.1 percent increase from 6.9 percent in 1992 to 43.0 percent in 1996 in Europe could be considered dim, given that in each respective year the share of firms reporting extensive use and

investment in information technology by the Japanese was more than twice the European.

Determinants	Europe			Japan*			United States		
	1992	1996	Δ	1992	1996	Δ	1993	1997	Δ
Information technology	6.9%	43.0%	36.1%	17.5%	76.7%	69.2%	7.9%	64.5%	56.6%
Human resource practices	N/A	30.4%	-	N/A	34.5%	-	6.4%	24.1%	17.7%

* Japanese figures obtained from Pettigrew, Massini and Numagami (2000)

Table 6.5: Organizational processes: general patterns in information technology and human resource practices

Table 6.5 illustrates that a somewhat similar pattern was found for the use of human resource practices, as measured by the use of internal labor markets, the installment of a corporate-wide mission, the use of teams, and the building of internal networks. With 34.5 percent of the firms adopting all four practices in 1996, Japanese firms also indicated that they used human resource practices extensively. In Europe, a comparable percentage (30.4%) of the firms reported use of all four human resource practices in 1996. Owing to the nature of the question in the European and Japanese questionnaires no data was available for 1992. The US questionnaire did include measures for 1992. Not surprisingly, from that data it appeared that the share of firms reporting extensive use of the four human resource practices has increased from 6.4 percent in 1992 to 24.1 percent in 1996. Although the European and Japanese data on the one hand, and the US data on the other could not be compared due to different questioning, it is clearly evident that the use of human resource practices became more prominent in 1996.

To summarize, of all the patterns that could be reported as a result of the questionnaires, human resource practices and information technology in particular appeared to have changed most substantially. With that, the general pattern of change described here indicated that, consistent with several accounts in the literature (e.g. Brown and Eisenhardt, 1998; Ghoshal and Bartlett, 1997), changes in organizational processes are more prominent than changes in structural elements.

COMPARING HIGH AND LOW KNOWLEDGE INTEGRATORS

The patterns of change among European, Japanese and US firms described above indicate that over the period 1992/3–1996/7 many changes relevant to the

current study took place. These patterns give, however, no concrete insight into how these changes influenced knowledge integration. To gain further insight into how changes in corporate-level elements relate to knowledge integration, in the remainder of this chapter, a distinction is made between firms that can be marked either low or high knowledge integrators.

To make the distinction between low and high knowledge integrating firms, a knowledge integration indicator was computed using four items from the questionnaire. Respondents were asked to indicate the extent to which knowledge linkages existed between headquarters and subsidiaries for the exchange of R&D knowledge and for the exchange of resources and skills in 1992 and 1996. Similarly, respondents were queried about the extent to which knowledge linkages existed among subsidiaries for the exchange of R&D knowledge and for resources and skills in 1992 and 1996. These items were used to compute a linear additive measure for knowledge integration, for 1992 and for 1996. With Likert-type scales ranging from 1 to 5, the knowledge integration measure could take values between 4 and 20.

Based on this computation, firms were classified as "low" knowledge integrators if the score on the knowledge integration construct was smaller than or equal to 8, indicating that on average every item was scored 2 or below. In contrast, firms were classified as "high" knowledge integrators if they scored 16 or above on the knowledge integration construct. Using these selection criteria, 8 groups of firms resulted on which the analysis focused. Apart from low knowledge integrators in 1992 (Lokin92) and 1996 (Lokin96), and high knowledge integrators in 1992 (Hikin92) and 1996 (Hikin96) that resulted immediately from these selection criteria, four other groups were selected. The first was the set of firms that were low knowledge integrators in 1992 and remained so in 1996 (Lo92Lo96). The second group consisted of firms that were already high knowledge integrators in 1992 and remained so in 1996 (Hi92Hi96). The third group was that set of firms that could be flagged as low knowledge integrators in 1992, but high knowledge integrators in 1996. The fourth and final group was the set of firms that moved from being high knowledge integrators in 1992 to being low knowledge integrators in 1996 (Hi96Lo92). Since only one firm appeared in this last group, while a minimum of five is needed to compare groups, this group was removed from consideration for the remainder of the analysis.

In 1992	In 1996	Lokin		Midkin		Hikin		Total (1992)	
Lokin	Lokin	N=23	(3.9%)	N=43	(7.2%)	N=6	(1.0%)	N=72	(12.1%)
		Europe: N=16	(6.2%)	Europe: N=25	(9.6%)	Europe: N=5	(1.9%)	Europe: N=46	(17.7%)
		Japan: N=5	(1.9%)	Japan: N=5	(1.9%)	Japan: N=0	(0.0%)	Japan: N=10	(3.9%)
		US: N=2	(2.5%)	US: N=13	(16.5%)	US: N=1	(1.3%)	US: N=16	(20.3%)
	Midkin	N=3	(0.4%)	N=379	(63.6%)	N=79	(13.3%)	N=461	(77.3%)
		Europe: N=3	(1.1%)	Europe: N=154	(53.8%)	Europe: N=39	(16.5%)	Europe: N=196	(75.4%)
		Japan: N=0	(0.0%)	Japan: N=176	(68.6%)	Japan: N=29	(11.3%)	Japan: N=205	(79.8%)
		US: N=0	(0.0%)	US: N=49	(62.0%)	US: N=11	(13.9%)	Us: N=60	(75.9%)
	Hikin	N=1	(0.2%)	N=0	(0.0%)	N=62	(10.4%)	N=63	(10.6%)
		Europe: N=1	(0.4%)	Europe: N=0	(0.0%)	Europe: N=17	(6.5%)	Europe: N=18	(6.9%)
		Japan: N=0	(0.0%)	Japan: N=0	(0.0%)	Japan: N=42	(16.3%)	Japan: N=42	(16.3%)
		US: N=0	(0.0%)	US: N=0	(0.0%)	US: N=3	(3.8%)	US: N=3	(3.8%)
Total (1996)		N=27	(4.5%)	N=422	(70.8%)	N=147	(24.7%)	N=596	(100.0%)
		Europe: N=20	(7.7%)	Europe: N=179	(63.4%)	Europe: N=61	(24.9%)	Europe: N=260	(100.0%)
		Japan: N=5	(1.9%)	Japan: N=181	(70.5%)	Japan: N=71	(27.6%)	Japan: N=257	(100.0%)
		US: N=2	(2.5%)	US: N=62	(78.5%)	US: N=15	(19.0%)	US: N=79	(100.0%)

Table 6.6: Change patterns in knowledge integration in Europe, Japan and the United States, 1992–1996

Knowledge integration

Clearly different patterns are discernible when comparing knowledge integration and changes in knowledge integration in Europe, Japan, and the US. Change patterns across regions are given in Table 6.6 and Figure 6.1. As mentioned, the focus here will be mainly on companies that were either Lokin or Hikin in 1992 and 1996, and on the companies that moved between these two categories over 1992 and 1996.

The percentages of companies that could be marked high knowledge integrating (Hikin) firms in 1992 were substantially higher in Japan (16.3%) than in Europe and the US. In Europe, 6.9 per cent of the companies in Europe could be flagged as Hikin companies in 1992, whereas only 3.8% per cent of the US companies were Hikin companies in 1992. The reverse can be observed regarding low knowledge integrating (Lokin) companies. The percentage of Lokin companies in 1992 in Japan was only 3.9 per cent, whereas that percentage amounted to 17.7 per cent for European companies and 20.3 per cent for US companies.

Over the period between 1992-1996, European companies caught up with the Japanese, as did US companies over the period 1993-1997. In 1996, 27.6 per cent of the Japanese companies were high knowledge integrators, an increase of 11.3 per cent compared to 1992. In Europe, the percentage of Hikin firms in 1996 was 24.9 per cent, marking an increase of 18 per cent compared to 1992. Japanese companies apparently jumped on the knowledge integration bandwagon earlier than their European and US counterparts did. Because levels of knowledge integration in Japan in 1992 were substantially higher in Japan than in Europe and the US, the change pattern of Japanese companies was more incrementalist, whereas European and US companies followed a more radical change journey.

This pattern can also be seen in the percentages of firms in each of the regions that were low knowledge integrators in 1992 but became high knowledge integrators by 1996. Of the 257 companies in the Japanese sample, none went from being low knowledge integrators to being high knowledge integrators. In contrast, in the European and US samples the percentage of firms that pursued such a change was 1.9 percent (5 companies) and 1.3 (1 company), respectively. In addition, the percentage of firms that could be marked as high knowledge integrators in both 1992 and 1996 was 16.3 per cent in Japan, whereas in Europe and the US these percentages were 6.5 and 3.8 per cent, respectively. The percentage of firms that were low knowledge integrators in both 1992 and 1996, on the other hand, was 1.9 percent in Japan, whereas the same figures were higher for Europe (6.2%) and the US (2.5%).

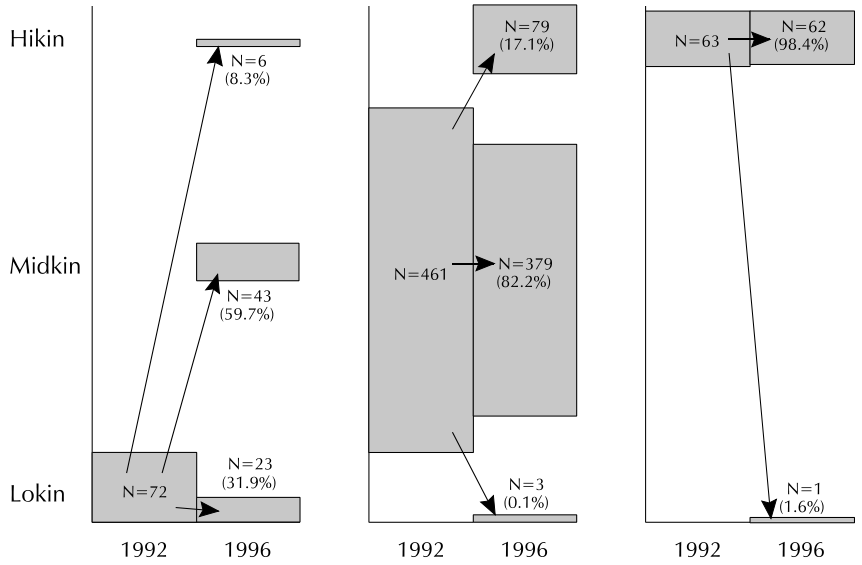


Figure 6.1: Knowledge integration change patterns

These patterns can be explained by the fact that the first management treatises on knowledge management and integration in firms were written by Japanese scholars or concerned Japanese companies (Itami, 1987; Nonaka and Takeuchi, 1995). From this, it evident that Japanese companies were the first to implement corporate-wide knowledge integration strategies in the world. The successes illustrated in such textbooks may have triggered European and US companies to adopt similar approaches to knowledge integration. Culture may also account for the differences in knowledge integration. Since European culture is closer to Japanese culture than US culture, European companies are likely more suitable to implement the organizing principles necessary to make knowledge integration a success. US culture is more individualistic, masculine, and has a larger power distance than the cultures of most European countries as well as Japan (Hofstede, 1991). The detriments such cultural characteristics pose, may have prevented US firms to adopt a more dedicated approach to knowledge integration. The differences may also be the result of other institutional differences between the regions. For example, Lewin, Long and Carroll (1999) and Whittington and Mayer (1997) argue that institutional differences lead to differences in organization form,

because, for example, macro-level economics capital structures differ across regions and countries.

Organizational layers.

On average, both low and high knowledge integrating firms were reducing the number of organizational layers. However, Hikin96 companies stand out of the pack. The reductions these companies pursue are generally the highest, but at the same time, Hikin companies generally have the highest absolute values on this measure. The reduction in organizational layers by Lo92Hi96 companies was marginal, but these companies had almost the lowest absolute values on this measure. Both the 1992 and 1996 values for Lo92Hi96 companies were lower than any other category of firms considered.

As can be observed in Table 6.7, European companies generally had the lowest number of organizational layers both in the Lokin and Hikin subsamples. European Hikin92 and Hi92Hi96 companies had fewest organizational layers. The reductions in organizational layers in European firms were at most marginal. Japanese companies appeared to have increased the number of organizational layers, although marginally. Absolute values were more or less equal across the board, and equal those of US Lokin92 companies. The only sub-samples that truly stand out in Japan are Lokin96 and Lo92Lo96 (which are the same sets) companies, in which an increase of 0.4 layers was reported.

Determinants		**Europe**		**Japan**		**United States**	
		1992	1996	1992	1996	1993	1997
Organizational layers	Lo92Lo96	3.5	3.3	4.0	4.4	7.0	8.0
	Hi92Hi96	2.8	2.8	3.9	4.0	7.0	7.0

Table 6.7: Organizational layers: Lo92Lo96 vs. Hi92Hi96

Overall, it appears that strong delayering relates to high knowledge integration, providing preliminary evidence for hypotheses (1). However, the differences between low and high knowledge integrators are small. Moreover, the values reported by firms from the various regions raise questions. In Europe, high knowledge integration requires fewer organizational layers seemed to hold. In Japan, this observation held too, but to a small extent. Japanese Lokin and Hikin companies still reported large reliance on organizational levels, which may be the result of the importance of hierarchy in Japanese culture (Hofstede, 1991). But this

observation did not at all hold for the US. This may be the result of culture, which in Europe is argued to be more collective with relatively small power distances, while in the US it is more individualistic with larger power distances.

Project-based structures

All firms appeared to have increased use of project-based structures. As illustrated in Table 6.8, especially the difference between Lo92Lo96 and Hi92Hi96 firms is noteworthy. Although Lo92Lo96 companies tended to increase project-based structures more than Hi92Hi96 companies, the absolute value for Hi92Hi96 companies is substantially higher. The 1992 value of Hi92Hi96 companies is much higher than the 1996 value for Lo92Lo96 companies (around 2.5), suggesting that Lokin companies tried to catch up with their Hikin counterparts, but were far from there. Lokin92 and Hikin96 companies report the highest increases, but many of these companies disappear in or come from the large bulk of companies that find themselves in the middle (no category), and may follow an incremental change pattern. As expected, Lo92Hi96 companies report the highest change, moving from Lokin92 values to Hikin96 values.

Determinants		Europe		Japan		United States	
		1992	1996	1992	1996	1993	1997
Project-based structures	Lo92Lo96	1.6	2.4	2.4	2.6	3.0	3.0
	Hi92Hi96	2.9	3.6	3.3	3.6	4.3	4.3

Table 6.8: Project-based structures: Lo92Lo96 vs. Hi92Hi96

Regional differences in this measure are quite remarkable. Although the finding that Lokin companies have lower levels and Hikin companies higher levels holds across all three regions, differences in 1992 and 1996 values (and thus changes) are substantial. Japanese companies generally have not increased the use of project-based structures much. Use of project-based structures in Japan appeared quite substantial in 1992 already, whereas in the US and Europe the implementation of project-based structures was much more established, especially in Europe. In 1996, however, European companies reported about as much use of project-based structures as Japanese companies. Although at different levels (see above), this applies to both Lokin and Hikin companies. US companies appear to have increased project-based structures as well, but not so much as European

companies did, and absolute values in 1996 lag about 0.5 points behind those of European and Japanese companies.

The results reported here provided preliminary evidence of hypothesis (4b) in chapter 3, which posited that increased reliance on project-based structures will likely lead to increased knowledge integration. Since the change values for Lokin companies moving into middle ground and Hikin companies coming from middle ground are highest, this suggests that the implementation of project-based structures is also a popular tool to attempt to increase knowledge integration. US and European companies reported substantial increases in the use of project-based structures in comparison to Japanese companies. This finding may be the result of mimetic behavior (e.g. DiMaggio and Powell, 1983) brought about by (1) the successful use of project-based structures in Japanese firms as described in many popular management textbooks in which teams are well covered (e.g. Nonaka and Takeuchi, 1995; Von Krogh, Ichijo and Nonaka, 2000), and (2) the internationalization of Japanese companies into Europe and the US (e.g. automotive industry), with their organizing principles being copied by native firms. For example, Imai, Nonaka and Takeuchi (1985) studied the introduction times of new automobiles in the automotive industry, and came to the conclusion that the teamwork in Japan, through which knowledge could be integrated quickly and efficiently, led to shorter production cycles. US and European companies may have copied such practices with similar intentions, explaining why in the US and Europe production cycles have also become shorter recently.

Decentralization

Considering the entire sample, both operational and strategic decentralization have increased over the period 1992-1996. The changes and absolute values for operational decentralization are, as expected, higher than for strategic decentralization. The companies that stand out are Hi92Hi96 companies (see Table 6.9), which not only increased operational decentralization more than Lo92Lo96 companies, but also the values for 1992 and 1996 are higher. Lo92Lo96 ended up in 1996 at about the value Hi92Hi96 companies had in 1992. The highest changes were reported by Lo92Hi96 companies, which increased operational decentralization 2.0 to 3.33 points. With that they increased operational decentralization twice as much as any other company, but still lagged behind Hikin companies when it came to absolute value in 1996. Nevertheless, they moved ahead of the companies that were Lokin companies in 1992, 1996, or both. Lokin92 and Hikin96 companies reported the second highest changes. These

sets of companies contain a substantial number of companies moving in or out of the large bulk of companies in the middle. Apparently, increasing operational decentralization was important to gaining in on other companies as regards increased knowledge integration.

Determinants		Europe		Japan		United States	
		1992	1996	1992	1996	1993	1997
Operational decentralization	Lo92Lo96	2.7	3.1	3.6	3.8	2.0	2.5
	Hi92Hi96	2.9	3.5	3.5	3.6	3.7	4.3
Strategic decentralization	Lo92Lo96	1.8	2.1	2.6	2.6	2.0	2.0
	Hi92Hi96	2.3	2.5	2.5	2.5	1.7	2.3

Table 6.9: Decentralization: Lo92Lo96 vs. Hi92Hi96

Lo92Hi96 companies also increased strategic decentralization most. The amount of change they pursued was equal to the change in operational decentralization (1.3), and with that the amount of change was 3 or 4 times higher than the other companies. Pursuing such change, Lo92Hi96 companies also achieved moving from the lowest absolute value in 1992 (1.3) to the highest absolute value in 1996 (2.7). Lokin and Hikin companies on average changed strategic decentralization to about the same degrees, with Hikin companies pursuing this at negligibly higher absolute values. The difference in change of Lo92Lo96 and Hi92Hi96 companies was also only marginal, but again Hikin companies commenced with higher initial levels in 1992 than the levels Lokin companies ended up with in 1996. This suggests that Hikin companies just moved ahead with Lokin companies not moving closer.

As illustrated in Table 6.9, regional differences between Europe, Japan and the US were revealing. In regards to operational decentralization, differences between Lokin and Hikin companies were widest in the US, followed by Europe and finally Japan. Differences in change (centering around 0.2) and absolute values (centering around 3.4/3.5 in 1992 and around 3.7 in 1996) between Lokin and Hikin companies in Japan were negligible. Change values were lowest in Japan when compared to Western companies. On the other hand, with the exception of US Hikin companies, the 1992 values were highest in Japan. Thus, in Japan companies apparently were already quite decentralized, and did not feel much need to change.

Different results were found for European and US companies, however. In these two regions, the finding that the 1992 values for Hikin companies were about the same as or higher than the 1996 values of Lokin companies upheld, especially in case of Lo92Lo96 and Hi92Hi96 companies. As in the US, in Europe Hi92Hi96 companies also increased operational decentralization more than Lo92Lo96 companies. While companies in Europe changed operational decentralization more than Japanese companies, without exceptions, the values in 1992 *and* 1996 were lower than in Japan, meaning that they gained on the Japanese but were not there yet. The same applies to Lokin companies in the US. These companies began at higher levels than European companies in 1992, and ended up at about the same value in 1996. Hikin companies in the US, on the contrary, had higher levels in 1992 than both European and Japanese firms. Furthermore, these companies also changed more to markedly higher levels in 1996, meaning that US companies drew further ahead.

As regards strategic decentralization, the picture is less differentiated. Again, differences between Lokin and Hikin companies in Japan were negligible; both reported that no or only marginal change had taken place between 1992/3-1996/7 (change values: 0–0.1) at the same absolute values (centering around 2.5). Differences between Lokin and Hikin companies in the US and Europe were more pronounced. While in Europe Lokin and Lo92Lo96 companies changed most, in the US these were Hikin and Hi92Hi96 companies. It is noteworthy to mention that in Europe Hikin companies had higher initial 1992 values for strategic decentralization, whereas in the US these were the Lokin companies. Apparently, firms from the two sub-samples were catching up on each other, but in the US these were the Hikin companies, and in Europe they were the Lokin companies. It may be that US Hikin companies increased strategic decentralization more than Lokin companies to catch up with the latter; Lokin companies had a value of 2.2 in 1992 which is slightly below the average of 2.4 of the entire dataset in 1996, so there was less perceived need to increase strategic decentralization. But it may also be that Hikin companies in the US wanted to gain in on strategic decentralization because they extended extensively on operational decentralization as well, so as to get a balanced situation.

Apparently, Japanese companies were already quite decentralized in 1992. This may the result of national culture, which emphasizes collectivism, teamwork and more freedom (Hofstede, 1991; Nonaka and Takeuchi, 1995). It may also be the result of Japanese companies experimenting earlier with new approaches to organizing for which higher levels of decentralization were required. That US

companies generally reported somewhat higher decentralization levels may be the result of the M-form still being strongly implemented in the US (Mayer and Whittington, 1997). Therefore, the results seem to provide only marginal precursory support for hypothesis (2), which postulated that increased levels of decentralization lead to increased knowledge integration. Although high knowledge integrating firms appeared to have decentralized most, the findings indicated no strong differences. Low knowledge integrators and firms with more traditional organization structures were also decentralized.

Diversification

A general pattern regarding diversification is that Lokin and Lo92Lo96 companies tend to be more diversified than Hikin and Hi92Hi96 companies (see Table 6.10). This finding is in line with many observations that knowledge-intensive firms move back to the core of their business (Hedlund, 1994; Hoskisson and Hitt, 1994). Being excessively diversified and having many lines of businesses restricts the integration of knowledge, since knowledge is unconnected and the absence of knowledge common to multiple units hinders the integration of knowledge. Changes in diversification are marginal and more or less equal among all companies, whether they are Lokin or Hikin.

Determinants		Europe		Japan		United States	
		1992	1996	1992	1996	1993	1997
Diversification	Lo92Lo96	1.9	1.9	2.2	2.2	3.0	3.5
	Hi92Hi96	1.8	1.9	1.8	1.8	1.7	1.3

Table 6.10: Diversification: Lo92Lo96 vs. Hi92Hi96

It is noteworthy, however, that Lo92Hi96 companies reported most change, moving 0.6 up from 1.7 to 2.3. Although the absolute levels are relatively low, the change value is not. An explanation for this could be that those firms diversified, perhaps through mergers and acquisitions, to obtain access to additional pools of knowledge. Another explanation could be that both increasing and decreasing the scope of activities produces gains in knowledge integration. Gains in knowledge integration from decreasing scope may be the result of gains achieved through specialization, while those achieved through increasing scope may be the result of gains achieved through coordination (cf. March and Simon, 1958). Specialization facilitates learning new knowledge and integrating knowledge in

a small domain, whereas coordination across divisions and departments may result in new combinations and innovations (cf. Henderson and Clark, 1990; Hoskisson, Hill and Kim, 1993).

Regional differences among Europe, Japan, and the US were almost absent. The change patterns and absolute levels of diversification reported by companies from the three regions were quite similar. The only noteworthy differences are (1) Lo92Lo96 and Hi92Hi96 companies in Europe reported the same diversification values, with the Hi92Hi96 companies exhibiting more change; (2) Hikin96 companies in Europe reported more diversification than their Japanese and US counterparts; and (3) that Lokin companies were more diversified in the US than in Europe or Japan.

The patterns described above provide marginal preliminary evidence for hypothesis (5), which posited that increases in the relatedness of a firm's divisions and businesses would increase knowledge integration. When compared to other corporate-level elements, the changes reported for diversification, and changes therein for Hikin and Lokin companies were small. The results indicate that European companies seemed to have implemented organizing principles that offset the detriments a diversified structure impose on a firm's knowledge integration, for example, project-based structures, which were reported highest by European companies. These project-based structures are less common in the US than in Europe and Japan, which could explain why Lokin companies in the US appeared to be most diversified. It could also explain why Lo92Hi96 companies, 80% of which are in the European dataset, diversified most.

Strategic alliances

As portrayed in Table 6.11, the most notable observation is that Lo92Lo96 companies had many more assets deployed in strategic alliances than Hi92Hi96 companies did. Although alliances allow for the integration of external and internal knowledge, this finding confirms that entering into alliances decreases internal knowledge integration across subunits. For companies maintaining alliances for access of knowledge, internal knowledge integration is less relevant. Lo92Hi96 companies had the lowest absolute values of all companies, and they increased assets deployed in strategic alliances the least.

When considering regional differences the same observation applies to Japanese Lokin and Hikin companies, but not to European and US Lokin and Hikin companies. In Europe and the US, Lokin92 companies had fewer assets deployed in strategic alliances than Hikin companies. Of course, this may be the

result of many Lokin92 companies moving into the large set of companies that were in between low and high knowledge integration. In Europe and the US, a fair amount of change also occurred in the use of strategic alliances, whereas in Japan almost no change occurred. Most likely, this is the result of Japanese companies having a long tradition of maintaining production networks (cf. Badaracco, 1991; Dyer, 1998; 1999) that has been widely copied by European and US companies in the period studied here.

Determinants		Europe		Japan		United States	
		1992	1996	1992	1996	1993	1997
Strategic alliances	Lo92Lo96	1.7	2.0	2.3	2.3	1.0	2.0
	Hi92Hi96	1.0	1.3	1.8	1.8	3.5	4.0

Table 6.11: Alliances: Lo92Lo96 vs. Hi92Hi96

Information technology

Of all the variables, information technology appeared to be most closely associated with knowledge integration. This applied to having a strategy for information technology (IT strategy), using information technology to transfer and share information and knowledge (IT sharing), and the use of Electronic Data Interchange (EDI). On these variables all companies reported the highest degree of change (with change values exceeding 1 or even 2 on a five-point scale in most sub-samples), and values in 1996 were generally highest among all variables. Although values in 1992 were high also, they were not necessarily the highest compared to other variables, suggesting that IT is indeed an organizing principle of recent date. Again, comparing Hikin vs. Lokin and Hi92Hi96 vs. Lo92Lo96 companies, high knowledge integrators reported higher absolute values of IT strategies and IT sharing than low knowledge integrators (see Table 6.12). However, low knowledge integrators changed more over the period 1992/93-1996/97. This applied especially to the 72 Lokin92 companies. Almost 60% of these companies moved ahead to accompany the large set of 422 firms that found themselves on middle ground in 1996. Apparently, increasing use of information technology was a popular means to attempt enhancement of knowledge integration.

This is corroborated by the finding that the change pattern described here applied in particular to IT sharing. Companies that were Lokin in both 1992 and 1996 (Lo92Lo96 companies) changed IT strategy with 0.9 from 2.3 to 3.2, but

increased IT sharing with 1.8 from 1.7 to 3.5. Thus, these companies started with levels of IT sharing lower than IT strategy in 1992 but ended up at higher levels in 1996. A similar pattern was observable for Lokin companies in 1992 or 1996, and follows the general misbelief that implementing a set of IT hardware is equal to implementing a knowledge integration strategy (cf. Nohria and Eccles, 1992). Firms that moved from low knowledge integrators in 1992 to being high knowledge integrators in 1996 (Lo92Hi96 companies) increased the use of IT about as much as Lokin92 companies did, but at higher absolute levels. Furthermore, Lo92Hi96 also reported substantial increases in other variables, suggesting that IT is important to enhancing knowledge integration, but not enough. These firms also increased the use of other organizing principles that allowed for the integration of tacit, non-codifiable knowledge alongside the integration of explicit, codifiable knowledge through information technologies. It is likely that Lo92Hi96 followed a systemic change pattern where complementarities between variables played a prominent role.

Determinants		**Europe**		**Japan**		**United States**	
		1992	1996	1992	1996	1993	1997
IT strategy	Lo92Lo96	2.4	3.6	2.0	3.2	2.0	4.0
	Hi92Hi96	3.6	4.6	3.8	4.6	4.0	3.7
IT for sharing knowledge	Lo92Lo96	1.6	3.4	2.0	3.6	2.0	4.0
	Hi92Hi96	2.8	4.2	3.5	4.6	4.3	4.3
Electronic Data Interchange	Lo92Lo96	1.7	2.9	2.0	3.0	2.5	3.0
	Hi92Hi96	2.6	3.7	3.3	4.2	3.0	3.3

Table 6.12: Information technology: Lo92Lo96 vs. Hi92Hi96

The change patterns between Lokin and Hikin companies that were observed on the entire dataset generally upheld in the different regions as well, though degrees of change differed across the regions. European, Japanese and US companies differed, however, as regards absolute values in 1992 and 1996. In 1992, the absolute values reported for using IT were highest in the US, followed by Japan, and then Europe. Thus, in the US information technology was part of firms' strategy earlier than in Europe and Japan. This may be explained by, for example, the Internet having emerged in the US and US companies consequently adopting email systems and Intranets earlier. In 1996, however, Japanese companies appeared to have superseded US companies in the use of IT, whereas

European companies had reached about the same levels of IT as US companies. The only difference between US and European companies was that Lokin92 companies in the US appeared to have increased the use of IT about one and a half times as much as European Lokin92 companies did.

These findings provide preliminary support for hypothesis (6), which argued that increases in the use of information technology will likely lead to increased knowledge integration. When these results were compared to the general patterns described in the previous section, an additional interesting issue emerged. In the analysis of general patterns, Japanese companies emerged as being the most extensive users of information technology. However, in the comparison of Hikin and Lokin companies described here, US companies seemed to be on the edge of information technology. Apparently, US companies more than companies from other regions rely extensively on information technology to integrate and organize knowledge. Probably mimetic behavior on behalf of European and, to a lesser extent, Japanese companies led to the implementation of IT that US companies appeared to have done with success already in 1992.

CONCLUSION

The findings reported in this chapter indicate that, overall, knowledge integration in firms in Europe, Japan and the United States did indeed increase during the nineties. With that, empirical insight was provided beyond that emerging from the exemplar case studies of knowledge integration. Not only did the corporate-level indicator of knowledge integration show that knowledge integration has increased, the three most important organizational features that seem to have changed concurrently are decentralization, project-based structures, and information technology. The changes that firms that moved from being low knowledge integrators in 1992/3 to being high knowledge integrating firms in 1996/7 undertook suggest that these three organizational features bring about the most important capability of firms to integrate knowledge across organizational units, providing preliminary support for hypotheses (2), (4b) and (6).

Although this could not be entirely substantiated by the general patterns across all firms, knowledge integrating firms tended to move towards fewer organizational layers, providing preliminary evidence for hypothesis (1) as well. Again, especially the firms that moved from being low knowledge integrating firms to high knowledge integrating firms exhibit this pattern. Likewise, the number of strategic alliances and the degree to which firms outsourced activities appears to have increased. This is indicative of firms integrating knowledge more

extensively, while moving back to the core of their business. However, this pattern was not found throughout all categories. While outsourcing allows a firm to return to the core of their business, it were Lokin companies that engaged more in strategic alliances as a vehicle for firms to obtain access to external knowledge, whereas this was expected for Hikin companies. Therefore, two patterns with different rationales may have occurred, leading to the same outcome.

The data also suggests that organizational features are not being implemented singularly. Companies that could be flagged as high knowledge integrators appear to have changed organizing principles indigenous to new forms of organizing more or less over the entire spectrum, whereas low knowledge integrating companies appear to have done much less of this. Although increases in those organizing principles seem to have occurred over the entire spectrum as well, in general they are less substantial. And when the changes made by low knowledge integrating companies exceeded the changes conducted by high knowledge integrators, they are single features. For example, low knowledge integrators appeared to have increased the use of information technologies to share information and knowledge more than high knowledge integrating firms. However, this seems to be catching-up behavior. The level of information technology low integrators ended up with in 1996 only marginally exceeds the level that high knowledge integrators already had in 1992. A similar pattern applied to increases in the use of project-based structures. However, in this case low knowledge integrating companies did not even achieve in 1996 the levels of project-based structure use that high knowledge integrators already had in 1992. This may be evident of the conception that knowledge sharing is achieved by the establishment of information technology networks alone, as a way to share documented, explicit knowledge.

When comparing changes over the three regions—Europe, Japan and the US—one finding in particular stands out above the rest. Japanese companies seem to have followed an incrementalist journey of change, whereas the changes reported by European and US companies were more radical. For example, in 1992 Japanese companies already had higher levels of operational and strategic decentralization and made more use of project-based structures and alliances. The changes seen between 1992-1996 were much less substantial than in Europe or the US. In other words, here too, catching-up behavior was illustrated by European and US companies. However, this catching-up behavior was not portrayed by firms that were high or low knowledge integrators in both 1992 and 1996. For these firms the pattern was more random: European firms were least

diversified, Japanese firms were most decentralized, and US firms made most use of project-based structures.

In summary, the results presented in this chapter illustrate that to enhance knowledge integration, other organizational features require change as well, specifically project-based structures, decentralization and information technology. With that, preliminary evidence was found for the hypotheses concerning the individual effects of corporate-level elements on knowledge integration postulated in chapter 3 (see Table 3.1). The descriptives reported in the current chapter also seem to indicate that firms improving knowledge integration changed organizational elements in systemic ways, providing preliminary evidence for the hypotheses concerning the effect of complementarities among elements in shaping knowledge integration posited in chapter 3 (see Table 3.2). The hypotheses of the effects of corporate-level elements as well as complementarities between them are fully tested in the next chapter.

CHAPTER 7

The Corporate Elements shaping Knowledge Integration

A Study of Continental European Firms

This chapter continues on the preliminary evidence obtained in the preceding chapter from the descriptive patterns of how corporate-level elements central to internal networks relate to knowledge integration. To that end, it tests empirically the hypotheses concerning the corporate-level determinants of knowledge integration postulated in chapter 3. Two sets of hypotheses were developed. First, hypotheses were developed on how individual corporate elements shape knowledge integration. Second, since organization forms, and thus internal network forms of organizing, are systemic entities, hypotheses were developed as to how complementarities between these corporate elements influences knowledge integration. In addition, a hypothesis on how firm performance influences these relationships was developed. A recap of the hypotheses developed in chapter 3 is portrayed in Table 7.1.

Chapter 6 illustrated that firms in general have adopted more elements that characterize internal networks. By distinguishing between firms that could be flagged as low knowledge integrators and firms that could be marked as high knowledge integrators, the patterns described in the preceding chapter illustrated that high knowledge integrating firms made more use of in particular project-based structures, decentralization, and information technology. The previous chapter also indicated that complementarities were important to influencing knowledge integration. Although these patterns provided preliminary evidence for the hypotheses on corporate-level determinants of knowledge integration, the findings were not sufficient to reject or adopt the hypotheses. Using data obtained through the questionnaire that was administered as part of the INNFORM research program, in this chapter, these hypotheses are tested on the basis of ordinary least squares hierarchical regression analyses.

Determinant	Hypothesis	
Organizational structure		
Organizational levels	H1	As the number of organizational levels increases, knowledge integration will decrease
Decentralization	H2	As the degree of decentralization increases, knowledge integration will increase
Corporate headquarters	H3	As the size of corporate headquarters increases, knowledge integration will decrease
Product-based structures	H4a	The more organizations make use of product-based structures, the less knowledge integration will take place
Project-based structures	H4b	The more organizations make use of project-based structures, the more knowledge integration will take place
Diversification	H5	As the relatedness between divisions and businesses increases, knowledge integration will increase
Organizational processes		
Information technology	H6	As the use of information technology increases, knowledge integration will increase
Human resource practices	H7	As the use of new human resource practices increases, knowledge integration will increase
Complementarities		
System I: Project-based structures Human resource practices Information technology Decentralization	H8	The systemic effect on knowledge integration of adopting project-based structures, human resource practices, information technology and decentralization will be higher than their individual effects
System IIa: Product-based structures System I	H9a	The effect of product-based structures on knowledge integration will become more positive as complementarities with project-based structures, human resource practices, information technology and decentralization increase
System, IIb: Organizational levels System I	H9b	The effect of the number of organizational layers on knowledge integration will become more positive as complementarities with project-based structures, human resource practices, information technology and decentralization increase
System IIc: Diversification System I	H9c	The effect of relatedness between divisions and businesses on knowledge integration will become more positive as complementarities with project-based structures, human resource practices, information technology and decentralization increase
Systems I, IIa, IIb, IIc	H10	The effect of complementarities between corporate elements in shaping knowledge integration will be higher for high performing firms than for low performing firms

Table 7.1: A recap of the corporate-level hypotheses

The agenda of this chapter is as follows. In the next section, the dependent, predictor and control variables used in this study are laid out, and it is presented. how the questionnaire was used to operationalize the variables. Next, the technique used to analyze the data, ordinary least squares hierarchical regression analysis, is elaborated. Then, results of testing the hypothesis will be presented. Finally, the findings are consolidated.

VARIABLES

To test the hypotheses postulated in chapter 3, 8 main predictors were included in the model. An additional 6 variables were controlled for before testing the hypotheses. All variables needed for this study were obtained from items in the INNFORM questionnaire (see Appendix A). The descriptions of these items are listed in Table 7.2. The descriptives of all variables and zero-order correlations between the variables are portrayed in Table 7.3.

Dependent variable

The dependent variable of this study, knowledge integration, was obtained by averaging the responses on four items in the questionnaire. All four items queried the extent to which knowledge linkages were present between units within a corporation. Especially at a corporate level of analysis, intraorganizational linkages between units are important to consider. Not only do interunit linkages provide a foundation for a firm to exchange and integrate knowledge since the presence of a linkage suggests that knowledge is being transferred (Nahapiet and Ghoshal, 1998; Tsai, 2000), but since each unit has its own knowledge base, they allow for the (re)combination of knowledge in novel ways (Galunic and Rodan, 1998).

In the questionnaire, a distinction was made between vertical linkages between corporate headquarters and subunits, and horizontal linkages between subunits (cf. Bartlett and Ghoshal, 1989; Nohria and Ghoshal, 1997). Vertical knowledge linkages were substantiated by two items, one of which probed linkages to share R&D knowledge between headquarters and subunits, the other of which examined linkages between headquarters and subunits to share skills and resources. The other two items measured knowledge linkages in the same areas but on a horizontal basis: linkages between subunits to share R&D knowledge, and linkages between subunits to share skills and resources.

The four items were averaged to obtain a measure of knowledge integration. The rationale for averaging the four items into one measure, instead of having one

measure for vertical knowledge flows and one for horizontal knowledge flows, is that in internal networks both horizontal and vertical knowledge flows are important. In internal networks the former supplant or supplement the latter. Cronbach's alpha for this measure was 0.78, which is well above the 0.7 cut-off level suggested by Nunnally (1978), indicating a reliable measure.

Variable name	Description
Knowledge integration	Extent to which linkages are present to share R&D knowledge and skills and resources between HQ and subunits and among subunits
Firm size	Number of employees
R&D Intensity	Percentage of turnover spent on research and development
Internationalization	Number of countries with operating businesses
Competition	Number of competitors in principal market
Nordic	Firms from Denmark, Finland, Netherlands, Norway and Sweden
Germanic	Firms from Austria, Germany and Switzerland
Latin	Firms from Belgium, France, Italy, Portugal and Spain
Organizational layers	Number of organizational levels between manager with lowest level of profit responsibility and the CEO, counted along longest line
Relative HQ size	Number of employees on headquarters' payroll
Product-based structure	Extent to which structure is organized along products and services
Project-based structure	Extent to which structure is organized along the line of projects
Diversification	Relatedness of divisions and businesses
Internal labor market	Use of internal labor market to transfer people between subunits
Teams	Use of managerial and professional teams across subunits
Internal networks	Use of internal networks and communication channels
IT strategy	Extent to which a common strategy for information technology is installed
IT sharing	Extent to which information technology is used to share data
EDI	Extent to which electronic data interchange with suppliers and customers is used
Oper. decentralization	Degree to which managers can make decisions regarding operating activities
Str. decentralization	Degree to which managers can make decisions regarding strategic activities
Performance	Financial performance compared to other companies in same industry

Table 7.2: Description of variables

Predictor variables

Organizational layers. The first predictor variable, the number of organizational or hierarchical layers, was obtained following the approach of

Dewar and Hage (1978), Pugh et al. (1968), and Van de Ven and Ferry (1980). In the questionnaire, therefore, respondents were asked how many organizational layers, counted along the longest line, were established between the lowest manager with profit responsibility and the chief executive. Using it as a measure of vertical differentiation, these studies have indicated that counting the number or organizational layers along the longest line is a reliable measure.

Relative headquarters size. The number of employees located in corporate headquarters was included as the second predictor variable to assess the size of corporate headquarters, and with that its impact and role. The assumption was made that larger headquarters have a more prominent, central role with larger influence (Holmström and Roberts, 1998; Young et al., 2000). However, the prominence of corporate headquarters as measured by size is dependent on firm size. The influence of large corporate headquarters will be larger in a small firm than in a large firm. Therefore, relative corporate headquarters size, constituted by the number of employees working in headquarters proportional to the total number of employees, was included as the second predictor variable.

Product-based vs. project-based structures. The third and fourth predictors included in the model were obtained following the approach used in the Aston studies (Pugh et al., 1968). The two predictors were the degrees to which a firm was characterized by product-based structures and by project-based structures. Respondents were queried as to what extent these structural attributes characterized their organization. The Aston studies did not use a measure for the use of project-based structures. Since many firms have begun experimenting with project-based structures to ameliorate knowledge organization, however, it was believed important to include that measure in a way similar to the Aston studies.

Having two separate indicators allowed for a richer analysis in the sense that respondents were not forced to tick the structure that was most representative of their firm, although both were significantly present. The literature on innovative forms of organizing as well as the case study in chapter 5 indicates that internal networks have dual structures in that they rely on both traditional and innovative structures (Nonaka and Takeuchi, 1995; Pettigrew and Fenton, 2000). The two separate indicators allowed for the testing of such dualities that may be present in organization structure when firms adhere to both.

Diversification. Following earlier studies examining the relationship of diversification with other constructs (e.g. Baysinger and Hoskisson, 1989), diversification, the fifth independent variable, was measured following the standard Wrigley-Rumelt classification (Rumelt, 1974; Wrigley, 1970). In the

	Mean	Standard Deviation	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Knowledge integration	3.33	0.83							
(2) Firm size	19749.62	41444.90	-0.09						
(3) R&D intensity	2.96	1.23	0.27***	0.16*					
(4) Internationalization	15.22	24.05	-0.05	0.33***	0.05				
(5) Competition	3.62	1.26	0.02	0.06	-0.07	0.17**			
(6) Nordic	0.13	0.33	0.07	0.06	0.04	0.15*	0.09		
(7) Germanic	0.38	0.49	0.02	0.06	0.02	0.14*	0.14*	-0.30***	
(8) Latin	0.42	0.50	-0.04	-0.09	-0.04	-0.22**	-0.19**	-0.33***	-0.68***
(9) Organizational layers	3.23	1.68	0.03	0.25***	0.16*	0.16*	0.01	-0.08	-0.02
(10) Relative HQ size	0.18	0.29	0.15*	-0.22**	-0.14*	-0.23***	0.08	-0.05	0.07
(11) Product-based structure	4.03	1.06	0.13*	0.04	0.15*	0.13*	0.02	-0.07	0.25***
(12) Project-based structure	3.25	1.33	0.27***	0.09	0.11†	0.01	0.05	-0.16*	0.37***
(13) Diversification	2.31	0.98	0.03	0.11†	0.15*	0.10	0.04	0.03	0.19**
(14) Internal labor market	0.68	0.47	0.12†	0.16*	0.02	0.12†	0.18**	0.14*	-0.03
(15) Teams	0.68	0.47	0.04	0.18**	-0.02	0.11†	0.02	0.11†	0.07
(16) Networks	0.57	0.50	0.04	0.20**	0.01	0.22**	-0.03	0.19**	0.02
(17) IT strategy	3.88	0.98	0.30***	-0.06	0.03	0.00	0.01	-0.06	0.06
(18) IT use and sharing	3.70	1.07	0.21**	0.08	0.11†	0.19**	0.06	-0.03	0.19**
(19) EDI	3.14	1.14	0.25***	-0.02	0.11†	0.12†	-0.06	-0.02	0.04
(20) Oper. decentralization	3.36	1.01	0.06	0.05	0.16*	0.17**	-0.04	0.06	0.14*
(21) Str. decentralization	2.35	1.08	0.03	0.07	0.23***	0.24***	-0.02	0.04	0.19**
(22) Performance	3.65	0.99	0.05	-0.18**	-0.04	-0.16*	0.02	0.04	0.02

two-tailed; † = $p < 0.10$; * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$

Table 7.3: Means, standard deviations, and zero-order correlations

questionnaire respondents were asked to indicate whether the range of businesses their firm operated could be described as (1) a single core business (95-100% of sales from one type of business), (2) a dominant core business (70-94.9% of sales from one type of business), (3) a set of related businesses (70% or more of sales related by technology or markets), or (4) a wide range of businesses (less than 70% of sales related by technology or markets). Markides and Williamson (1996) and Tsai (2000) argue that businesses are strategically related if they use the same assets. Since, in a single core business firm assets and thus knowledge are more likely to be related than in a firm with a wide range of businesses, the increasing scale suggested decreasing relatedness of divisions, and therefore decreasing relatedness of divisions' knowledge bases.

(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
0.07													
-0.05	-0.11†												
-0.24***	0.06	0.01											
-0.24***	0.05	0.12†	0.34***										
-0.23***	0.11†	-0.09	0.27***	0.03									
-0.09	-0.01	-0.02	0.10	0.08	-0.06								
-0.03	-0.14*	-0.03	-0.06	-0.02	-0.16*	0.62***							
-0.17**	-0.04	-0.17**	0.07	0.02	-0.03	0.55***	0.52***						
0.04	-0.07	0.13*	0.18**	0.26***	-0.12†	0.13*	0.13*	0.15*					
-0.10	0.08	0.09	0.17**	0.33***	-0.07	0.13*	0.05	0.12†	0.51***				
-0.02	0.14*	-0.05	0.17**	0.22**	0.09	-0.02	0.02	0.10	0.37***	0.44***			
-0.23***	0.16*	-0.19**	0.20**	0.09	0.24***	0.14*	0.01	0.18**	0.01	0.03	0.06		
-0.24***	0.17**	-0.17**	0.15*	0.20**	0.26***	0.10	0.00	0.11†	-0.04	0.08	0.04	0.56***	
-0.07	-0.10	0.08	0.02	0.03	-0.05	0.02	0.15*	0.07	0.08	0.10	0.18**	0.09	-0.01

Table 7.3: Means, standard deviations, and zero-order correlations (continued)

Decentralization, information technology and human resource practices. The sixth, seventh and eight predictors were obtained by employing factor analysis on 8 questionnaire items. The results of the factor analysis are illustrated in Table 7.4. Three items queried the use of internal labor markets, teams and internal networks among employees, as indicators of the use of human resource practices. Three items were used to assess the extent to which information technology was used. The three items queried the extent to which a firm had in place a strategy for using information technology, actually used information technology to share knowledge, and relied on Electronic Data Interchange. Two final items queried the extent to which lower-level managers have discretion to make operational and strategic decisions as indicators of operational and strategic decentralization respectively. These two items were constructed similar to the approaches of Frost, Birkinshaw and Ensign (2002), Gupta and Govindarajan (2000) and Pugh et al.

(1968). Respondents were given five choices to indicate the degree of discretion managers have in making decisions at the operational (e.g. modifying a production process) and strategic (e.g. long-term strategic planning) level.

Variables	Factors		
	(1) New human resource practices	(2) Information technology	(3) Decentralization
Internal labor market	**0.846**	0.044	0.091
Teams	**0.851**	0.027	-0.073
Internal networks	**0.772**	0.121	0.149
Information technology strategy	0.150	**0.786**	-0.060
Use of information technology	0.068	**0.824**	0.051
Electronic Data Interchange	-0.025	**0.756**	0.059
Operational decentralization	0.113	0.020	**0.873**
Strategic decentralization	0.019	0.024	**0.880**
% of variance explained	29.83	20.94	18.55
Initial Eigenvalue	2.386	1.675	1.484
Cronbach's α	0.79	0.70	0.72

Orthogonal rotation; 69.3 percent of variance explained

Table 7.4: Results of factor analysis

The factors were obtained by employing a principal components analysis on the items, and by rotating the scores orthogonally. All factors with Eigenvalues below 1 were dropped from the analysis. By so doing, three factors remained that explained 69.3 percent of the variance in the items. All the factor loadings were considerably high. Three factor loadings were above 0.7, while 5 items loaded above 0.8 on the factors, suggesting that the factors were convergently valid. Also, no cross-loadings of the items on the factors were present, indicating the discriminant validity of the factors. Considering that alpha coefficients associated with the factors were all on or above the 0.70 cut-off level specified by Nunnally (1978), all factors, labeled new human resource practices (Cronbach's $\alpha = 0.79$), information technology (Cronbach's $\alpha = 0.70$) and decentralization (Cronbach's $\alpha = 0.72$), were demonstrated to be reliable. The three factors were saved and added to the dataset for inclusion as predictors in regression models.

Control variables

Firm size. The first variable that was controlled for before testing the hypotheses was firm size. As exemplified by the case study in chapter 5, the size of a firm may influence knowledge integration and organization, as well as its outcomes. Although larger firms may have more resources to devote to knowledge integration and may have a larger opportunity set of knowledge transfers, their size may prove a liability in terms of integrating knowledge. Various studies, including the case study conducted as part of the current study, have found that increasing size as measured by the number of employees may hamper knowledge transfers (e.g. Pettigrew and Fenton, 2000). To that end, similar to the studies of Ahuja and Lampert (2001) and Yli-Renko, Autio and Sapienza (2001), the logarithm of total number of employees was computed. The rationale for choosing an employee-based measure of size instead of a sales-based measure of size was that it was believed that responses to structural and processual elements of organization would be more closely associated with the number of employees than with sales. It was conjectured that increasing firm size would negatively relate to knowledge integration.

R&D intensity. The second control variable that was included is R&D intensity. In knowledge-intensive firms, R&D investments tend to account for a large part of cost and value-added (Dosi, 1988; Nelson and Winter, 1982). What is more, knowledge is not only required for successful R&D operations, but R&D activities produce knowledge (Cohen and Levinthal, 1989; Nelson, 1982). Following standard computation, R&D intensity was obtained from a questionnaire item querying the percentage of corporate turnover spent on R&D activities.

Internationalization. Following Gupta and Govindarajan (2000), Yli-Renko, Autio and Spienza (2001) and Zahra, Ireland and Hitt (2000), the third control variable was embodied by the degree of internationalization. This variable was constituted by the number of operating units a firm maintained in foreign countries. Given the nature of the sample—large and medium-sized firms—the majority of firms in it controlled international units. Although MNCs have emerged because external markets for knowledge are less effective than internal mechanisms (Kogut and Zander, 1993), knowledge integration in MNCs is fraught with complications that domestic firms are less likely to experience. First, because of different cultures and business contexts, and therefore not rarely different products, services and goals, subsidiaries of MNCs often may have conflicting strategic demands (Forsgren, 1997). These characteristics may provide MNCs an

edge, because resource combinations may be pursued in which knowledge deployed in one product or market may be successfully deployed in another (Zander, 2002). However, they also hamper knowledge integration in the absence of overlapping knowledge bases. Second, sheer spatial distance decreases the likelihood of communication, interaction, and integration (Mayhew and Levinger, 1976). As such, increasing internationalization is likely to decrease knowledge integration.

Competition. The fourth variable that was controlled for before testing the hypotheses was the level of competition a firm experienced as regards its primary products and services. As competition intensifies, a firm has greater incentives to integrate knowledge (D'Aveni, 1994; Eisenhardt and Martin, 2000). Following Industrial Organization (IO) economics, the item used from the questionnaire queried respondents to indicate on a five-scale measure against how many rivals their firm competed in markets of their principal products (Scherer and Ross, 1990).

Nordic, Germanic and Latin. The fifth, sixth, and seventh control variables were indicators of a firm's country of origin. Not only do the differences in response rates across the countries justify a control for this effect, national cultures and institutional contexts may impact on the extent to which knowledge integration takes place in organizations. Different institutional contexts bear effects on the distribution of organization forms (Whittington and Mayer, 1997), and thus on firms' ability to integrate knowledge. In addition, cultural variations are suggested to inhibit knowledge integration (Bhagat et al., 2002).

Hofstede (1991) found that countries differ in power distance, masculinity, individualism and uncertainty avoidance. Based on the Aston studies (Pugh et al., 1968), Hofstede found that the difference in organization designs and forms of organizing in various countries was strongly reflected in the power distance and uncertainty avoidance characterizing a country. For instance, as it suggests increased reliance on centralization, greater power distance is likely to hamper knowledge integration. Each of Hofstede's cultural determinants is likely to influence knowledge integration. Therefore, based on Hofstede (1991), the firms in the sample were therefore divided into three groups: Nordic, Germanic and Latin firms. Included in the Nordic group were typically firms from Scandinavian and other Northern European countries: Norway, Sweden, Finland, Denmark, and The Netherlands. Firms from Germany, Austria, and Switzerland were coded as Germanic firms. In the Latin group appeared firms from France, Spain, Portugal, Italy, Belgium, and Luxembourg, typically Mediterranean and other Southern

European countries with Latin influences. Based on that division, three dichotomous variables were created, where a value of '1' indicated that the firm originated in that European region, while a value of '0' meant that the firm belonged to another group.

ANALYSIS

In order to evaluate the hypotheses ordinary least squares hierarchical regression analysis was employed. Essentially, four steps were performed. The first step involved the inclusion of the control variables in the model. In the second step, all main predictor variables were included in the model. The third step centered around the inclusion of complementary or systemic effects, which were included as individual interaction effects to uncover the extent to which they added explanatory power to the model. Finally, a full model was specified with all interaction effects as the fourth step.

Consistent with the hypotheses in Tables 3.2 and 7.1, the interactions assessing systemic effects are listed in Table 7.5. System I was included to test Hypothesis (8), which postulated that complementarities between corporate attributes that ceteris paribus enhance knowledge integration further increase knowledge integration. Systems IIa, IIb and IIc were included to test Hypotheses (9a), (9b) and (9c) respectively, which centered around the argument that complementarities between elements enabling and restricting knowledge integration are required to increase knowledge integration above the effects of the elements individually.

System	Interactions
System I	Project-based structure x decentralization x information technology x HR practices
System IIa	Product-based structure x System I
System IIb	Number of hierarchical levels x System I
System IIc	Diversification x System I

Table 7.5: Systemic interactions

In addition to the models above, two full regression models were specified for high and low performing firms to test for Hypothesis (10). In the questionnaire, respondents were asked to indicate on a five-scale measure the financial performance of their firm compared to other firms in the same industry and

sector. Although this might introduce potential bias, earlier studies have indicated that objective and subjective measures of performance strongly correlate (Dess and Robinson, 1984). As such, in the absence of more objective measures, this item was used to differentiate between high and low performing firms. The five-scale measure was recoded into a binary variable, where firms indicating similar or lower performance than their main rivals were assigned the value '0', and the value '1' otherwise.

Missing values were treated by listwise deletion. Studentized residuals, Mahalanobis distances and Cook D statistics were employed in eliminating outliers. Three cases were omitted from the dataset because the associated Mahalanobis distances indicated they were overly leveraging the slope of the regression line. Multicollinearity associated with the control and predictor variables was tested for by analyzing tolerances and partial correlations, but was not considered material. To preclude multicollinearity effects to occur because of the interaction effects, the recommendations of Aiken and West (1991) and Jaccard, Turrisi and Wan (1990) were followed by centering all variables around the mean before computing the interaction terms. Further, the minimum conditional standard errors X_i of the regression coefficients were computed from which appeared that the standard errors were not inflated because of the interaction terms. To interpret the direction of significant interaction effects, Aiken and West's (1991) and Cohen and Cohen's (1983) guidelines were followed. A series of simple regression equations were computed for three different levels of variance. Next, the slopes were examined to see how they differed from zero and each other.

RESULTS

The results of the hierarchical regression analyses are portrayed in Table 7.6. Model 1 ($R^2 = 0.24$; $F_{8,100} = 3.97$; $p < 0.001$) lists the control model from which appears that R&D intensity, as predicted, had a positive effect on knowledge integration. No effect was found for firm size and the degree of competition. Although linear relationships between firm size and knowledge integration and between the degree of competition and knowledge integration were conjectured, closer attention to the data revealed that both relationships were curvilinear. Therefore, a squared term of firm size and of competition was included in the model, which indicated that both relationships had the shape of an inverted-U. Analyses of variance corroborated this finding.

In large firms increasing scope and complexity in transferring knowledge is higher, preventing the integration of knowledge. In small firms, the scale of operations may be so limited that interunit knowledge integration is hardly necessary or even possible. Similarly, although monopolists and oligopolists have more resources to integrate knowledge, monopolists and, to a lesser extent, oligopolists may feel less need to do so, since few rivals are present which could capture some market share. Fierce competition with many rivals, on the other hand, may prevent firms from integrating knowledge as they lack the time and resources to do so. The region a firm was located in proved to have no significant effect on knowledge integration.

With the addition of the main effects in model (2), an additional 27 percent of variance was explained ($\Delta R^2 = 0.27$; $\Delta F_{8,92} = 6.18$; $p < 0.001$). This model was used to test Hypotheses (1) through (7). Of these, Hypotheses (4b), (6) and (7) could be adopted. As predicted, the use of project-based structures, new Human Resource practices and information technology were demonstrated to have a positive effect on knowledge integration. Given that the relative size of corporate headquarters proved to have a positive effect on knowledge integration, Hypothesis (3), which postulated that increasing headquarters size relates to less knowledge integration, had to be rejected. Apparently, corporate headquarters has an important role in the knowledge integration process. However, no support was found for Hypotheses (1), (2), (4a) and (5). The number of hierarchical levels, the degree of decentralization, the use of product-based structures and the relatedness between divisions and businesses had no significant effect on knowledge integration.

The reason why these results were obtained appeared when systemic effects were added as interactions to the main effects model; first individually (models 3 through 6), then together in a full model (model 7). As no significant increase in R-squared resulted from the addition of the System I interaction, Hypothesis (8) had to be rejected. Systemic effects between project-based structures, new Human Resource practices, information technology and decentralization did not enhance knowledge integration over the effects of these corporate elements individually in shaping knowledge integration.

The effect of System IIa did, however, did add to knowledge integration, explaining an additional 5 percent of the variance that was unaccounted for in previous models ($\Delta R^2 = 0.05$; $\Delta F_{1,91} = 11.30$; $p < 0.001$). The interaction is illustrated in Figure 7.1, and proved to be in the hypothesized direction. Firms characterized by a product-based structure that, at the same time, were

Table 7.6: Results of OLS hierarchical regression analyses for knowledge integration

	Models								
	(1) Controls	(2) Main	(3) System I	(4) System IIa	(5) System IIb	(6) System IIc	(7) Full	(8) Hi perf.	(9) Lo perf.
Intercept	2.49***	2.12***	2.18***	2.43***	2.14***	2.12***	2.50***	1.57†	2.64*
	(0.53)	(0.54)	(0.54)	(0.52)	(0.55)	(0.54)	(0.53)	(0.86)	(0.94)
Main effects									
Number of hierarchical levels		0.04	0.05	0.04	0.04	0.05	0.04	0.06	0.07
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.06)	(0.06)
Relative headquarters size		0.58*	0.56*	0.77**	0.59*	0.57*	0.79**	0.82*	0.04
		(0.27)	(0.27)	(0.26)	(0.27)	(0.27)	(0.27)	(0.32)	(0.67)
Product-based structure		-0.08	-0.09	-0.14*	-0.09	-0.09	-0.14*	-0.18†	-0.08
		(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.11)	(0.12)
Project-based structure		0.16**	0.16**	0.14**	0.15**	0.16**	0.15**	0.12	0.30**
		(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.08)	(0.09)
Diversification		0.05	0.05	0.00	0.05	0.05	-0.00	0.00	0.16
		(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.10)	(0.16)
New Human Resource practices		0.18*	0.16*	0.12†	0.18*	0.16*	0.13†	0.12	0.29†
		(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.10)	(0.14)
Information technology		0.32***	0.30***	0.25**	0.32***	0.32***	0.23**	0.41***	-0.14
		(0.07)	(0.08)	(0.07)	(0.08)	(0.08)	(0.08)	(0.12)	(0.20)
Decentralization		-0.01	-0.04	0.00	-0.01	-0.02	0.01	-0.00	-0.15
		(0.07)	(0.08)	(0.07)	(0.08)	(0.08)	(0.07)	(0.10)	(0.12)
Interaction effects									
System effect I			-0.05				-0.03	-0.05	-0.00
			(0.04)				(0.05)	(0.06)	(0.13)
System effect IIa				0.07**			0.08**	0.08*	0.05
				(0.02)			(0.03)	(0.03)	(0.03)

Table 7.6: Results of OLS hierarchical regression analyses for knowledge integration (continued)

System effect IIb					0.02		0.00	0.04	-0.25
					(0.05)		(0.05)	(0.07)	(0.15)
System effect IIc						-0.04	0.07	0.01	0.33†
						(0.06)	(0.07)	(0.10)	(0.18)
Controls									
Firm size (log)	0.10	0.04	0.04	0.05	0.04	0.04	0.05	0.18	0.04
	(0.13)	(0.13)	(0.13)	(0.12)	(0.13)	(0.13)	(0.12)	(0.21)	(0.26)
Firm size (log squared)	-0.20†	-0.19*	-0.20*	-0.17†	-0.19†	-0.19†	-0.17†	-0.15	-0.25
	(0.11)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.20)	(0.23)
R&D Intensity	0.18**	0.15**	0.14**	0.14**	0.14**	0.15**	0.14**	0.22**	-0.12
	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.07)	(0.11)
Internationalization	-0.01†	-0.01*	-0.01†	-0.01*	-0.01*	-0.01*	-0.01†	-0.01	-0.01*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
Competition	0.08	0.12*	0.11†	0.12*	0.12*	0.12*	0.11†	0.19*	0.02
	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.08)	(0.10)
Competition (squared)	-0.18**	-0.14**	-0.14**	-0.12*	-0.14**	-0.14**	-0.11*	-0.03	-0.13
	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.07)	(0.09)
Nordic	0.27	0.39*	0.38†	0.41*	0.39*	0.39*	0.42*	0.53†	0.04
	(0.22)	(0.19)	(0.19)	(0.18)	(0.20)	(0.19)	(0.19)	(0.28)	(0.32)
Germanic	0.17	0.02	0.00	0.03	0.02	0.01	0.04	-0.12	-0.20
	(0.17)	(0.15)	(0.15)	(0.15)	(0.16)	(0.16)	(0.15)	(0.21)	(0.28)
R square	0.24	0.51	0.52	0.56	0.51	0.51	0.57	0.63	0.77
F-value	3.97***	5.90***	5.73***	6.84***	5.51***	5.55***	5.75***	4.07***	3.15**
Δ R square	0.24	0.27	0.01	0.05	0.00	0.00	0.06	-	-
Δ F-value	3.97***	6.18***	1.96	11.30***	0.11	0.47	3.04*	-	-
degrees of freedom	8, 100	16, 92	17, 91	17, 91	17, 91	17, 91	20, 88	20, 47	20, 19

† = p < 0.10; * = p < 0.05; ** = p < 0.01; *** = p < 0.001

decentralized, had implemented project-based structures, new Human Resource practices, and information technology appeared to influence knowledge integration above the effects of these determinants individually. Increasing reliance on product-based structures, thus, did prove not to be detrimental, but to contribute to knowledge integration. On the basis of these results Hypothesis (9a) could be adopted. Using the same technique, Hypotheses (9b) and (9c), which postulated respectively that firms with an increasing number of organizational levels and unrelated diversifiers are still able to foster knowledge integration if the elements of System I were used in a complementary way, had to be rejected considering that the addition of Systems IIb and IIc did not explain more variance in the model (System IIb: $\Delta R^2 = 0.00$, $\Delta F_{1,91} = 0.11$; System IIc: $\Delta R^2 = 0.00$, $\Delta F_{1,91} = 0.47$). All interactions could be maintained when included together in a full model (model 7).

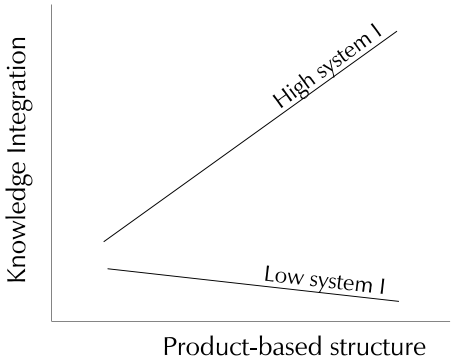


Figure 7.1: Interaction effect

Also, two different regression equations were computed, one for high performing firms, and one for low performing firms (models 8 and 9 in Table 7.6) to test for Hypothesis (10), which postulated that the effect of complementarities on knowledge integration will be higher for high performing firms than for low performing ones. The same interactions as in model 7 could be maintained for high performing firms, but not for low performing ones. Although not every system of complementarities proved to have a significant relationship with knowledge integration in high performing firms, Hypothesis (10) could be

adopted. Apparently, complementarities between corporate elements shaping knowledge integration added to increased performance.

Noteworthy in the difference between high and low performers was also that the negative effect of internationalization was only present for low performers. This suggests that high performing firms through their implementation of corporate attributes may be better able to overcome the difficulties an internationalized firm poses on integrating knowledge. Given the strong correlation between internationalization and the use of Information Technology systems, in turn, this may be result of the positive effect of information technology, which removes physical and spatial boundaries in knowledge integration. The positive effect of information technology in the previous models could be maintained for high performers but not for low performers. The effects of R&D intensity and competition on knowledge integration, on the other hand, were found strongly positive in high performing firms, but absent in low performing firms. Apparently, high performing firms are better able to capitalize on R&D activities and are more aware of the necessity of integrating knowledge to maintain an edge in the competitive equation.

CONCLUSION

In this chapter, a study testing the corporate elements shaping knowledge integration has been reported to add to an undernourished field of study in strategy and organization. Two sets of hypotheses were developed: hypotheses postulating the effects of elements individually or ceteris paribus (see Table 7.7), and hypotheses centering on complementarities between these elements (see Table 7.8).

Regarding the ceteris paribus effects, it was found that project-based structures, new human resource practices and information technology systems relate to increased knowledge integration. Contrary to expectations, however, the hypothesis that large corporate headquarters and less knowledge integration go together was not demonstrated. Instead, the opposite was found, in that a large headquarters related to increased knowledge integration. Although discretion to action is said to be moving down the hierarchy, arguing for a smaller size of corporate headquarters, the architectural and supporting role of corporate headquarters may still justify a larger size. The size of corporate headquarters does not exclusively inform us of its role. No relationship was found for the relationship between decentralization and knowledge integration. Similarly, no negative relationships with knowledge integration were found for the number of

hierarchical levels, and the degree to which firms made use of diversified and product-based structures.

H1	As the number of organizational levels increases, knowledge integration will decrease	Not supported
H2	As the degree of decentralization increases, knowledge integration will increase	Not supported
H3	As the size of corporate headquarters increases, knowledge integration will decrease	Not supported
H4a	The more organizations make use of product-based structures, the less knowledge integration will take place	Partially supported
H4b	The more organizations make use of project-based structures, the more knowledge integration will take place	Supported
H5	As the relatedness between divisions and businesses increases, knowledge integration will increase	Not supported
H6	As the use of information technology increases, knowledge integration will increase	Supported
H7	As the use of new human resource practices increases, knowledge integration will increase	Supported

Table 7.7: Corporate-level hypotheses: individual effects

The most important finding of the chapter was, however, that product-based structures, or many hierarchical levels are not detrimental to knowledge integration as long as project-based structures, new human resource practices, information technology and decentralization are used concurrently. The concerted impact of the knowledge integration enabling attributes, without elements that ceteris paribus were hypothesized to restrict knowledge integration, appeared to have no additional effect over the influence of the knowledge integration enabling elements individually. This finding could also be maintained for high performing firms, but not for low performing ones. This finding confirms that both elements individually enabling knowledge integration and elements individually restricting knowledge integration are required for enhanced knowledge integration and performance from a corporate-level of analysis.

In summary, knowledge integration is influenced by corporate-level elements. This applies especially to elements that are characteristic of internal network forms of organizing, such as project-based structures, use of information technology and human resource practices. Consistent with the notion that

H8	The systemic effect on knowledge integration of adopting project-based structures, new human resource practices, information technology and decentralization will be higher than their individual effects	Not supported
H9a	The effect of product-based structures on knowledge integration will become more positive as complementarities with project-based structures, new human resource practices, information technology and decentralization increase	Supported
H9b	The effect of the number of organizational layers on knowledge integration will become more positive as complementarities with project-based structures, new human resource practices, information technology and decentralization increase	Not supported
H9c	The effect of relatedness between divisions and businesses on knowledge integration will become more positive as complementarities with project-based structures, new human resource practices, information technology and decentralization increase	Not supported
H10	The effect of complementarities between corporate elements in shaping knowledge integration will be higher for high performing firms than for low performing firms	Supported

Table 7.8: Corporate-level hypotheses: systemic effects

organization forms are systemic entities, complementarities between elements proved to influence knowledge integration more than the sum of the individual effects of the corresponding elements. In particular, consistent with the finding of the case study in chapter 5, the test of the effect of complementarities indicated that by overlaying a product-based structure, a traditional characteristic of organizations, with innovative elements knowledge integration was influenced above the individual effects of corporate-level elements. While this chapter tested hypotheses on the effect of corporate-level elements, in the next chapter, the business-level is addressed by testing how knowledge flows influence absorptive capacity and performance, and thus how internal networks contribute to developing absorptive capacity.

CHAPTER 8

Business-level Determinants of Knowledge Integration

Absorptive Capacity, Knowledge Transfers, and Innovative Performance

In chapter 3, it was argued that absorptive capacity is one of the most important determinants of knowledge integration. Several studies have been conducted that underscore this notion (Birkinshaw, Morrison and Hulland, 1995; Gupta and Govindarajan, 2000; Szulanski, 1996). However, these studies have not considered the role of absorptive capacity in internal networks. Since absorptive capacity is important to internal knowledge integration, studying it at the business level is important. In internal networks, management aims to foster processes of organic growth (Ghoshal and Bartlett, 1997; Goold and Campbell, 2002). Since absorptive capacity is largely dependent prior knowledge endowments, the development of absorptive capacity in one period will foster its development in the next period. Absorptive capacity enables knowledge integration, thus increasing the knowledge base of a unit, and contributing to improved absorptive capacity. Therefore, absorptive capacity will likely contribute to achieving such growth in internal networks.

Research on distinctly organizational determinants of absorptive capacity is, however, undernourished (Van den Bosch, Van Wijk and Volberda, 2003). A key characteristic of internal networks is its configuration of knowledge flows, in which horizontal knowledge flows supplant and supplement vertical ones. To that end, it was proposed that the set of relationships among a firm's knowledge transfers, its absorptive capacity, and its innovative performance is multidimensional. Based on the premise that absorptive capacity is dependent on a relevant knowledge base and the distinction that can be made between deep, specialist knowledge and broad, generalist knowledge, it was demonstrated that absorptive capacity too has a depth and breadth dimension. Further, next to horizontal knowledge transfers or flows, vertical knowledge transfers or flows were considered as part of a firm's knowledge flow configuration. It was proposed

that horizontal and vertical knowledge flows have disparate associations with both dimensions of a firm's absorptive capacity. Finally, it was submitted that both dimensions of absorptive capacity relate differently to innovative performance, as measured by exploration as against exploitation. This chapter empirically tests hypotheses (11) through (12) that were developed in chapter 3, and are repeated in Table 8.1.

Determinant	Hypothesis	
Vertical knowledge flows	H11a	As vertical knowledge flows become more prevalent, the depth of absorptive capacity will increase
Horizontal knowledge flows	H11b	As horizontal knowledge flows become more prevalent, the breadth of absorptive capacity will increase
Depth of absorptive capacity	H12a	As the depth dimension of absorptive capacity increases, the degree of exploration over exploitation will decrease
Breadth of absorptive capacity	H12b	As the breadth dimension of absorptive capacity increases, the degree of exploration over exploitation will increase

Table 8.1: A recap of business-level hypotheses: absorptive capacity

The chapter is structured as follows. The next section explains how the variables used in this study were obtained. Then, the technique to analyze the data is addressed. In addition to elaborating on the structural equation modeling technique LISREL, the validity and reliability of the constructs and the model are addressed. In the fourth section, the findings from the questionnaire administered at Spectrum are reported and hypotheses tested. In the final section, the findings are concluded.

VARIABLES

To substantiate the constructs of the theoretical model illustrated in Figure 8.1, 12 questionnaire items were used to develop the variables that were included in this study (see Appendix B). All 12 questionnaire items needed to be ticked on a five-point Likert-type scale ranging from "completely disagree" to "completely agree" in case a certain statement was propounded, and from "to a small extent" to "to a large extent" when respondents were queried as to the extent to which certain organizational practices were used. Two variables were incorporated as indicators of internal knowledge flow configuration. Four variables were included to substantiate the depth and breadth dimension of absorptive capacity. For the

specification of exploration as against exploitation one variable was used. All variables are summarized in Table 8.2.

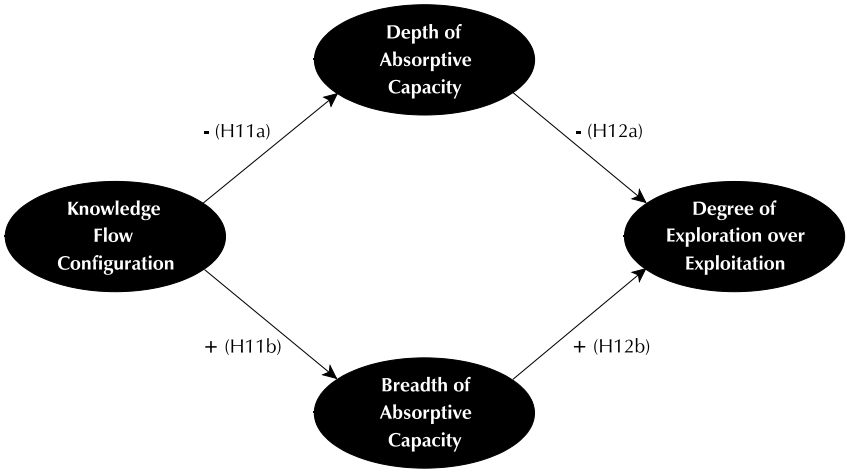


Figure 8.1: Theoretical model

Knowledge flow configuration. In line with the studies of Aoki (1986), Burns and Stalker (1961) and Hedlund (1994), Van Wijk and Van den Bosch (1998) argued that a firm's knowledge flow configuration can be captured by taking the ratio of its horizontal to vertical knowledge flows. Although that ratio is a strong measure to compare firms' configuration of knowledge flows, it is also strongly curvilinear, and was therefore believed inappropriate for current purposes. In this study, the proportion of horizontal to total knowledge flows, HTRATIO, was included as an indicator of a firm's knowledge flow configuration. Since interunit interactions, and thus knowledge flows, occur either vertically with units along the hierarchy or horizontally with units outside the hierarchy, the total sum of a firm's knowledge flows can be grasped by adding vertical to horizontal knowledge flows.

Observed variable	Description
HTRATIO	Ratio of horizontal knowledge flows to total knowledge flows
HTCOMM	Ratio of horizontal communications to total communications
DPSELF	The degree of specialized knowledge created or generated by organizational unit itself
DPEXT	The degree of specialized knowledge acquired external to the firm
BRSELF	The degree of non-specialized knowledge created or generated by organizational unit itself
BREXT	The degree of non-specialized knowledge acquired external to the firm
EERATIO	Ratio of exploration activities to total activities

Table 8.2: Variables used in the study

Three items in the questionnaire were employed to construct this measure. Respondents were asked to indicate the extent to which knowledge was shared vertically along the hierarchy (V) and horizontally between organizational units (H). Since the possible number of horizontal knowledge flows generally exceeds that of vertical ones, these two items are unequally distributed. The potential set of vertical and horizontal knowledge flows is different for a unit interacting with other units at three different organizational levels than for one interacting with two organizational levels. To compensate for this, another questionnaire item was used to compute weight *w*. The item queried respondents to indicate the maximum number of organizational layers their unit normally interacts with. Weight *w* was then computed as the maximum number of organizational layers a unit interacts with as a percentage of the average number of organizational layers units interact with.[4] Following this approach, HTRATIO measure was computed as H/(H+*w*V).

The structure of communications, HTCOMM, complements HTRATIO as an indicator of a firm's knowledge flow configuration. Although medias used differ for different sorts of knowledge (Daft and Lengel, 1984), communication is a prerequisite for knowledge transfer. The sharing of information and explicit knowledge may take place through documents or information technology systems, whereas the sharing of tacit knowledge requires face-to-face communications (Argote, 1999; Hansen, 1999). Although a firm's employees do not always communicate for the purpose of sharing knowledge, communication often involves unanticipated transfers of knowledge among individuals and organizational units. In a that vein, Cohen and Levinthal (1990) argue that a firm's

communication structure contributes to knowledge transfers, and with that determines a firm's absorptive capacity. Frequencies of communication have also been effectively used in a variety of studies of innovation (e.g. Allen, 1977; Tushman, 1977; 1979). Since communications may also be vertical and horizontal (Blair, Roberts and McKechnie, 1985; Simpson, 1959; Wickesberg, 1968; Wilson, 1992), a computation similar to that of HTRATIO was executed for HTCOMM, which measures horizontal communications proportionate to total communications (horizontal and vertical communications). The two questionnaire items used for constructing this measure inquired the respondents to indicate to what extent communications took place along horizontal lines (HC) and to what extent they occurred along vertical lines (VC). Compensating again for the possible number of horizontal and vertical communications with weight w, HTCOMM = HC/(HC+wVC).

Depth and breadth of absorptive capacity. To differentiate between the depth and breadth dimensions of absorptive capacity, Cohen and Levinthal's (1990) viewpoint on the influence of specialization on absorptive capacity was adopted, so that high specialization relates to depth of knowledge, while low specialization associates with breadth of knowledge. In congruence with operationalizations of Aiken and Hage (1968) and Pugh et al. (1968), three items from the questionnaire were averaged to determine the specialization of a unit: the degrees of specialized jobs, of separated tasks and responsibilities, and of division of labor. The variables DPSELF and DPEXT were computed by multiplying two questionnaire items assessing the extent to which existing knowledge was obtained through internal creation or through external appropriation with the specialization measure to obtain two measures of the depth dimension of absorptive capacity. The variables BRSELF and BREXT were computed in a fashion similar to that of depth, by multiplying the two items indicating the source of existing knowledge with a reverse-coded specialization measure to obtain two measures of the breadth dimension of absorptive capacity.

Exploration vs. exploitation. The degree of exploration over exploitation was measured by EERATIO. Two items from the questionnaire were used to compute this measure. The first item queried the respondents to indicate to what degree activities and resources were directed at the exploitation of current products and processes. For the second item respondents were asked to indicate to what extent activities and resources were aimed at the exploration of new opportunities. Since firms may differ in the absolute number of activities or resources devoted to exploration and exploitation, and since the ratio of exploration to exploitation is

strongly curvilinear, EERATIO was computed by dividing the level of exploration by the sum of the levels of exploration and exploitation.

DATA ANALYSIS

The structural equation modeling technique LISREL 8 (Jöreskog and Sörbom, 1993) was used to test whether the hypothesized pattern of relationships among the constructs could be confirmed. Although the sample size of 100 observations is generally considered small for employing LISREL, the relatively small number of observed variables and parameters estimates justified its use and allowed for the identification of a model (Bagozzi and Yi, 1988; Bentler and Chou, 1987). Based on the theoretical model in Figure 8.1, a recursive model was identified to examine the hypotheses postulated. Since none of the variables were subject to violations of multivariate normality, the parameter vector θ was estimated using a Maximum Likelihood (ML) fitting function. No further adjustments and transformations were made to the variables and measures. The descriptive statistics of the variables are given in Table 8.3.

	Mean	Standard deviation	Correlations					
			(1)	(2)	(3)	(4)	(5)	(6)
(1) HTRATIO	0.73	0.11						
(2) HTCOMM	0.80	0.09	0.64***					
(3) DPSELF	9.51	3.58	-0.21*	-0.20†				
(4) DPEXT	7.65	3.74	0.03	-0.04	0.45***			
(5) BRSELF	9.84	4.03	0.09	0.12	0.15	-0.06		
(6) BREXT	7.93	4.24	0.14	0.06	-0.15	0.17†	0.52***	
(7) EERATIO	0.50	0.11	0.14	0.07	-0.10	0.00	0.15	0.14

*** = $p < 0.001$; ** = $p < 0.01$; * = $p < 0.05$; † = $p < 0.10$

Table 8.3: Descriptive statistics: means, standard deviations, and Spearman rankorder correlations

LISREL assumes by default that error variances are uncorrelated (Bollen, 1989; Jöreskog and Sörbom, 1993). Inspection of the standardized residuals of the observed variables revealed, however, that the error variances between DPSELF and BRSELF as well as between DPEXT and BREXT correlated. Since the variables in both sets share questionnaire items, however, this correlation was neither surprising, nor considered detrimental to model specification and results (Kenny

and Judd, 1984). Therefore, the errors were allowed to correlate. Following the specifications set forth by Jöreskog and Sörbom (1993), error covariances were added between the variables in each set to account for the correlation between the error variances of these variables.

Validity and reliability

Before using the model for testing purposes, Anderson and Gerbing's (1988) two-step approach was followed to assess the model's quality (see also, Bollen, 1989; Jöreskog and Sörbom, 1993). First, the measurement model was verified to establish the construct validity, convergent validity, discriminant validity, and reliability of the measures used in the model. Second, the quality of the structural model was examined by assessing how well it fitted the data (Bollen, 1989). The goodness of fit statistics of both the measurement model and the structural model developed in this paper are depicted in Table 8.4.

Statistic	**Measurement model**	**Structural model**
χ^2 (degrees of freedom)	12.41 (12 df.)	14.42 (14 df.)
RMSEA (90%-confidence interval)	0.018 (0.0; 0.077)	0.017 (0.0; 0.074)
GFI	0.98	0.97
AGFI	0.95	0.94
NFI	0.93	0.91

Table 8.4: Goodness of fit statistics

As a first test to assess the validity and reliability of the constructs in the model, the measurement model was evaluated for its goodness of fit to the data. As portrayed in Table 8.4, all goodness of fit statistics indicate that the measurement model reflected good fit with the data. With a point estimate of 0.018 and a 90%-confidence interval of <0.0–0.077>, the Root Mean Square Error of Approximation (RMSEA) indicated that the measurement model fitted the data well (Browne and Cudeck, 1993). Similarly, the χ^2-statistic with a value of 12.41 and 12 degrees of freedom ($p = 0.41$) indicated that the measurement model did not differ significantly from the data (Bollen, 1989; Jöreskog and Sörbom, 1993). With values of 0.98, 0.95, and 0.93 respectively, the Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), and Normed Fit Index (NFI) corroborated

the goodness of fit of the measurement model, and established the construct validity of the variables (Jöreskog and Sörbom, 1993; Kelloway, 1998).

Convergent validity, discriminant validity, and reliability of separate constructs were further assessed by taking the constructs and their observed indicators separately, and examining the confirmatory factor analysis performed for the measurement model. The factor scores, standard errors, *t*-values, and multiple squared correlations of each observed variable are depicted in Table 8.5. With values ranging from 0.51 to 0.97, all factor loadings were above the recommended minimum of 0.40 specified by Nunnally (1978). Also, because the entire measurement model fitted the data, the factor loadings in the measurement model could be taken as validity coefficients (Jöreskog and Sörbom, 1993). Since every factor loading was statistically significant at $p < 0.05$, a first indication was obtained that the measures were convergently and discriminantly valid.

Measurement paths	Factor loading	Standard error	*t*-value	R^2	Cronbach's α
ξ_1: Knowledge flow configuration					
➛ HTRATIO	0.92	0.08	11.98***	0.85	0.77
➛ HTCOMM	0.76	0.12	6.07***	0.57	
η_1: Depth of absorptive capacity					
➛ DPSELF	0.51	0.09	5.77***	0.24	0.68
➛ DPEXT	0.86	0.27	3.20**	0.75	
η_2: Breadth of absorptive capacity					
➛ BRSELF	0.86	0.14	6.33***	0.76	0.71
➛ BREXT	0.57	0.13	4.49***	0.30	
η_3: Degree of exploration over exploitation					
➛ EERATIO	0.97	0.15	6.40***	0.95	-

*** = $p < 0.001$; ** = $p < 0.01$; * = $p < 0.05$; + = $p < 0.10$

Table 8.5: Measurement model: factor loadings, *t*-values, and reliability coefficients

Further proof of validity was obtained by considering the correlations between observed variables and between latent variables. As can be observed from Table 8.3, within every set of observed variables indicating one particular latent variable the variables correlated significantly with each other, establishing convergent validity (Jöreskog and Sörbom, 1993). Further, discriminant validity was proven

because no cross-loadings on multiple latent variables were present; all of the observed variables in the current model loaded only on a single latent variable. This conclusion of discriminant validity was further supported in that, like their indicators, none of the latent variables correlated significantly at 1 (Bollen, 1989; Jöreskog and Sörbom, 1993).

The reliability of the measures was determined by considering the multiple squared correlations (R^2) associated with the parameter estimates and Cronbach's α coefficients. Both indicated that the measures were reliable. Values for R squared, determining the variance in the observed variables that was accounted for by the corresponding latent variables, ranged from 24 percent to 95 percent. The alpha coefficients ranged from 0.68 for the Depth of Absorptive Capacity construct to 0.77 for the Knowledge Flow Configuration construct. With these values, the reliabilities of the constructs came close to or were beyond the value of 0.70 that indicates highly reliable constructs (Nunnally, 1978). As a result, it was concluded that the constructs in the model were both valid and reliable, allowing for the identification of the structural model.

The quality of the structural model was established by assessing how adequately the model that converged from the sample fitted the data (Bentler and Bonett, 1980; Bollen, 1989). As portrayed in Table 8.4, the χ^2-statistic of the entire structural model reflected that the model did not deviate significantly from the data ($\chi^2 = 14.42$; 14 d.f.; $p = 0.42$). The point estimate of RMSEA for the structural model was 0.017 with a 90%-confidence interval of <0.0–0.074>. Like the χ^2-statistic, this statistic also indicated that the model fitted the data well (Browne and Cudeck, 1993). Additionally, with values of 0.97, 0.94 and 0.91 respectively, GFI, AGFI and NFI were above the threshold level of 0.90, so that the model could also be maintained on these grounds (Jöreskog and Sörbom, 1993; Kelloway, 1998).

RESULTS

Table 8.6 portrays the parameter estimates of the paths in the structural model with their accompanying *t*-values and R-squares. Figure 8.2 illustrates the structural model and corresponding parameter estimates that converged from the data using a Maximum Likelihood fitting function.

Given that 37 percent of the variance in depth of absorptive capacity, and 18 percent of the variance in breadth of absorptive capacity was explained by knowledge transfers, it could be concluded that a firm's knowledge flow configuration is a significant determinant of absorptive capacity. The parameter

estimate for the path from knowledge flow configuration to depth of absorptive capacity was negative (γ_{11} = -0.14; *t*-value = 2.83; $p < 0.01$). As such, hypothesis (11a), which postulated that vertical knowledge flows relate postively to the depth of absorptive capacity, was supported. Hypothesis (11b), which stated that horizontal knowledge flows influence positively the breadth of absorptive capacity, was supported as well. The parameter estimate that converged from the data was, as expected, positive (γ_{12} = 0.18; *t*-value = 2.67; $p < 0.01$).

	Structural paths		**Parameter estimate**	***t*-value**	**R^2**
H11a	ξ_1: Knowledge flow configuration	→ η_1: Depth of absorptive capacity	-0.14	2.83**	0.37
H11b	ξ_1: Knowledge flow configuration	→ η_2: Breadth of absorptive capacity	0.18	2.67**	0.18
H12a	η_1: Depth of absorptive capacity	→ η_3: Degree of exploration over exploitation	0.08	0.40	0.08
H12b	η_2: Breadth of absorptive capacity	→ η_3: Degree of exploration over exploitation	0.26	2.15*	

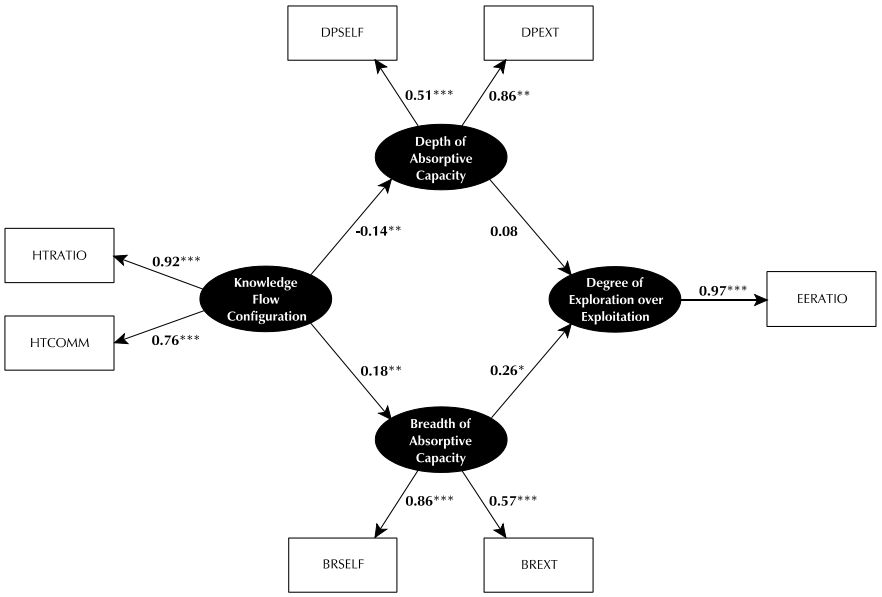
*** = $p < 0.001$; ** = $p < 0.01$; * = $p < 0.05$; + = $p < 0.10$

Table 8.6: Structural model: parameter estimates, *t*-values, and multiple squared correlations

Hypotheses (12a) and (12b) related the depth and breadth dimensions of absorptive capacity to the level of exploration over exploitation. Hypothesis (12b) was supported, hypothesis (12a) was not. As was expected, increases in the breadth dimension of absorptive capacity are likely to lead to higher levels of exploration over exploitation (β_{13} = 0.26; *t*-value = 2.15; $p < 0.05$), supporting hypothesis (12b). The estimation parameter of the path between depth of absorptive capacity and the degree of exploration over exploitation, on the other hand, was not significant (β_{23} = 0.08; *t*-value = 0.40; n.s.). As a result, Hypothesis (12a), which postulated that increases in the depth dimension of absorptive capacity have a negative relation to the level of exploration over exploitation activities, had to be rejected. Apparently, increases in the depth dimension of absorptive capacity have effects on both exploration and exploitation.

Noteworthy in the results was that the amount of variance explained by the parameter estimates of exploration over exploitation was not substantial (R^2 =

0.08). Part of this relatively small value may be ascribed to the insignificant effect that was found for the relation between depth of absorptive capacity and exploration as against exploitation. It is also likely, however, that the level of exploration as opposed to exploitation is determined by variables other than absorptive capacity. Nevertheless, although a relatively small amount of variance was explained, the parameter estimates are considered *ceteris paribus*, and thus did not affect the rejection or adoption of the hypotheses postulated.



*** = $p < 0.001$; ** = $p < 0.01$; * = $p < 0.05$; † = $p < 0.10$

Figure 8.2: Structural model

CONCLUSION

In this chapter, hypotheses on the relationships between a firm's knowledge transfers, its absorptive capacity, and its innovative performance have been examined empirically (see Table 8.7). As Cohen and Levinthal (1990) conjectured, knowledge transfers were found to be an important organizational determinant of a firm's absorptive capacity. Consistent with the findings of earlier studies (e.g. Cohen and Levinthal, 1990; Pennings and Harianto, 1992; Powell, Koput and

Smith-Doerr, 1996; Van den Bosch, Volberda and De Boer, 1999), it was also found that absorptive capacity contributes to innovative performance. More importantly, however, the findings reported in this chapter indicate that the relationships between knowledge transfers, absorptive capacity and innovative performance are multidimensional. The distinctions made between vertical and horizontal knowledge transfers (cf. Aoki, 1986; Van Wijk and Van den Bosch, 1998), between depth and breadth of absorptive capacity (cf. Cohen and Levinthal, 1990; Marengo, 1998; Wang and Von Tunzelmann, 2001), and between exploration and exploitation (cf. March, 1991; Levinthal and March, 1993) proved valuable to understanding absorptive capacity in internal networks. While vertical knowledge transfers appeared to relate to increases in the depth of absorptive capacity, horizontal knowledge transfers were found to have a positive relationship with the breadth of absorptive capacity. Breadth of absorptive capacity, in turn, proved to relate positively to the level of exploration over exploitation. With that, most of the findings supported the hypotheses emerging from the theoretical model developed in this study.

H11a	As vertical knowledge flows become more prevalent, the depth of absorptive capacity will increase	Supported
H11b	As horizontal knowledge flows become more prevalent, the breadth of absorptive capacity will increase	Supported
H12a	As the depth dimension of absorptive capacity increases, the degree of exploration over exploitation will decrease	Not supported
H12b	As the breadth dimension of absorptive capacity increases, the degree of exploration over exploitation will increase	Supported

Table 8.7: Business-level hypotheses

The only finding that contradicted the theoretical model was that the depth dimension of absorptive capacity had no significant relation with the degree of exploration over exploitation, whereas a negative association was hypothesized. This result suggests that absorptive capacity based on deep knowledge contributes equally to exploration and exploitation, which could be due to the role of basic research in innovation. Mostly performed by professional specialists who aim to discover technological breakthroughs and innovations, basic research is fostered by specialization (Henderson and Cockburn, 1996; Scott, 1996) and vertical

knowledge flows (Aoki, 1986). As technological advances progress in a field the firm already serves, a broad knowledge base may be too superficial to benefit from those advances, and intensity of learning effort and deep knowledge accumulated from basic research may become critical to innovation (Cohen and Levinthal, 1990). The advantages a deep knowledge base brings to innovation may partially annul the limitations of such a knowledge base, which would explain the insignificant effect found. Hence, while innovation may come about through the combination and integration of knowledge from multiple domains (cf. Schumpeter, 1934), it also benefits from deep knowledge.

In summary, the set of relationships covered in this paper proved to be multidimensional, rather than unidimensional. Transposing the results to the context of internal networks, it can be argued that internal networks facilitate the development of absorptive capacity at the business level. Since vertical knowledge flows in internal networks are supplanted and supplemented by horizontal ones (Hedlund, 1994), both depth and breadth of absorptive capacity are fostered. As a consequence, internal networks are likely able to pursue both exploration and exploitation, being able to insure short-term and long-term performance. Since absorptive capacity is dependent on prior knowledge endowments, the development of absorptive capacity in one period fosters its development in the next period. In that vein, absorptive capacity is crucial to the organic growth of internal networks (Ghoshal and Bartlett, 1997; Zenger, 2002). Consistent with the findings of Szulanski (1996), therefore, in internal networks absorptive capacity is one of the most important determinants as well as facilitators of knowledge integration.

The partitioning of knowledge transfers into vertical and horizontal ones, the identification of a depth and breadth dimension of absorptive capacity, and the consideration of exploration as against exploitation as an indicator of innovative performance proved to be a valuable addition to our understanding of absorptive capacity as a firm-level construct. The results and ramifications described above will hopefully encourage future research to examine additional determinants, considerations and outcomes of absorptive capacity to get a better grasp of the construct. A discussion of these issues, as well as the issues that emerged from the preceding chapters, will be discussed in the next, final chapter.

ENDNOTES

[4] Mathematical support for adding weight w is that in a firm with n organizational layers, with one unit at the apex, where each unit in each organizational layer up to the n-1th layer has k subunits, only considering dyadic relations between units, there is a maximum of $\sum_{x=1}^{n-1} k^x$ relations characterized

by vertical knowledge. In the same hypothetical firm, the set of potential relations characterized by horizontal knowledge flows is delimited by $\sum_{x=1}^{n-1} k^x !/2!(k^x - 2)!$. Apart from the cases where $n = 2$ and $k \leq 3$, in all cases H > V. Although this exception did not apply to the organization studied here, note that the inclusion of HTRATIO without adjusting for weight w resulted in more or less the same inferences that could be made from the data.

CHAPTER 9
Discussion and Conclusion

The central question addressed in the present study concerned how internal networks influence the integration and organization of knowledge. First, to gain further understanding of knowledge integration and organization in internal networks, determinants of knowledge integration were examined from an internal network perspective at the corporate level as well as the business level. Second, the performance implications of knowledge integration and organization in internal networks were considered. By addressing these issues, both the determinants and outcomes of knowledge integration in internal networks were addressed.

To develop hypotheses around determinants of knowledge integration and organization as well as their performance implications, the study pivoted on three bodies of literature. Using insights gained from network theory, studies of knowledge integration and the literature on corporate strategy, 13 hypotheses were developed regarding corporate-level determinants of knowledge integration, and 4 hypotheses were developed centering on business-level determinants of knowledge integration. The hypotheses regarding corporate-level determinants focused on both individual effects of these determinants and complementarities between these determinants in shaping knowledge integration. The hypotheses considering the business-level determinants focused on how a firm's knowledge flow configuration contributes to absorptive capacity, rather than being dependent on it, and how absorptive capacity influences the ratio of exploration over exploitation.

Since empirical research on internal networks is strongly dominated by cross-sectional case studies, both idiographic and nomothetic research approaches addressing change and dynamics were considered. As illustrated in Table 9.1, a multi-method, multi-level approach consisting of four substudies was employed

to test the hypotheses, as part of the INNFORM research program (Pettigrew, Whittington and Conyon, 1995). An embedded case study design was adopted to gain insight into how the Dutch multinational financial services corporation Rabobank changed its organization form over the period 1988–1998, and how this transition influenced the integration and organization of its knowledge at both corporate and business levels.

Study	Period	Level of analysis	Unit of analysis
Knowledge integration and the effect of transition processes towards internal networks (Chapter 5)	1988–1998	- Corporate - Business	- Rabobank Group - Rabobank local banks - Business unit Spectrum
Patterns of change in knowledge integration and its determinants (Chapter 6)	1992–1996	- Corporate	Top 4500 companies in: - Europe - Japan - US
Determinants of knowledge integration (Chapter 7)	1996	- Corporate	Top 2000 companies in Europe
Knowledge integration and the role of absorptive capacity (Chapter 8)	1998	- Business	Business unit Spectrum

Table 9.1: The four studies

Data obtained from a questionnaire developed and administered as part of the INNFORM research program was used to map organizational change and changes in knowledge integration in Europe, Japan and the US over the period 1992/3–1996/7. Subsequently, the European sample was used to test how corporate level elements that differentiate internal networks from other organization forms influence knowledge integration and organization. Finally, data obtained from a questionnaire administered in a business unit of Rabobank, Spectrum, was used to test how knowledge flows as a characterizing feature of internal networks, absorptive capacity and performance relate at the business level. Using and triangulating these idiographic and nomothetic research approaches at multiple levels of analysis, this study not only illustrated how a transition process towards internal network forms of organizing contributes to the

integration and organization of knowledge, but also provided generalizable results on how internal networks influence knowledge integration and how this influences performance.

In this final chapter, the findings on the ways in which and levels at which internal networks influence knowledge integration and organization are discussed and consolidated. The agenda for this chapter is as follows. First, the findings of the four studies conducted are discussed and consolidated. Next, the limitations inherent in the research are addressed. Then, in addition to the future research directions that emerged from the study's limitations, general avenues for future research are considered. Finally, conclusions from the current study are drawn.

DISCUSSION OF MAIN FINDINGS

Determinants and performance implications of knowledge integration and organization in internal networks were addressed at both the corporate level and business level. Centering on the research questions addressed in the present study, Table 9.2 illustrates the main findings at each level of analysis.

Corporate-level findings

From the case study it was evident that Rabobank Group increased its effectiveness in integrating and organizing throughout the organization in the period 1988–98. Since it aimed to differentiate itself from its main competitors by providing fully tailored products to its customers, Rabobank needed a strong capability in integrating and organizing knowledge. The analysis of the extent to which firms in a larger population were pursuing change journeys illustrated that the changes taking place in firms in Continental Europe, Japan and the United States largely coaligned with the transition process pursued by Rabobank. The findings reported in chapter 6 indicated that, overall, knowledge integration in firms in Europe, Japan and the United States increased substantially during the nineties. When comparing changes over Europe, Japan and the US, however, it appeared that Japanese companies seem to have followed an incremental journey of change, whereas the changes reported by European and US companies were more radical. Consistent with the fact that many of the first books and articles on knowledge originated from Japan (e.g. Imai, Nonaka and Takeuchi, 1985; Itami, 1987; Nonaka, 1994; Nonaka and Takeuchi, 1995), the finding that Japanese firms had high levels of knowledge integration already in 1992 is not surprising. Trying to copy the successes of Japanese companies integrating knowledge, European and

Table 9.2: Main findings

Level of analysis	Question	Main findings	Source*
Corporate-level	Individual elements	- Firms in Europe, Japan and the US have increased knowledge integration over period 1992-1996	- CLQ
		- Project-based structures, information technology and human resource practices facilitate knowledge integration	- CLQ; CS
		- Large, central corporate headquarters contribute to knowledge integration	- CLQ; CS
			- CLQ; CS
		- Partial support for inhibiting effect of product-based structures	- CLQ; CS
		- Decentralization, org. levels and diversification less important	- CLQ
		- Competition inverted-u shape with knowledge integration	- CLQ; CS
		- Size inverted-u shape with knowledge integration	- CS
		- Units pursue different paces of change	
	Complementarities	- Complementarities between structural and processual elements important	- CLQ; CS
		- Complementarities between traditional and innovative elements important	- CLQ; CS
	Performance implications	- High performing firms effectuate complementarities more effectively	- CLQ
		- Complementarities increase innovative and financial performance	- CS
Business-level	Individual elements	- Vertical knowledge flows contribute to depth of absorptive capacity	- BLQ
		- Horizontal knowledge flows contribute to breadth of absorptive capacity	- BLQ
	Complementarities	- Complementarities between structural and processual elements important	- CS
	Performance implications	- Breadth of absorptive capacity increases exploration over exploitation	- BLQ
		- Depth of absorptive capacity contributes equally to exploration and exploitation	- BLQ

* CS = Case Study; CLQ = Corporate-level questionnaire; BLQ = Business-level questionnaire

US firms seem to have caught up with the Japanese behavior over the period 1992/3–1996/7 as a result of mimetic behavior.

The study examining patterns of change among firms in Europe, Japan and the United States in the period 1992/3–1996/7 also illustrated that firms that could be marked as high knowledge integrators increased their reliance on both project-based structures and information technology. Even in 1996, low knowledge integrating companies did not use project-based structures as much as high knowledge integrators did in 1992. On the other hand, low knowledge integrators did increase their reliance on information technology over the four-year period to such extent that they surpassed high knowledge integrators in 1996/7. The inconsistence between low and high knowledge integrators was evident of the general belief among many managers that knowledge integration is achieved by the establishment of information technology networks alone, as a way to share documented, explicit, non-complex knowledge (cf. Almeida, Song and Grant, 2002; Nohria and Eccles, 1992). These findings were largely confirmed in chapter 7 in which support was found for the hypotheses postulating that project-based structures, use of human resource practices and use of information technology systems relate to increased knowledge integration (see Table 9.2). In the case study, too, it was found that the relatively low levels of knowledge integration among local member banks were the consequence of the banks focusing largely on systems and not making use of teams. Spectrum, on the other hand, had an approach of using IT and teams in which one supplements the other, and was so able to sustain high levels of knowledge integration. In that vein, the findings corroborated that both electronic interaction and face-to-face interaction facilitate knowledge integration, but that a multiplex approach is most effective to knowledge integration (Argote, 1999).

Contrary to expectations, however, the hypothesis positing that as corporate headquarters' size increases knowledge integration decreases was not supported. Instead, the opposite was found. As illustrated in Table 9.2, knowledge integration was found to be facilitated by a large rather than a small headquarters. This finding was supported by the finding that no relationship was found for the relationship between decentralization and knowledge integration. Although previous studies suggest that discretion to act has moved down the hierarchy in internal networks (e.g. Ghoshal and Bartlett, 1997), arguing for a smaller size of corporate headquarters, increased decentralization did not influence knowledge integration. An explanation of this finding was found in the case study at Rabobank. The case of the local member banks illustrated that autonomy of units

fostered power issues and increased the sense of competition among them, impairing knowledge integration. Similar findings have been reported in a study of franchising by Darr, Argote and Epple (1995), who found that while knowledge was generally shared between stores of the same franchisee, the sharing of knowledge between the stores of different franchisees was significantly less frequent. One reason for this finding may be legal and power issues. For franchisees are generally located in the same geographic region, another may be distance. In another study, intraplant transfers were found more common than interplant transfers, especially when the geographical dispersion of plants increased (Argote, Beckman and Epple, 1990; see also, Schulz, 2001).

In the case study, the local member banks continued to rely heavily on the vertical knowledge flows generated by the central organization, mainly because the central organization remained developing the bulk of the products and played a central role. Furthermore, when tailoring products to client needs at the local site, local member banks did not consult other local member banks often. As a consequence, knowledge integration in among local banks was mainly vertical. Similarly, Gupta and Govindarajan (2000) found that a large part of knowledge transfers takes place between headquarters and subsidiaries in MNCs. Corporate headquarters at Rabobank aimed, however, to lay out a proper context for the integration of knowledge across local banks in the shape of a vision, which constituted Rabobank's driver for change. This architectural and supporting role of corporate headquarters may justify a larger size (Goold, Pettifer and Young, 2001; Young, 2000; Young et al., 2000). A central role of corporate headquarters may also be required to foster interunit knowledge integration. Because of specialization, knowledge may be less related among units and divisions, since interunit differences within a unit or division are generally less that interunit differences among units and divisions. In that vein, Galunic and Eisenhardt (2001) remarked that transfer and integration of knowledge among divisions may require corporate initiative, whereas transfer and integration of knowledge among units of a division may be established without corporate intervention.

Table 9.2 also lists the effects that were hypothesized but not found. Although the firms moving from low knowledge integrating firms in 1992 moving to being high knowledge integrators in 1996 tended to have reduced the number of organizational layers, no negative relationship was found for the hypothesis that as the number of organizational layers increases, knowledge integration decreases. Similarly, no relationship was found between relatedness between divisions and knowledge integration, so that the corresponding hypothesis had to be rejected.

This was also evident in the case study. Increasing the number of divisions from four to eight as part of its transition, Rabobank became not only more diversified, but since this increase was mainly the result of acquiring companies whose activities were more distant from Rabobank's core activities, its divisions became less related. Nevertheless, Rabobank was able to increase knowledge integration among them. For example, the products and services developed by the acquired firm were further developed in Rabobank Nederland and sold through the local member banks. In effect, Rabobank also maintained a product-based structure. Rabobank offset the detrimental effect of product-based structures by implementing a wide range of other complementary organizational elements that were more innovative.

In the sample of Continental European companies, partial support was found for the hypothesis that the use of product-based structures decrease knowledge integration. Corroborating the case study findings, one of the most important findings of this study was that the use of both traditional and innovative elements concurrently were found to facilitate knowledge integration and organization more than the adoption of innovative elements alone. The results from the corporate-level questionnaire indicated that product-based structures, or many hierarchical levels are not detrimental to knowledge integration as long as project-based structures, new human resource practices, information technology and decentralization are used concurrently. The concerted impact of the knowledge integration enabling attributes, without elements that ceteris paribus were hypothesized to restrict knowledge integration, appeared to have no additional effect over the influence of the knowledge integration enabling elements individually. In that vein, the findings were consistent with those from Rivkin and Siggelkow (2003). They found that 'interdependencies arise because [organizational] design elements influence *both* how broadly a firm searches its environment to discover good sets of coordinated choices *and* whether the firm is able to stabilize around those sets once they are discovered' (2003: 307; original emphasis). Similarly, support was found for Zenger's (2002: 84) argument that changes achieved through the infusion of market control into hierarchy with single elements 'violate the patterns of complementarity', and that more comprehensive bundles of complementary elements are necessary. In line with existing studies arguing that complementarities increase performance (Milgrom and Roberts, 1990; 1995; Whittington et al., 1999), as indicated in Table 9.2, this finding could also be maintained for high performing firms, but not for low

performing ones, suggesting that complementarities relate to increased performance.

Likewise, in the case study, at all levels of analysis it was found that 'significant change initiatives unleash complementary pressures to alter other organizational elements' (Zenger, 2002: 82). At Rabobank, complementarities were needed not only between structural and processual elements of the company and its units during change, but between traditional and innovative elements so that bipolarities in structure emerged. As mentioned above these bipolarities in structure were imperative to provide different customers with the products and services they demanded. A hierarchy needed to remain existent for mass products, while an internal network was considered crucial to develop tailored products by integrating various stocks of knowledge in the firm and the market. These findings confirm that both elements individually enabling knowledge integration and elements individually restricting knowledge integration are required for enhanced knowledge integration and performance.

The case study at Rabobank, in particular the embedded case of Spectrum, illustrated that size had a strong impact on the evolution of an internal network and, as a consequence, knowledge integration in it. Spectrum introduced Areas of Attention and clusters as additional organizational layers to remedy the impact of size, underscoring the importance of implementing both a hierarchical and a network structure to facilitate the integration and organization of knowledge. Furthering on the impact of size found in the Rabobank case study, the quantitative study did provide generalizable insight into how size influences knowledge integration. Included as a control variable to compensate for potential size effects influencing the other predictors of knowledge integration, size was found to have inverted-u relationship to knowledge integration. Apparently, in firms of small size, with not many units, inter-unit knowledge integration does not have to take place extensively. In small organizations employees are likely to work on similar issues. The need to integrate knowledge may be perceived as less compelling. As size increases, and therefore the number of units likely increases, inter-unit knowledge integration becomes more important. At a certain point, however, the number of units increases too such an extent that they become more unrelated, size becomes detrimental to knowledge integration.

Although corporate-level elements proved to contribute knowledge integration and organization, the case study illustrated that when the decision to implement an internal network form of organizing was taken, divisions and units pursued their own change trajectories at different paces of change. At Rabobank, several

internal networks developed concurrently at different paces in distinct divisions and organizational units. Two antecedent of this process were illustrated in the case study. First, although the transition instigated by Rabobank in 1988 was corporate-wide, its size restricted Rabobank to develop one large internal network. Second, the heterogeneity of Rabobank prevented it from developing one large internal network spanning divisions and units. Although knowledge was shared among divisions, divisions and units served different customers, each demanding distinct products and services. Since knowledge integration within a division or unit occurs more frequently than between divisions and units, these divisions and units were required to pursue different change processes. Since each division and unit pursued a different change trajectory, how knowledge was integrated and organized also differed among units and divisions. These findings illustrate that while corporate-level elements contribute to the integration and organization of knowledge, they also provide a context in which units operate and underscore the importance of considering business-level determinants of knowledge integration and organization in conjunction with corporate-level determinants.

Business-level findings

In chapter 8, the level of analysis was adjusted to the business level, and the relationships between a firm's knowledge transfers, its absorptive capacity, and its innovative performance were examined empirically. As Cohen and Levinthal (1990) contend, knowledge transfers were found to be an important organizational determinant of a firm's absorptive capacity. Consistent with the findings of earlier studies (e.g. Cohen and Levinthal, 1990; Pennings and Harianto, 1992; Powell, Koput and Smith-Doerr, 1996), it was also found that absorptive capacity contributes to innovative performance.

More importantly, however, as indicated in Table 9.2, the findings illustrated that the relationships between knowledge transfers, absorptive capacity and innovative performance are multidimensional. The distinctions made between vertical and horizontal knowledge transfers, between depth and breadth of absorptive capacity, and between exploration and exploitation proved valuable to understanding the relationships. While vertical knowledge transfers appeared to relate to increases in the depth of absorptive capacity, horizontal knowledge transfers were found to have a positive relationship with the breadth of absorptive capacity. Breadth of absorptive capacity, in turn, proved to relate positively to the level of exploration over exploitation. With that, most of the findings supported

the hypotheses emerging from the theoretical model developed in the current study.

The only finding that contradicted the theoretical model was that the depth dimension of absorptive capacity had no significant relation with the degree of exploration over exploitation, whereas a negative association was hypothesized. This result suggests that absorptive capacity based on deep knowledge contributes equally to exploration and exploitation (see Table 9.2), which could be due to the role of basic research in innovation. Mostly performed by professional specialists who aim to discover technological breakthroughs and innovations, basic research is fostered by specialization (Henderson and Cockburn, 1996; Scott, 1996) and vertical knowledge flows (Aoki, 1986). As technological advances progress in a field the firm already serves, a broad knowledge base may be too superficial to benefit from those advances, and intensity of learning effort and deep knowledge accumulated from basic research may become critical to innovation (Cohen and Levinthal, 1990). The advantages a deep knowledge base brings to innovation may partially annul the limitations of such a knowledge base, which would explain the insignificant effect found. Hence, while innovation may come about through the combination and integration of knowledge from multiple domains (cf. Schumpeter, 1934), it also benefits from deep knowledge (Katila and Ahuja, 2002; Zahra, Ireland and Hitt, 2000).

The findings amplify Cohen and Levinthal's (1990: 132) argument that 'the character and distribution of expertise' is crucial to absorptive capacity. Absorptive capacity is relative and dependent on the partners involved (Dyer and Singh, 1998; Kumar and Nti, 1998; Lane and Lubatkin, 1998). Both deep and broad knowledge eventually condition whether knowledge will likely be common or divers to interacting partners. Therefore, it is important for firms to assign employees appropriate places within the organization not only to protect knowledge (Liebeskind, 1996), but to give scope to interaction among them and with the external environment (see also, Tushman, 1977) so as to increase a firm's absorptive capacity. A study by Tsai (2001) confirmed that position in a social network is closely associated with absorptive capacity in determining innovative and business performance. Considering the findings of this study, this calls for further social network studies in which the effect of an actor's network position, the stocks of knowledge present at a network node, the structural embeddedness associated with that network position, and the flows of knowledge between actors on a firm's absorptive capacity are examined (cf. Ahuja, 2000; Dyer and Singh, 1998; Stuart, 1998; Tsai, 2001).

In addition, in congruence with Boisot's (1998: 116) observation that learning 'requires a blend of exploratory and exploitative learning, as well as an ability to balance out the claims of each', it has been shown that exploration and exploitation are dependent on the choices of firms investing in deep and broad knowledge. Both exploration and exploitation are necessary to ensure future and current survival (Levinthal and March, 1993; March, 1991). In that vein, the model suggests that both deep and broad knowledge are necessary, supporting Leonard-Barton's (1995) argument that a firm's knowledge structure is to be T-shaped, where the bar resembles broad knowledge while the stem associates with deep knowledge. Furthermore, through deliberate decisions about their configuration of knowledge flows, firms may be able to influence their depth and breadth of absorptive capacity, and with that their levels of exploration and exploitation.

Since exploration is associated with long-term performance and exploitation with short-term performance (March, 1991), this study also provides insight into the performance implications of absorptive capacity. In a study at the business unit level, Tsai (2001) found a positive relationship between absorptive capacity and business performance. Considering that depth and breadth of absorptive capacity relate distinctly to exploration and exploitation, this study extended Tsai's (2001) study in that the two dimensions of absorptive capacity discerned here are likely to have different performance implications. Following the findings of this study, horizontal knowledge flows and breadth of absorptive capacity would be associated with long-term performance as they contribute to exploration. On the other hand, short-term performance would benefit from vertical knowledge transfers and depth of absorptive capacity, which contributed to both exploration and exploitation.

Internal networks have a knowledge flow configuration in which horizontal knowledge flows not only supplement but supplant vertical knowledge flows (Hedlund, 1994; Van Wijk and Van den Bosch, 1998). Because horizontal knowledge flows were found to contribute to the development of breadth of absorptive capacity and the level of exploration over exploitation, the study indicated that internal networks are able to increase the level of exploration. This finding is in line with the existing literature which forwards internal networks as forms of organizing to increase exploration (e.g. Hedlund, 1994). However, internal networks also contribute to the development of deep knowledge, since hierarchy is not completely abandoned in them, and vertical knowledge flows remain present. Because deep knowledge was found to contribute equally to

exploration and exploitation, internal networks appeared to contribute to increasing both exploration than exploitation. Based on these results, internal networks appeared to be in a better position to manage the trade-off between exploration and exploitation to ensure both current and future survival (cf. Levinthal and March, 1993).

LIMITATIONS OF THE STUDY

Despite the insights and understanding gained, the study had some limitations that may be valuable to account for in future research. These limitations related to three issues: (1) the method used in the study, in particular the lack of a longitudinal quantitative method, (2) the scope of the study and (3) the operationalization of constructs. It must be noted here that, since essentially four studies were conducted as part of a larger whole, limitations that applied to one study were generally compensated by another.

The first limitation relates to *methodological* issues. Although both qualitative and quantitative approaches were employed as part of a multi-method, multi-level research design, limitations inherent to the research designs of the various approaches remain. For example, the data used in examining absorptive capacity was cross-sectional. Our understanding of the absorptive capacity construct may take an important step further when it is examined with longitudinal data. Since 'accumulating absorptive capacity in one period will permit its more efficient accumulation in the next' (Cohen and Levinthal, 1990: 136), absorptive capacity has two faces making it cumulative and time-dependent. Knowledge transfers not only contribute to but also require absorptive capacity, for example, in the shape of an existing stock of related knowledge or shared language and symbols (Cohen and Levinthal, 1990; Szulanksi, 1996). To that end, studies are needed that uncover how knowledge flows at time period T1 influence stocks of knowledge and absorptive capacity at T2, and how these, subsequently, influence knowledge flows at T3. Also, establishing a change in the ratio of exploration to exploitation requires managerial intent because the short-term returns associated with exploitation tend to filter out exploration (Levinthal and March, 1993; March, 1991). In addition, such a change takes time due to built up stocks of deep and broad knowledge. Because of the cumulative nature of absorptive capacity, a firm with a substantial base of deep knowledge may experience difficulty in broadening the knowledge base. A quantitative longitudinal study may be more conclusive on how firms break away from the path dependencies created by exploration and exploitation.

In the study of absorptive capacity in internal networks, the data was also obtained from a single unit. Care must therefore be taken into consideration generalizing the results. On the other hand, since Spectrum was created as an internal network, the setting was in context, suggesting that the results of the study appear to have broader application than the firm studied. Spectrum maintained internal and external linkages, and also relied purposefully on both specialists and generalists. In addition, Spectrum made use of both vertical and horizontal knowledge transfers, and directed its activities to both exploration and exploitation. However, other firms may still rely on, for example, a multidivisional organization, in which units are likely to make less use of horizontal knowledge transfers (cf. Hedlund, 1994; Van Wijk and Van den Bosch, 1998), to be less generalist (cf. Hannan and Freeman, 1977), and to be trapped in the general tendency of exploitation to weed out exploration (cf. Hedlund, 1994; Levinthal and March, 1993). Therefore, studies in a wider variety of organizations are necessary to generalize the findings further.

Although the entire study is broad in scope, the second limitation concerns the *scope* of the various studies. In testing the hypotheses concerning knowledge integration at the corporate level US and Japanese firms were excluded, and the tests were limited to Continental European firms. While no differences were found for firms from different European regions in testing the hypotheses, firms in the United States and Japan, due to greater differences in institutional forces (Whittington and Mayer, 1997) and cultures (Hofstede, 1991) as opposed to intra-European differences, may well exhibit different patterns from the ones found in the present study.

The data of the case study research as well as of the study on the role of absorptive capacity in internal networks was obtained from a single organization. In the case study several important contextual measures have to be taken into account in future research. The failure of the local banks to operate as an internal network may be partly ascribed to the fact that Rabobank is a cooperative. The cooperative structure made banks largely autonomous, and with the involvement of local inhabitants as members in the Boards of local member banks, leading to power issues and senses of competition, local banks were not prone to share their knowledge with other local banks. Thus, while the cooperative structure certainly proved valuable in the development of internal networks for the mere absence of a strong hierarchy as, for example, multidivisional organizations have, it also provided Rabobank with some barriers that impinged upon the development of its internal network.

Further, the number of determinants considered in the various studies was limited. Although the results of the study at the corporate level were evident that the corporate-level elements addressed here are important to shaping knowledge integration and organization, certain influential corporate-level elements that characterize organization forms were not considered. For example, Almeida, Song and Grant (2002) and Bartlett and Ghoshal (1989) assert that next to structure and processes, culture characterizes organization form in use. Likewise, Boisot (1998) argues that organization culture has a strong impact on knowledge integration processes. Adler (2001) also illustrates that a culture of trust facilitates knowledge transfer internally and externally. Studies of social networks, and external networks have demonstrated empirically that trust is important to effective knowledge transfer (Bradach and Eccles, 1989; Gulati, 1995a). Since Bartlett and Ghoshal (1993), in their study of management roles in internal networks, also recognized the importance of creating a culture of trust, these determinants may strongly add to the set of determinants addressed in the current study.

Yet others (Holmström and Milgrom, 1994; Jensen and Meckling, 1992; Lane and Lubatkin, 1998) argue that incentive structures, normally installed by corporate-level managers, influence knowledge integration. For example, Zenger (2002) contends that high-powered group rewards are a necessary component of the set of complementarities required for an effective team-based organization. Knowledge-intensive organizations such as internal networks require, however, more than high-powered incentives to motivate employees. Osterloh and Frey (2000) argue that next to the extrinsic motivation such incentives generate among employees, intrinsic motivation emerging from, for example, work satisfaction is important, especially when tacit knowledge is to be transferred and integrated. Asserting that organization forms enable different types of motivation, they demonstrate that team-based organizations expedite the development of both intrinsic and extrinsic motivation, and are therefore effective to knowledge transfer and integration. Addressing incentives and motivational aspects may therefore further improve our understanding of knowledge integration in internal networks.

In the study examining absorptive capacity in internal networks, the number of determinants of absorptive capacity was limited to a firm's knowledge flow configuration. Although an internal network's knowledge flow configuration differentiates it from other organization forms (Burns and Stalker, 1961; Hedlund, 1994; Van Wijk and Van den Bosch, 1998), it is likely that other organizational aspects contribute to absorptive capacity as well. Similarly, the relatively large

amount of variance in exploration as against exploitation that was not accounted for in this study may be explained by studying other organizational aspects. Firms that do not transfer knowledge extensively may come around increasing absorptive capacity and innovative performance in other ways. Lewin, Long and Carroll (1999) argue that a firm's ability to explore and exploit is dependent on many other features of a firm's organization form.

Van den Bosch, Volberda and De Boer (1999) proposed that three types of combinative capabilities influence absorptive capacity. Malerba (1998) argues that although differentiation of knowledge makes coordination more difficult inhibiting the exploitation of this broad knowledge base, commonly shared knowledge reduces the scope for decentralized experimentation. To that end, emphasizing the tension between centralization and decentralization, Malerba (1998: 230) submits that 'decentralization in the acquisition of knowledge is a source of variety and experimentation, and, hence a fundamental source of learning … but, ultimately, knowledge has to be made available for exploitation by the entire organization'. Cohen and Levinthal (1990) assert that the decision to centralize or decentralize the gatekeeper function in an organization influences absorptive capacity, and hinges on the randomness of outside information flows. When information flows are random, a decentralized structure is likely the most effective link to the environment, as it increases the number of entry points of knowledge, and changes a firm's distribution of knowledge across units.

Although decentralization, as a feature of internal network forms of organizing, was not found to increase knowledge integration, decentralizing gatekeepers may well influence horizontal knowledge transfers. The proportion of horizontal to vertical knowledge flows is likely to be small in centralized firms (Burns and Stalker, 1961). In that vein, interdependencies and interactions between organization form, decentralization, and knowledge flows are present in determining absorptive capacity. Some of these interdependencies were covered in the examination of corporate-level determinants of knowledge integration in the shape of complementarities which future research may consider in examining absorptive capacity in internal networks further.

The final limitation of the current exercise relates to the *operationalization* of certain constructs. Although chapter 7 reported the first results of an empirical test of knowledge integration at a corporate level of analysis, knowledge integration is a process that encompasses more than the existence of knowledge linkages in a firm. As employees and organizational units integrate knowledge, micro-level processes take place not captured in this study. For example, in their

treatise on communities-of-practice, Brown and Duguid (1991) submit that learning is inherently context-specific, and therefore differs in each situation. Similarly, consistent with the finding that headquarters positively influence corporate-wide knowledge integration, Okhuysen and Eisenhardt (2002) found that formal interventions in group processes lead to increased knowledge integration, especially in groups of specialists. Part of this limitation was accounted for in the case study at Rabobank and in the study examining how knowledge transfers among units contribute to the development of absorptive capacity, both of which considered the business level of analysis. However, due to the nature of the study in which the corporate level mainly guided the analysis and the effect of corporate-level decisions on the business level were addressed, these micro-level processes were hardly considered. Still, by examining micro-level processes, more objective measures of knowledge integration can be used. In light of the knowledge linkage and knowledge sharing questionnaire items used in this study, more studies are required that include more objective measures of knowledge integration and organization. Similarly, the performance measures used in the current study are self-reported measures. Although self-reported and objective measures were found to correlate strongly (Dess and Robinson, 1984), potential bias may have entered the study. Studies incorporating secondary performance data may further unravel the performance implications of knowledge integration in networks.

Additionally, no distinction was made between explicit and tacit knowledge. Although 'all knowledge is either tacit or rooted in tacit knowledge' (Polanyi, 1966: 44; Tsoukas, 1996), the distinction is an important one. The current study found that a multiplex approach to knowledge integration in which electronic means and face-to-face means of interaction was most effective. Since electronic means, such as information technology systems, facilitate the integration of explicit, documented knowledge, whereas face-to-face means, such as project-based structures and human resource practices, contribute to the integration of tacit knowledge, the distinction was partially included. That this distinction was not included more explicitly was also the result of the character of this study. The study focused strongly on the corporate level, where the distinction between explicit and tacit knowledge are less central concerns. Furthermore, since firms with a size as those in this study generally consist of more than one division or unit, each of which may be organized differently, the question how interunit knowledge integration occurs in general was deemed a crucial first step to understand knowledge integration in internal networks. Nevertheless, many

scholars argue that especially tacit knowledge leads to innovation (Nonaka and Takeuchi, 1995; Von Krogh, Ichijo and Nonaka, 2000) and bears most competitive potential as it is imperfectly imitable (Barney, 1991). In their study in the adhesives industry, McEvily and Chakravarthy (2002) found that tacitness of knowledge was especially instrumental to prolonging competitive advantage and performance generated by major product improvements. Since internal networks appear to make use of face-to-face mechanisms of knowledge transfer more than other organization forms, and with that appear to facilitate the integration of tacit knowledge, knowledge integration in internal networks certainly needs further scrutiny by addressing these issues. Nevertheless, as the first study combining longitudinal and generalizable results on knowledge integration in internal networks, these limitations did not prevent new light being shed on a complex phenomenon that may pave the way for future research.

FUTURE RESEARCH DIRECTIONS

Apart from suggesting future research avenues as a result of its limitations, the present study also forwards future research directions emerging from its results. In chapter 2, three types of networks were discerned to understand how knowledge is integrated and organized in networks. Overarching all future research directions is to provide further cross-fertilization of the concepts employed by these three streams of research on knowledge and networks. Social network analysis has addressed many issues of the networks of firms, especially formation patterns and the effect of tie strength. These studies have been conducted, however independent of organization form or governance mode. Nevertheless, many of the concepts deployed in social networks analysis may be influenced by organization form. For example, received insights indicate that centrality in a social network provides benefits to information and knowledge access (Burt, 2000; Tsai and Ghoshal, 1998). But actors may be central in a hierarchy, as a CEO or headquarters is, or may be central in an internal network with only one layer, where an individual other than the CEO or a unit other than headquarters may be the most central actor. Because the integration and organization of knowledge is less effective in a hierarchy than in an internal network (Ghoshal and Bartlett, 1997), the benefits of a central actor in transferring knowledge may be moderated by the degree of hierarchy.

In cross-fertilizing the three research streams, other characteristics of organization form and governance mode may be incorporated as well. As in social network analysis, the nodes comprising internal networks can be considered not

only as organizational units, but as activities and resources as well. Since each of the dispersed organizational units controls unique resources giving rise to differentiated activities and abilities, these three classes of variables are related to each other in the overall structure of the network. Here, the question arises how specialist units and generalist units can absorb knowledge from each other. Absorptive capacity was found to be an important determinant of knowledge transfer (Lane and Lubatkin, 1998; Tsai, 2001). In chapter 8, it was found that, since absorptive capacity is a function of prior knowledge endowments, firms face a trade-off in investing in deep, specialist and broad, generalist knowledge, and that a firm's knowledge flow configuration contributes to that investment. Two specialists having non-overlapping knowledge bases may experience difficulty in transferring knowledge. Also, because the units are different, the activities of one unit may to some extent be dependent on activities of other units (Powell, 1990), as is the case when the resources held by units are complementary. This gives rise to the question to what extent interdependence between units guides knowledge transfers. Since internal networks rely on teams, this interdependence can most likely be characterized as reciprocal and team-based, rather than pooled or sequential (Thompson, 1967; Van de Ven, Delbecq and Koenig, 1976).

The findings also indicated that the relationships between firm size and knowledge integration and between the degree of competition and knowledge integration have an inverted-U shape. Both firm size and competition were included as control variables in this study. Future studies are required to unravel how firm size and competition influences knowledge integration any further. Whereas knowledge integration may be inhibited by the scope and inherent complexities of large firms, it may be considered less important in small firms. Small firms may consist of fewer units, restricting the opportunity set of interunit knowledge integration. Monopolists and, to a lesser extent, oligopolists, may feel less inclination to integrate knowledge. Since such firms have fewer rivals to outmaneuver, they consequently have less need to innovate. On the other side of the continuum, however, when firms compete against a substantial number of rivals, time constraints may explain why firms do not integrate as much knowledge as their counterparts with mediocre levels of competition do (cf. D'Aveni, 1994). This finding also aligns to discussions in the field of Industrial Organization on how R&D intensity and market concentration relate (Cohen and Levin, 1989). In that field, a similar inverted-U relation has been found between market concentration and R&D intensity. Considering the strong controlling effect of R&D intensity on knowledge integration, this finding may add to that discussion

as well. These studies also indicated, however, that when industry was controlled for, the relationship disappeared. Future studies into knowledge integration may therefore need to control for the effects of industry.

The results also hint at future research of the relationship between performance and knowledge integration. Although the study indicated that high performing firms are generally better able to adjust corporate attributes fostering knowledge integration, the correlation between knowledge integration and performance was weak. This suggests that increased knowledge integration does not *per se* relate to performance increments. This may be the result of that knowledge integration more closely relates to the exploration of new products and processes than to the exploitation of those products and processes. Although efficiency of knowledge integration may contribute to exploitation, scope and flexibility of knowledge integration relate to exploration (De Boer, Van den Bosch and Volberda, 1999). Integrating differentiated knowledge, which is of broad scope, is one of the foremost engines of innovation (Galunic and Rodan, 1998; Schumpter, 1934). The performance benefits of exploration are long-term and uncertain, while those from exploitation are short-term and certain. This could explain the finding that low performing firms were using project-based structures to integrate knowledge, whereas high performing ones were not. Project-based structures constitute an important vehicle to integrate knowledge, but since the integration of knowledge is likely performed to explore and innovate, performance may suffer. Therefore, more research is necessary treating performance instead of knowledge integration as the dependent variable. Alternatively, future research may further consider the distinction between exploration and exploitation as suggested by March (1991) at a broader level than in the current study to find more conclusive results.

Another prospect for research is whether firms with an internal network form of organizing engage in external networks more than, for example, functional and multidivisional organization forms do, and whether they are more efficacious in so doing. It has been found that firms can develop an 'alliance capability' that allows them to create more value as experience in networking and transferring knowledge increases (Anand and Khanna, 2000; Kale and Singh, 1999; Lyles, 1988; Simonin, 1997). Similarly, it has been submitted that networks constitute knowledge (Kogut, 2000). From that viewpoint, knowing how to network internally may make firms more adept to network externally as well, because the processes involved are similar. Also, Lane and Lubatkin (1998) found that similarity between organization structures and incentive systems fostered

interorganizational learning. A related question to investigate is whether firms that both have internal network structures are in a better position to learn from each other than when those firms have, for example, a multidivisional structure.

Given that networks also essentially are knowledge (Kogut, 2000; Kogut, Shan and Walker, 1993), a promising avenue for future research is the differentiation of knowledge into knowledge components, such as know-what, know-how, know-when, know-where, know-who, and know-why components (cf. Garud, 1998; Van den Bosch and Van Wijk, 2001). This differentiation essentially relates to the concept of transactional knowledge content used social network analysis (cf. Tichy, Tushman and Fombrun, 1979). For example, Tyler and Steensma (1998) found that executives with technical experience were more favorable to entering into a technology alliance than executives without that experience were. Such issues may be investigated by considering the different components of knowledge. In addition to being important to absorptive capacity (Cohen and Levinthal, 1990), know-who and know-where may be important knowledge components to examine in studies of networks as knowledge. Van den Bosch and Van Wijk (2001) argue that different kinds of knowledge components manifest themselves in distinct ways at different organizational levels. The knowledge set of executive managers is different from that of functional managers. Future studies of knowledge and networks may differentiate between these knowledge components and examine how actors in a network transmit that knowledge, and how the integrated sets of knowledge operate in a firm. Since internal network forms of organizing rely on far-going decentralization, studies may also focus on how the knowledge sets of managers in internal networks are different from managers in, for example, multidivisional organizations.

Finally, a question that is still open in the context of studies on networks as knowledge is how network capabilities contribute to performance. The findings of Simonin (1997) and Anand and Khanna (2000) indicate that firms that internalize the experience of previous alliances and external networks, and developed this experience into collaborative know-how by sharing the experience among employees, the subsequent alliances of these firms generated better performance. If one of the firms studied by Simonin (1997) also operates as an internal network, the sharing of this alliance experience, and thus the development of collaborative knowledge may proceed faster. In a later study, Simonin (1999) found that collaborative know-how mitigated the positive effects of complexity, as well as of cultural and organizational distance on ambiguity in alliance learning. The presence of network capabilities may overcome the barriers

of knowledge transfer in internal networks as well, and as such increase performance. However, further studies are necessary to become more conclusive about this issue. One way future research could obtain further insight into the performance implications of networks, as well as other network phenomena, is by studying dynamics and network transition processes, and by viewing network capabilities as dynamic capabilities (Eisenhardt and Martin, 2000; Teece, Pisano and Shuen, 1997). Another way to gain further insight into this issue is by considering processes of coevolution (cf. Baum, 1994; Lewin and Volberda, 1999). Similar to the coevolution of alliances (Koza and Lewin, 1998) and new organizational forms (Dijksterhuis, Van den Bosch and Volberda, 1999; Lewin, Long and Carroll, 1999), social, external and internal networks may coevolve. Operating in a competitive system where networking capabilities and knowledge coevolve with competition (Huygens et al., 2001), and so determine survival on a fitness landscape (Levinthal, 1997), coevolutionary approaches to study networks and knowledge may provide valuable insights.

CONCLUSION

In the past decade, research into knowledge and networks has made substantial progress. The study of knowledge integration and organization in internal networks has, however, remained limited in scale and scope. Using a multi-method, multi-level approach to extend existing cross-sectional case study research, the current study addressed the research question how internal networks influence the integration and organization of knowledge at the corporate and business level. It has contributed to the field in three ways. First, the study uncovered how corporate-level and business-level elements characteristic of internal networks shape knowledge integration and organization among units. Second, the study disclosed how knowledge integration and organization in internal networks influences financial and innovative performance. Third, extending current studies by incorporating dynamics of change at the corporate and business level in a qualitative study, and by using data obtained from two questionnaires addressing the corporate and business level, the study obtained both longitudinal and generalizable results on how internal networks influence knowledge integration and organization. By means of this research approach, this study has shown that internal networks facilitate knowledge integration and organization at multiple levels resulting in positive performance benefits. The main conclusions are summarized in Table 9.3.

Level of analysis	Main conclusions
Corporate level	- Firms in Europe, Japan and the US have increased knowledge integration over period 1992/3–1996/7 - Project-based structures, information technology and human resource practices contribute to knowledge integration - Large corporate headquarters contributes to knowledge integration - Decentralization, number of organizational levels and diversification do not influence knowledge integration - Complementarities between traditional and innovative elements influence knowledge integration above the elements individually - High performing firms make more effective use of complementarities
	Internal networks facilitate the integration and organization of knowledge at the corporate level
Business level	- Vertical knowledge flows contributes to depth of absorptive capacity - Horizontal knowledge flows contributes to breadth of absorptive capacity - Depth of absorptive capacity fosters exploration and exploitation equally - Breadth of absorptive capacity fosters exploration
	Internal networks contribute to absorptive capacity and, with that, to integration and organization of knowledge at the business level

Table 9.3: Main conclusions of study

At the corporate level, it has been shown that knowledge integration has generally increased among firms in Europe, Japan and the United States. Supported by a comparison of low and high knowledge integrating firms, tests of the hypotheses revealed that especially project-based structures, information technology and human resources were found to influence knowledge integration. In contrast to what was hypothesized, a central and large corporate headquarters was found to contribute to knowledge integration. On the other hand, the degree of decentralization, the number of organizational layers and the relatedness of diversification were found not to influence knowledge integration. These findings were supported by the case study. Particularly, it was found that complementarities between corporate-level elements are crucial in influencing knowledge integration. The questionnaire results showed that a combination of innovative elements and more traditional elements of organization form influence knowledge integration more than the sum of the individual effects of these elements, and that maintaining certain traditional elements, such as product-based structures and hierarchy, is not detrimental to knowledge integration but improves it. The case study illustrated a similar pattern in that both internal network and hierarchical forms of organizing were necessary. The case study also

indicated, however, that although actions and decisions to change organization form are taken at the corporate level, this bipolarity in structure manifested itself at the business level where different units and division pursued distinct change trajectories at different paces as part of the corporate-wide change process.

At the business level, absorptive capacity was found to be a crucial element of knowledge integration and organization. Absorptive capacity not only determines the extent to which knowledge can be transferred and integrated, but the latter also contributes to the development of the former. The study illustrated that a firm's knowledge flow configuration contributes to its absorptive capacity. Vertical knowledge flows are more specialist and contribute to deep knowledge. On the other hand, horizontal knowledge flows traverse specializations and foster the development of broad knowledge. As a result, whereas vertical knowledge flows were found to contribute to depth of absorptive capacity, horizontal knowledge flows were found to foster breadth of absorptive capacity. In turn, breadth of absorptive capacity was found to facilitate the exploration of new products and processes, whereas depth of absorptive capacity contributed equally to exploration and exploitation. Because of their configuration of knowledge flows in which horizontal knowledge flows supplant and supplement vertical ones, internal networks appeared to facilitate the development of absorptive capacity on both dimensions. By contributing to depth and breadth of absorptive capacity, internal networks also contribute to managing the trade-off between exploration and exploitation, so that both current and future survival is warranted.

These findings indicate that internal networks facilitate knowledge integration at both the corporate and business level. Elements at the corporate level seem to lay the foundation for more organic processes at the business level. Since knowledge integration not only depends on but contributes to absorptive capacity, the role of absorptive capacity in internal networks was evident of this. The field of study is wide, however, and in its current state had left investigators with a variety of open terrains that deserve academic pursuit. The results found in this study as well as their ramifications to wider level will hopefully encourage future researchers to address additional issues of knowledge integration and organization in internal networks as well as other types of networks. I hope the insights gained from this study contribute to further understanding of how firms influence knowledge integration and organization at multiple levels by adopting internal network forms of organizing so as to create and sustain competitive advantage.

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APPENDIX A
INNFORM Questionnaire: Corporate level

How many **organisational levels** were there between the manager with the lowest level of profit responsilibity and the chief executive in 1996 and in 1992? *Please count longest line*.

1996 ..... 1992 .....

How many **employees** were there on the head office payroll in 1996 and 1992?

1996 ..... 1992 .....

Please indicate the extent to which your **corporate structure** was formally organised along each of the following lines in 1996 and how it was organised in 1992? *For each item please tick the box which most closely applies for each of the two time periods*.

		None	Little	Moderate	Much	Great
a. Product-based structures	1996	1	2	3	4	5
	1992	1	2	3	4	5
b. Geographical regions	1996	1	2	3	4	5
	1992	1	2	3	4	5
c. Functions (eg marketing, finance)	1996	1	2	3	4	5
	1992	1	2	3	4	5
d. Project-based structures	1996	1	2	3	4	5
	1992	1	2	3	4	5

To what degree can subunit managers make decisions regarding **operating activities** (eg modifying a production or operating process, changing main suppliers)? *Please tick the box which most closely applies*

	1996	1992
1. No discretion, decision is solely the responsibility of the HQ	.....	.....
2. Some discretion to act but HQ takes most responsibility for decisions	.....	.....
3. HQ has equal responsibility with the subunit for decisions	.....	.....
4. Subunit managers have large discretion to act but HQ has some involvement	.....	.....
5. Total discretion, action is solely the responsibility of the subunit	.....	.....

To what degree can subunit managers act with discretion in making **strategic decisions** (eg long-term strategic planning, major investment appraisal)? *Please tick the box which most closely applies*

	1996	1992
1. No discretion, decision is solely the responsibility of the HQ	.....	.....
2. Some discretion to act but HQ takes most responsibility for decisions	.....	.....
3. HQ has equal responsibility with the subunit for decisions	.....	.....
4. Subunit managers have large discretion to act but HQ has some involvement	.....	.....
5. Total discretion, action is solely the responsibility of the subunit	.....	.....

To what extent do the following vertical linkages exist between **corporate headquarters and subunits** (profit centres, divisions or subsidiaries)? *For each item please tick the box which most closely applies for 1996 and for 1992*.

		None	Little	Average	Much	Great
a. Linkages to share R&D knowledge	1996	1	2	3	4	5
between HQ and subunits	1992	1	2	3	4	5
b. Linkages between HQ and subunits	1996	1	2	3	4	5
to share skills and resources (eg	1992	1	2	3	4	5
technical personnel)						

To what extent do the following horizontal linkages exist **between subunits** (profit centres, divisions or subsidiaries)? *For each item please tick the box which most closely applies for 1996 and for 1992*.

		None	Little	Average	Much	Great
a. Linkages to share R&D knowledge	1996	1	2	3	4	5
between HQ and subunits	1992	1	2	3	4	5
b. Linkages between HQ and subunits	1996	1	2	3	4	5
to share skills and resources (eg	1992	1	2	3	4	5
technical personnel)						

To what extent does your company have any of the following? *For each item please tick the box which most closely applies for 1996 and for 1992*.

		None	Little	Moderate	Much	Great
a. A common strategy for information technology	1996	1	2	3	4	5
	1992	1	2	3	4	5
b. An information technology system for the sharing and exchange of data (eg e-mail, Lotus Notes)	1996	1	2	3	4	5
	1992	1	2	3	4	5
c. An electronic data interchange (EDI) with suppliers and/or customers	1996	1	2	3	4	5
	1992	1	2	3	4	5

Please indicate which of the following **human resource practices** your company used during 1996? *Please tick all that apply*. Then indicate to what extent these practices have become moe or less important to the organisation since 1992. *Please tick that which most closely applies*.

		——— Change in importance since 1992———				
	Used in 1996	Large decline	Small decline	No change	Small growth	Large growth
a. Internal labour market (planned transfer of people and skills between subunits)	.....	1	2	3	4	5
b. Managerial/professional teams (managers/professionals brought together across subunits to collaborate on a project)	.....	1	2	3	4	5
c. Internal networks (communication channels established between subunits for the purposes of knowledge transfer)	.....	1	2	3	4	5

Approximately what proportions of total assets were deployed in **strategic alliances** in 1996 and in 1992? *Please tick one for each year*.

	1-10%	11-20%	21-30%	31-40%	>40%
1996	1	2	3	4	5
1992	1	2	3	4	5

How would you describe the range of **businesses** your company had in 1996 and in 1992? *Please tick the one which most closely applies for each year.*

	1996	1992
a. A **single** core business (ie 95-100% of sales from one type of business)	.....	.....
b. A **dominant** core business (ie 70-94.9% of sales from one type of business)	.....	.....
c. A set of **related** businesses (ie no dominant core business and 70% or more of sales from businesses related by technology or markets)	.....	.....
d. A **wide range** of businesses (ie no dominant core business and less than 70% of slaes from businesses related by technology or markets)	.....	.....

In how many countries did your firm have **operating businesses** (eg producing products/services) in 1996 and in 1992?

1996 ..... 1992 .....

Thinking about the market for your company's principal product/service, approximately **how many firms** did your company compete against in 1996 and in 1992? *Please tick one for each year.*

	1	2-5	6-10	11-15	16+
1996	1	2	3	4	5
1992	1	2	3	4	5

Approximately what percentage of your company's turnover did your company spend on **research and development** activities in 1996 and in 1992? *Please tick one for each year.*

	none	<1.0%	1.0-2.9%	3.0-4.9%	5.0-9.9%	≥10%
1996	1	2	3	4	5	6
1992	1	2	3	4	5	6

How would you assess the financial performance of this company compared with other companies in the same industry/sector? *Please tick as appropriate.*

1 A lot higher
2 A little higher
3 About the same
4 A little lower
5 A lot lower

APPENDIX B
Rabobank Questionnaire: Business level

	a small extent				a large extent
Please indicate to what extent work in your unit is:					
- specialized	1	2	3	4	5
- separated into tasks and responsibilities	1	2	3	4	5
- divided over various persons	1	2	3	4	5

Please indicate to what extent work in your unit involves communication with others:					
- vertically; within the hierarchy	1	2	3	4	5
- horizontally; outside the hierarchy	1	2	3	4	5

Please indicate the maximum number of organizational layers your unit has to interact with for its operations

..... layers

Please indicate to what extent knowledge relevant to the organization is shared by your unit with others:					
- vertically; within the hierarchy	1	2	3	4	5
- horizontally; outside the hierarchy	1	2	3	4	5

Please indicate to what extent knowledge relevant to the organization is obtained by your unit:					
- through external partners and actors	1	2	3	4	5
- through internal creation	1	2	3	4	5

Please indicate to what extent work in your unit is directed towards:					
- the exploitation, use and gradual improvement of *existing* products, services, processes, procedures, etc.	1	2	3	4	5
- the exploration, development and search of *new* products, services, processes, procedures, etc.	1	2	3	4	5

Nederlandse Samenvatting
(Dutch Summary)

Onderzoek in strategie richt zich met name op hoe ondernemingen concurrentievoordelen kunnen behalen en behouden. Recent onderzoek heeft zich hiertoe vooral gericht op kennis en netwerken. Veranderingen en nieuwe mogelijkheden in de omgeving nopen ondernemingen tot innoveren. Aangezien kennis van groot belang voor innovatie is, heeft de veranderende omgeving kennis tot één van de strategisch meest belangrijke middelen van een onderneming gemaakt.

Innovatie komt in belangrijke mate tot stand door de combinatie van bestaande kennis met nieuwe kennis, alsmede de combinatie van bestaande kennis op nieuwe wijzen. Omdat kennis van nature naar plaats en tijd verspreid is over verschillende actoren en daarmee gedifferentieerd is naar context, heeft het bezitten van waardevolle kennis ook consequenties voor de organisatie ervan. Niet alleen de kennisvoorraden zijn van groot belang. maar ook de kennisstromen in en tussen ondernemingen die ervoor zorgen dat de juiste kennis op juiste plek beschikbaar is. De transfer van kennis brengt met zich mee dat de ontvangende partij de kennis integreert in diens bestaande kennisvoorraad. Derhalve ligt aan de basis van de organisatie van kennis de noodzaak tot kennisintegratie.

De grote variëteit aan contexten waarin bestaand onderzoek naar de integratie en organisatie van kennis heeft plaatsgevonden zijn te reduceren tot interorganisationele en intraorganisationele contexten. Netwerk vormen van organiseren worden door ondernemingen in belangrijke mate geïmplementeerd om de organisatie en integratie van kennis in deze contexten te beïnvloeden. Zo zijn in de afgelopen decennia veel organisaties toegetreden tot externe netwerken met andere organisaties om door middel van allianties en joint ventures kennis van hun partners te verkrijgen. Het uitgangspunt dat elke organisatie gekenmerkt wordt door sociale relaties heeft in de wetenschap eveneens geleid tot hernieuwde interesse in het functioneren van sociale netwerken in en tussen organisaties. Sociale netwerken bevorderen niet alleen in het aangaan van nieuwe allianties en andere externe samenwerkingsverbanden, maar vertegenwoordigen eveneens een mechanisme om kennis te integreren in een organisatie.

Alhoewel externe en social netwerken sterk bijdragen aan het vermogen van een onderneming kennis te integreren, veranderen zij niets aan de formele interne organisatie van een onderneming. Hiërarchische besluitvormingsstructuren en routines, die bijvoorbeeld functionele en multidivisionele organisatievormen karakteriseren, blijven veelal bestaan en verhinderen dat ondernemingen kennis net zo ambitieus intern als extern kunnen organiseren. Dit heeft ertoe geleid dat ondernemingen met andere vormen van organiseren zijn gaan experimenteren. Ondanks de diverse labels kunnen vele van deze organisatievormen gekenmerkt worden als interne netwerken. In de literatuur wordt gesuggereerd dat interne netwerkvormen ondernemingen de mogelijkheid geven kennis en vaardigheden tussen gedifferentieerde eenheden van een organisatie over te brengen en te integreren. Hiertoe worden zij gekenmerkt door organisatie-elementen die niet of beperkt in meer traditionele organisatievormen te vinden zijn.

Ondanks het feit dat onderzoek naar de integratie en organisatie van kennis in externe en sociale netwerken nog sterk in ontwikkeling is, ligt de focus van het proefschrift om drie redenen op interne netwerken. Allereerst staan theorieën over deze vorm van organiseren nog in de kinderschoenen en zijn er pleidooien voor het ontwikkelen van adequate theorieën. Ten tweede lijkt het aantal ondernemingen dat met interne netwerkvormen experimenteert het laatste decennium sterk te zijn toegenomen. Tenslotte blijkt uit recent onderzoek dat organisaties ten opzichte van het zelf creëren van kennis en het extern vergaren van kennis vooral problemen ondervinden met het intern verplaatsen en overbrengen van kennis.

De onderzoeksvraag die in dit proefschrift aan de orde wordt gesteld betreft dan ook *hoe interne netwerken de integratie en organisatie van kennis beïnvloeden*. Om deze vraag te beantwoorden wordt in het bijzonder aandacht geschonken aan twee aspecten. Ten eerste wordt onderzocht hoe organisatie-elementen die interne netwerken onderscheiden van andere organisatievormen de integratie en organisatie van kennis beïnvloeden. De implementatie van een organisatievorm berust gewoonlijk op een beslissing van het top management en heeft gevolgen voor het functioneren van een gehele onderneming. Daarom wordt in het onderzoek de nadruk gelegd op het analyseniveau van de onderneming. Daar verschillende eenheden binnen een onderneming zichzelf ook aanpassen wordt daarnaast aandacht besteed aan determinanten van kennisintegratie op een business niveau van analyse. Ten tweede wordt onderzocht hoe kennisintegratie en de determinanten daarvoor in interne netwerken op beide analyseniveaus bijdragen aan de financiële en innovatieve prestatie van een onderneming.

Gebruikmakend van theorieën over kennisintegratie, netwerken en ondernemingsstrategie is eerst een literatuuronderzoek verricht. Dit literatuuroverzicht diende vervolgens als achtergrond om hypothesen te ontwikkelen die aan de hand van een viertal complementaire studies getest zijn. Onderzoek naar hoe interne netwerken de integratie en organisatie van kennis beïnvloeden is met name beperkt gebleven tot cross-sectionele case studies. Derhalve betrof de onderzoeksaanpak een *multi-level, multi-methode studie*. Allereerst is een longitudinaal case studie onderzoek bij Rabobank Groep

verricht waarin op beide niveau's van analyse is onderzocht hoe een transitieproces naar een interne netwerkvorm kennisintegratie beïnvloedt. Ten tweede zijn een tweetal enquêtes uitgevoerd. De eerste enquête is uitgevoerd in het van het INNFORM onderzoeksprogramma. Deze enquête is verstuurd naar het top management van 4500 ondernemingen. Van deze enquête is gebruik gemaakt om de hypothesen aangaande de determinanten van kennisintegratie op ondernemingsniveau te testen. De tweede enquête is verzonden naar de werknemers van Spectrum, een business unit van Rabobank Groep. Deze enquête is gebruikt om de hypothesen betreffende determinanten op business niveau te testen. Door deze combinatie van longitudinaal kwalitatief en breder kwantitatief onderzoek is getracht verder aan het beperkte bestaande onderzoek over kennisintegratie in interne netwerken bij te dragen.

THEORIE

De analyse van bestaand onderzoek over netwerken en kennis in hoofdstuk 2 leert dat de *drie typen van netwerken*—sociaal, extern en intern—allen een unieke bijdrage leveren aan het inzicht hoe kennis zich manifesteert in netwerken. Zo worden in onderzoek naar sociale netwerken de inbedding van actoren in het netwerk, de sterkte van de verbanden tussen deze actoren en de aanwezigheid van vertrouwen als belangrijkste parameters bekeken. In studies naar externe netwerken wordt daarentegen met name onderzocht hoe een onderneming sneller leert dan de partner-onderneming, wat het effect van concurrentie tussen de samenwerkende ondernemingen is, alsmede hoe governance structuren bijdragen aan het functioneren van externe netwerken. In onderzoek naar interne netwerken worden vooral de organisatiestructuur en organisatieprocessen die deze vorm van organiseren kenmerken als belangrijkste parameters bekeken. De analyse zet echter ook uiteen dat de drie typen van netwerken niet wederzijds uitsluitende typen zijn. Aspecten die van belang zijn voor het functioneren van het ene type netwerk kunnen eveneens van belang zijn voor een ander type netwerk. Dit wordt onderstreept door het feit dat blijkt dat elk type netwerk met name bijdraagt aan het innovatief vermogen van een onderneming, en dat netwerken zelf eveneens een vorm van kennis zijn. Kennis over hoe een onderneming opereert in externe netwerken kan eveneens van toepassing zijn op interne netwerken.

Het literatuur overzicht wordt vervolgens in hoofdstuk 3 gebruikt voor de ontwikkeling van hypothesen die in het empirische onderzoek getest zullen worden. De hypothesen zijn opgedeeld naar hypothesen die betrekking hebben op determinanten die interne netwerken karakteriseren op ondernemingsniveau en op business niveau. Op ondernemingsniveau wordt gehypothetiseerd dat kennis integratie afneemt door een toenemend aantal organisatielagen, toenemend gebruik van op product gebaseerde organisatiestructuren, en een groter hoofdkantoor. Aan de andere kant wordt beargumenteerd dat toenemende decentralisatie en gerelateerdheid van divisies, alsmede een toenemend gebruik van op project gebaseerde organisatiestructuren, van informatie technologie en van human resource middelen kennisintegratie positief beïnvloeden.

Elementen van een organisatievorm hangen onderling echter samen. Het effect van deze samenhang is in het algemeen groter dan de individuele effecten van elementen samen. Derhalve wordt eveneens op het effect van deze zogenaamde complementariteiten tussen de in beschouwing genomen organisatie-elementen ingegaan. Hiertoe wordt onderscheid gemaakt tussen complementariteiten tussen elementen die individueel kennisintegratie positief beïnvloeden, en complementariteiten tussen enerzijds elementen die kennisintegratie positief beïnvloeden en anderzijds elementen die kennisintegratie negatief beïnvloeden, maar waarvan het effect door de samenhang met andere elementen juist positief uitpakt. Tevens wordt gepostuleerd dat deze complementariteiten beter tot hun recht komen in goed presterende ondernemingen dan in minder presterende ondernemingen.

Op het business niveau van analyse wordt het vermogen van ondernemingen en haar eenheden om kennis te kunnen absorberen centraal gesteld, het zogenaamde kennisabsorptievermogen. Uit eerder onderzoek is gebleken dat dit vermogen één van de meest cruciale determinanten van kennisintegratie op business niveau is. Het kennisabsorptievermogen van een onderneming of eenheid is in belangrijke mate een functie van de reeds aanwezige kennis. Daarmee is kennisintegratie door een eenheid niet alleen afhankelijk van het absorptievermogen van die eenheid, maar draagt ook bij aan het absorptievermogen voor een later stadium. Hiertoe wordt een onderscheid gemaakt in de breedte en diepte van kennisabsorptievermogen. Deze zijn respectievelijk aan te duiden als het vermogen om brede, nieuwe kennis en diepe, complexe kennis te kunnen absorberen. Het absorptievermogen is naast reeds aanwezige kennis tevens afhankelijk van typisch organisationele aspecten. Een van de karakteristieke kenmerken van interne netwerken is dat verticale kennisstromen tussen hoofdkantoor en eenheden worden vervangen of aangevuld met horizontale kennisstromen tussen organisatie-eenheden onderling. Er wordt vervolgens gehypothetiseerd hoe verticale en horizontale kennisstromen bijdragen aan de breedte en diepte van het kennisabsorptievermogen. Tenslotte wordt beargumenteerd hoe de diepte en breedte van het kennisabsorptievermogen bijdraagt aan het vermogen van eenheden om te exploreren en te exploiteren.

METHODE

Zoals eerder aangegeven zijn voor het empirisch inzicht in de wijze waarop interne netwerken de integratie en organisatie van kennis beïnvloeden een viertal studies verricht, zoals omschreven in hoofdstuk 4. Voor elk van de twee niveaus van analyse, waren de onderliggende methoden tweeledig. De dynamiek van interne netwerken en veranderprocessen in ogenschouw nemend, is allereerst een kwalitatieve case studie uitgevoerd waarin het transitieproces van Rabobank Groep naar een interne netwerkorganisatie over de periode 1988-1998 is geanalyseerd. Hierbij is met name gekeken hoe dit transitieproces heeft bijgedragen aan kennisintegratie in Rabobank Groep. Het onderscheid tussen het ondernemings- en business niveau van analyse heeft

plaatsgevonden door naar Rabobank op groepsniveau en naar twee eenheden op business niveau te kijken. Deze twee eenheden betreffen het netwerk van lokale banken en de business unit Spectrum. De nodige informatie is vergaard door 40 managers te interviewen op alle niveaus van analyse.

Ten tweede is gebruik gemaakt van een tweetal kwantitatieve enquêtes. Om determinanten van kennisintegratie op ondernemingsniveau te analyseren, betrof de eerste enquête een vragenlijst die is uitgevoerd onder 4500 ondernemingen in Europa, Japan en de Verenigde Staten in het kader van het INNFORM onderzoeksprogramma. Aan de hand van deze enquête zijn veranderingspatronen in kennisintegratie en diens determinanten geanalyseerd in een bredere populatie van ondernemingen. Hiertoe is onder andere een onderscheid gemaakt tussen ondernemingen die veel kennis integreerden en die weinig kennis integreerden in 1992 en 1996. Vervolgens is de subpopulatie van Continentaal-Europese ondernemingen die deze enquête hebben ingevuld gebruikt om de hypothesen betreffende de determinanten van kennisintegratie te testen.

Tenslotte is een enquête verspreid over de werknemers van Spectrum, een als intern netwerk gecreëerde business unit van Rabobank. Middels deze enquête is onderzocht hoe interne netwerken het kennisabsorptievermogen beïnvloeden, en hoe dit vermogen het innovatief vermogen beïnvloedt. Door triangulatie van de technieken en methoden zijn de conclusies die getrokken worden uit de vier studies worden gevalideerd.

EMPIRISCHE RESULTATEN

Uit de case study in hoofdstuk 5 kwam naar voren dat Rabobank Groep door middel van haar transitieproces naar een interne netwerkvorm van organiseren haar vaardigheid in het integreren van kennis heeft vergroot. De case studie toonde echter ook aan dat verschillende eenheden van Rabobank Groep elk hun eigen transitieproces naar een intern netwerk bewerkstelligd hebben. Daarnaast bleek dat niet voor elke eenheid een intern netwerk de meest effectieve en efficiënte vorm van organiseren was. Zo levert Rabobank bijvoorbeeld standaardproducten en maatwerk. Voor het maatwerk, waar verschillende soorten kennis bijeengebracht moet worden, bleek een intern netwerk een adequate oplossing. Voor het standaardwerk daarentegen werd een traditionele hiërarchie als de beste vorm van organiseren beschouwd. In lijn met de hypothese dat complementariteiten tussen organisatorische elementen belangrijk zijn om kennisintegratie en -organisatie te beïnvloeden, bleek dat Rabobank en haar verschillende eenheden door organisatorische elementen in samenspel te brengen de integratie van kennis van verschillende eenheden heeft verbeterd.

Consistent met de literatuur en de resultaten van de hieraan voorafgaande case studie, toonde het descriptieve onderzoek in hoofdstuk 6 aan dat kennisintegratie in het laatste decennium sterk is toegenomen in Europa, Japan en de Verenigde Staten. Eveneens bleek dat ondernemingen die hun kennisintegratie hebben verbeterd veelal ook de mate van decentralisatie, het gebruik van op projecten gebaseerde structuren en het gebruik van informatie technologie vergroot hebben. In mindere mate gold dit tevens voor reducties

in het aantal organisatielagen. Naast het individuele effect van organisatie-elementen, gaven de resultaten ook aan dat met name ondernemingen die werden gekenmerkt door een hoge mate van kennisintegratie elementen in samenspel met elkaar hebben veranderd. Tenslotte bleek uit het onderscheid tussen Europese, Japanse en Amerikaanse ondernemingen organisatie-elementen weliswaar op gelijkwaardige wijze hebben veranderd, maar dat Japanse ondernemingen wel een meer incrementeel veranderingspatroon gevolgd hebben, daar waar Europese en Amerikaanse ondernemingen radicaler zijn veranderd.

Uit de resultaten van het onderzoek in hoofdstuk 7 bleek dat verschillende hypothesen op ondernemingsniveau van analyse bevestigd konden worden. Zo bleek dat een toenemend gebruik van op project gebaseerde structuren, een toenemend gebruik van informatie technologie en een toenemend gebruik van human resource technieken positief bijdragen aan kennisintegratie. In tegenstelling tot wat gehypothetiseerd was, bleek een groter hoofdkantoor juist bij te dragen aan kennisintegratie, wat toegeschreven kan worden aan de facilitaire rol die zij speelt. Aangezien er geen verbanden werden gevonden, moesten in het onderzoek onder de 2000 ondernemingen in Continentaal Europa de hypothesen aangaande de hoeveelheid organisatielagen, decentralisatie, het gebruik van op product gebaseerde structuren, en de samenhang tussen divisies verworpen worden. Eén van de belangrijkste bevindingen van dit onderzoek betrof de rol van complementariteiten tussen verschillende elementen. Uit de resultaten bleek dat het samenspel van die elementen die individueel kennisintegratie positief beïnvloeden geen extra bijdrage levert aan kennisintegratie. Het samenspel van die elementen die enerzijds kennisintegratie negatief beïnvloeden en anderzijds kennisintegratie positief beïnvloeden bleek wel van groot belang. Ondernemingen met een op producten gebaseerde organisatiestructuur en die tegelijkertijd gebruik maakten van een op projecten gebaseerde organisatiestructuur, van een hoge mate van decentralisatie, van informatie technologie, en van human resource technieken bleken kennisintegratie meer te beïnvloeden dan ondernemingen die de individuele elementen afzonderlijk gebruikten. Tevens bleek dat juist de goed presterende ondernemingen deze samenhang tussen elementen weten te bewerkstelligen.

Het onderzoek in hoofdstuk 8 naar de rol van het kennisabsorptievermogen in kennisintegratie toonde aan dat, op één hypothese na, alle hypothesen bevestigd konden worden. Zoals gepostuleerd bleek dat verticale kennisstromen bijdroegen aan de diepte van het kennisabsorptievermogen en dat horizontale kennisstromen juist bijdroegen aan de breedte van het kennisabsorptievermogen van een eenheid. Horizontale kennisstromen bleken vervolgens bij te dragen aan de vaardigheid van eenheden om nieuwe mogelijkheden en kansen te exploreren. In tegenstelling tot wat gepostuleerd was, bleken verticale kennisstromen niet alleen bij te dragen aan de exploitatie van bestaande producten en processen, maar eveneens aan exploratie. Deze resultaten gaven aan dat kennisabsorptievermogen een multidimensionaal construct is. Vertalend naar de context van interne netwerken valt uit deze resultaten te concluderen dat interne netwerken door

hun configuratie van kennisstromen waarin èn verticale èn horizontale kennisstromen zijn vertegenwoordigd, een hoger absorptievermogen in diepte en breedte hebben en zodoende de noodzakelijke balans tussen exploitatie en exploratie weten te bewerkstelligen.

CONCLUSIE

Uit de vier onderzoeken valt te concluderen dat interne netwerken op verschillende niveaus van analyse bijdragen aan de integratie en organisatie van kennis in een onderneming. Op ondernemingsniveau van analyse blijken met name op projecten gebaseerde structuren, een centraal en groot hoofdkantoor, informatie technologie, en human resource technieken een belangrijke bijdrage te leveren aan de integratie van kennis. Eén van de belangrijkste bevindingen van het onderzoek was dat de samenhang in organisatie-elementen de integratie en organisatie van kennis positief beïnvloedt. Ondernemingen die elementen individueel aanpassen weten kennisintegratie niet zo sterk te beïnvloeden als ondernemingen die een scala van elementen karakteristiek voor een interne netwerkvorm tegelijkertijd aanpast. In het bijzonder bleek dat de combinatie van meer traditionele elementen met innovatievere elementen bijdraagt aan kennisintegratie. Op business niveau viel te concluderen dat het kennisabsorptievermogen een belangrijke determinant van kennisintegratie is. Tevens bleek dat interne netwerkvormen dit absorptievermogen kunnen beïnvloeden door hun configuratie van kennisstromen waarin horizontale de verticale kennisstromen vervangen of aanvullen. Op beide niveaus van analyse viel eveneens te concluderen dat interne netwerken middels kennisintegratie ook de financiële en innovatieve prestaties van ondernemingen verbeteren. Op deze wijze lijken interne netwerkvormen sterk bij te dragen aan het creëren en behouden van concurrentievoordelen.

Curriculum Vitae

Raymond van Wijk (Voorburg, May 27, 1972) studied business administration from 1992 until 1996 at Erasmus University Rotterdam, where he obtained his Master's Degree with a specialization in strategic management. From 1996 until 2000 he held a position as Research Associate at the Department of Strategy and Business Environment at the Rotterdam School of Management. Since 2000, he continued to work at the same department as an Assistant Professor teaching various courses on strategy. His research has been published in a variety of journals and books, and has been presented at major conferences. Two of his papers were awarded a best paper prize at the Academy of Management Meeting in 1998 and the Strategic Management Society Conference in 1999. A reviewer for various journals and conferences, since 2000 he has been granted outstanding reviewer awards for his review activities for the Business Policy and Strategy division of the Academy of Management in four consecutive years.

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