TECHNOLOGICAL CHANGES AND BUSINESS NETWORK DYNAMICS: A LONGITUDINAL PERSPECTIVE FROM THE OPTICAL RECORDING MEDIA INDUSTRY

A thesis submitted to the University of Manchester for the degree of
Doctor of Philosophy
in the Faculty of Humanities

2010

HSIN-HUI CHOU

MANCHESTER BUSINESS SCHOOL

LIST OF CONTENTS

Part IV: Discussion, Implications and Conclusions

Word count: 76,533

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

In the past thirty years, the IMP Group's Interaction and Network Approach has gained its increasing popularity in researching economic behaviours among resource-dependent business actors through relational linkages (Håkansson *et al.*, 2004; Turnbull *et al.*, 1996). Within network research, understanding the dynamics in business networks, in which interfirm relationships are regarded as crucial constituents, has been of particular interest (Johnston *et al.*, 2006; Möller and Halinen, 1999). Moreover, technology has been identified as an important component driving the evolution of a business network, where technological change may bring about positive and negative effects on the relationships embedded in this network, and consequently, results in network dynamics (Afuah, 2000; Christensen, 1997; Håkansson and Waluszewski, 2002b; Lundgren, 1995). A perspective of resource interaction (e.g. Håkansson *et al.*, 2009) suggests that technological change needs to be treated as a process rather than a critical event. However the nature of this process as well as how it impacts on the configuration of a technology-based business net and on dynamics of relationships constituting this net remains under-examined.

Based on qualitative research methods, a longitudinal single-case study is chosen to conduct an empirical investigation in the optical recording media industry, in order to address the above research problems. To facilitate the data collection, a focal net perspective and an input-process-output model are employed. The focal net under study is characterised as a value-creating and technology-bundled business net. A total of 72 interviews were carried out in three stages and with the focal actor, its customers, suppliers and a complementor. The empirical data allows the research to reconstruct the evolution of the focal business net, which covers a time-span of more than 10 years from 1998 to 2008, and in which major technological change has taken place three times, from CD-R to DVD-/+R, DVD Double Layer and HD/Blu-ray technologies. In the development of the optical recording technology, the focal net has experienced four net reconfigurations in which radical changes of relationships as well as disturbance in resource interaction are observed. Based on the case study result, empirical observations are offered and new insights into the process of the arrival of technological change and net reconfiguration and relationship dynamics affected by this technological arrival are developed. Moreover, theoretical contribution, managerial implications, limitations and future research directions are provided.

Keywords

Business relationship, network dynamics, network position, technological change

DECLARATION AND COPYRIGHT STATEMENT

No portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning;

I. The author of this thesis (including any appendices and/or schedules to this thesis) owns any copyright in it (the "Copyright") and s/he has given The University of Manchester the right to use such Copyright for any administrative, promotional, educational and/or teaching purposes.

II. Copies of this thesis, either in full or in extracts, may be made only in accordance with the regulations of the John Rylands University Library of Manchester. Details of these regulations may be obtained from the Librarian. This page must form part of any such copies made.

III. The ownership of any patents, designs, trade marks and any and all other intellectual property rights except for the Copyright (the "Intellectual Property Rights") and any reproductions of copyright works, for example graphs and tables ("Reproductions"), which may be described in this thesis, may not be owned by the author and may be owned by third parties. Such Intellectual Property Rights and Reproductions cannot and must not be made available for use without the prior written permission of the owner(s) of the relevant Intellectual Property Rights and/or Reproductions.

IV. Further information on the conditions under which disclosure, publication and exploitation of this thesis, the Copyright and any Intellectual Property Rights and/or Reproductions described in it may take place is available from the Head of School of Manchester Business School (or the Vice-President) and the Dean of the Faculty of Life Sciences, for Faculty of Life Sciences' candidates.

ACKNOWLEDGEMENTS

I find that the journey of my PhD research is as interactive process. This process of the search for knowledge, just like business interaction in a network, is never smooth. Due to the feedback from my supervisor and some fellow researchers and my continuous reflection upon the work, the direction of this research was adjusted for a number of times. Even so, I was fascinated by this IMP-based research and enjoyed this "lumpy" process. This process is meaningful to me because I have learned and grasped "something" in the journey. However, without interacting with my supervisor and some researchers, my research cannot be completed and I may find this research process lonely and boring. Hence, by this opportunity, I will express my gratitude to those who contributed to this thesis.

First of all, I would like to thank my supervisor, Dr. Judy Zolkiewski, for providing me with valuable support and supervision. She has always been kind, enthusiastic and inspirational, keeping me on track in my PhD programme. In addition, Judy has always been ready to read and comment on my papers and drafts with insightful and challenging feedback. She also encouraged me to write and present at international conferences, which acted as a useful channel to gain additional comments on my work in progress and to learn from other researchers. Judy, I am extremely grateful for all of your efforts and support. I would also like to thank my PhD examiners, Dr. Debbie Harrison from BI Norwegian School of Management and Professor Stephan Henneberg from Manchester Business School, for their valuable and constructive opinions in my oral defense. Because of their feedback, I was able to enhance the quality of doctoral research.

My warmest thanks go also to a few people who contributed to my thesis. At the 3rd International Conference on Business Market Management held by St. Gallen University, Professor Thomas Ritter offered his valuable comments on my initial research framework. Then, at the 24th IMP Conference held at Uppsala University, Professor Håkan Håkansson at BI in Norway gave his insightful suggestions on defining my research problem. Moreover, at a PhD research seminar held by the IMP Group at Manchester Business School, Professors Peter Naudé and Stephan Henneberg provided their developmental and challenging comments on my research project. I also received useful and constructive feedback from Professor Ian Wilkinson at Australian School of Business, Professor Aino Halinen-Kaila at Turku School of Economics and Professor Susanne Hertz at Jönköping International Business School, when I presented at the 25th IMP Conference held in Marseille.

Finally, I would like to thank my wife Ju-Hui for always being there for me and for being so supportive throughout my life. With her continuous encouragement and support during the doctoral programme, the process of my PhD research was filled with joy and confidence, leading me forward.

Thank you all!

Hsin-Hui Chou
Manchester, June 2010

Part I Introducing the Research Setting

1 Introduction

1.1 Justification of the research

A paradigm shift from a transaction towards a relational oriented approach has taken place over the past 20 years, directing our attention of strategic thinking and marketing on webs of intricately connected organisations, known as networks (Achrol, 1997; Achrol and Kotler, 1999; Grönroos, 1999; Håkansson *et al.*, 2004a; Sheth and Sharma, 1997). Given that networks consist of nodes (actors) and threads (relationships) (Anderson *et al.*, 1994; Håkansson and Ford, 2002; Halinen *et al.*, 1999; Uzzi, 1997), understanding and coping with "network dynamics", which derive from actors' management of their interfirm relationships by establishing, maintaining, ending or even reactivating them (recognised as "relationship dynamics"), has been at the heart of network research as well as this doctoral research which focuses its attention on a technology-intensive network context.

This emerging paradigm reflects heterogeneity: firms are considered as "bundles of resources" and they are dependent on the resources controlled by external organisations to perform productive activities, so as to achieve desired economic outcomes (Penrose, 1995; Pfeffer and Salancik, 1978). Resources, both internal and external, are not only important to a firm's competitive advantage but also crucial to its renewal when in the face of changing environments (Barney, 1991; Helfat *et al.*, 2007; Zahra and George, 2002). This paradigm, in a network era, conveys an imperative message: no firms can evade "interacting" with others through relating their respective resources and activities across the firm boundary (Håkansson *et al.*, 2009; Möller and Halinen, 1999; Parolini, 1999).

Interaction between business actors through developing exchange relationships seems to be prevailing in the economic world. However, this prevalence does not suggest that business interaction merely takes place within separate dyads nor that the effects of interaction only act upon interacting parties; instead the consequence of interaction has significance for those directly involved in the interaction as well as other connected parties embedded in an aggregate structure (Anderson *et al.*, 1994; Håkansson *et al.*, 2009; Uzzi, 1997). Networks, which consist of interconnected business relationships, are claimed to be complex, adaptive and self-organising systems, being able to be better adapted to knowledge-rich environments because of their superior information-processing capacity and flexible governance (Achrol and Kotler, 1999; Möller and Svahn, 2006; Wilkinson, 2006). Thus, a firm's innovativeness or operational

effectiveness and efficiency is determined by how it embeds in a network structure, namely by its network position (Harryson *et al.*, 2008; Johanson and Mattsson, 1992; Low, 1997; Powell *et al.*, 1996; Zaheer and Bell, 2005).

The structure of a business network does not remain unchanged; instead it evolves. This evolving nature emanates from continuous business interaction within and between dyads (or relationships) where actors act upon or react to changing conditions based on their own interpretations of surroundings, which are influenced by their respective interaction histories (Andersson and Mattsson, 2010; Ford and Håkansson, 2006; Halinen, 1998). Consequently, both consensus and confrontation with the combination of resources and the connection of activities performed by different actors are co-produced, resulting in stabilising and changing forces that drive the evolution of a network (Håkansson and Henders, 1995; Johnston *et al.*, 2006). For a firm which is a part of a network, it is essential to sense network dynamics occasioned by stabilising and changing forces and to come up with strategies to cope with these dynamics in order to survive, grow and prosper because network dynamics usually reflect the changes in the ways actors combine resources and carry out activities individually and collectively.

In the evolution of business networks, technology has been a key ingredient. The development of a certain technology (e.g. wireless communication technology or digital image technology) can be seen as the evolution of business networks that develop this technology (Håkansson and Waluszewski, 2002a; Laage-Hellman, 1997; Lundgren, 1995). Technological development is closely related to the evolution of business networks in which a variety of actors (e.g. suppliers, users and competitors) contribute to the innovation process and their continuous interactions allow problems to be solved and opportunities to be identified. In Lundgren's (1995, p. 89) work which centres on technological innovation and network evolution, three general propositions are offered:

> (1) technological development is an interactive process; (2) technological innovation results from local search processes elicited by locally perceived problems; and (3) the evolution of technology is a process of accumulation

Technology is not only a driving component of network evolution but also an engine of firm growth. Penrose (1995) stresses that a firm has to develop expertise in technology and maintain strong technological competence in order to grow with the development of the network in which it is embedded. Since the knowledge of technology is advanced by actors' collective actions instead of the contribution by a single actor, an actor in this web of organisations must keep its technological resources adapting to its surroundings,

so as to stay competitive. In Ansoff's (1965) work *Corporate Strategy*, the importance of technology in the pursuit of competitive advantage is emphasized. It is argued that technology can be used to define a firm's relationships with other firms in an aggregate structure in which each firm's technological resources are linked together. In addition, Danneels (2002) regards product innovation as a crucial means of corporate renewal. He argues that this type of renewal necessitates a firm's ability to balance the exploitation and exploration of resources and its integrative capability. Therefore, the ability to bridge technological change or embrace new technology determines a firm's sustainability, especially for those in technology-intensive industries (John *et al.*, 1999; Moore, 1991; Slater and Mohr, 2006; Sood and Tellis, 2005; Suárez and Utterback, 1995).

Regarding technological development in a network context, we can make sense of it at least in two notions: firstly, no single actor is able to determine the arrival of technological change; and secondly, technological change may impact on a number of different, but interconnected actors, altering the interdependence structure of a network. For the first notion, technology-intensive networks (e.g. high-tech industries) can be conceptualised as technology-bundled systems or value-creating systems, in which different actors (e.g. customers, suppliers and complementors) systematically combine their respective, specialised technologies to co-create value for participating parties as well as end-users (Ford and Saren, 2001; Möller and Svahn, 2006; Normann and Ramirez, 1993; Parolini, 1999; Ritter *et al.*, 2004). In other words, each actor's move to bundle, re-bundle or even unbundle a certain technology (including resources and competences applied) has to be agreed or compromised by other actors embedded in the system, so as to allow technological development to occur.

The second notion relates to the point that technological change may endanger cooperative relationships which are embedded in a technology-intensive network characterised by universal connection of activities and combination of resources. The radical changes of relationships (e.g. dissolution of relationships) caused by technological change could result from actors' constrained views of interaction, which beget strategic or time misfit (Laage-Hellman, 1997; Ritter and Ford, 2004; Slater and Mohr, 2006). Moreover, a number of studies have shown that technological change may render a firm's competence obsolete, and on many occasions, requires the firm to look for new complementary resources (Afuah, 2000; Anderson and Tushman, 1990; Christensen, 1997; Danneels, 2002; Kash and Rycroft, 2002), leading to the exit and/or entrance of business actors in a network. In this vein, the relationship dynamics that arise from technological change colour the evolution of networks.

Despite the above notions of technological development in a network setting, the interrelationship between technological development and network evolution remains under-explored, especially in terms of the arrival process of technological change and relationship dynamics occasioned by this arrival. To address this gap, this doctoral research adopts the IMP[1] (Industrial Marketing and Purchasing) Group's Interaction and Network Approach to provide the theoretical foundation. This adoption has been made after taking into account several considerations. Firstly, the IMP approach, which comprises a core "interaction model[2]" and two subsequently developed models: "ARA model[3]" and "4R model[4]" built on an interaction perspective, offers beneficial frameworks for investigating the complexity of business interactions in network contexts with regard to relatedness (e.g. bonds between actors), variety (e.g. multi-facet of resources) and motion (e.g. development of relationships) (Håkansson *et al.*, 2009). Secondly, the employment of a Relationship Marketing (RM) approach is excluded because of its lack of emphasis on interdependence between actors (Mattsson, 1997; Pels *et al.*, 2009). Thirdly, other network studies, such as Burt's (1992) work that focuses on structures and measurement of network formation to bridge "structural holes", does not suit the interest of this research which looks at network evolution triggered by technological change from a processual point of view.

Being grounded in the IMP approach, this research employs a focal net perspective to undertake a processual (or longitudinal) analysis in order to study the evolution of a business net triggered by the arrival of technological change. The focal net here is analogous to Parolini's (1999) "value net[5]", which stresses value co-creation by different economic actors via connection of productive activities; while the processual analysis used in this research is built on an "input-process-output" model and with a particular emphasis on the developmental process (Pettigrew, 1997; Van de Ven and Huber, 1990). Few studies, particularly in the IMP research area, combine a focal net perspective with processual analysis to capture network dynamics driven by technological change. This is where the contribution of this research resides.

---

[1] For more information about this research community, see www.impgroup.org.

[2] This model, which is built on a heterogeneity perspective, deals with social interaction between buyers and sellers. This model is introduced in Chapter 3.

[3] "ARA" stands for the layers of actors, resources and activities. The model emphasizes the interplay between these layers through business interaction. It is also introduced in Chapter 3.

[4] "4R" refers to four types of resources: products, facilities, business units and business relationships. The 4R model emphasizes the interplay between these resources across the firm boundary. The model is introduced in Chapter 5 when reviewing the literature on technological development.

[5] It has been recognised that the "nodes" in Parolini's value net model represent "value creation or consumption activities" (p. 81), which is different to the usage of nodes in this thesis: nodes as actors. Despite this, her views on value-creation are consistent with IMP view that: value can be generated through bundling, unbundling or re-bundling of activities which are carried out by different economic actors using both tangible and intangible resources.

1.2 Research objective, questions, methods and limitations

The central interest of this research is to investigate the interrelationship between technological development and network evolution using a processual analysis based on a focal net perspective. This research interest comprises two objectives: (1) to study the process of the arrival of technological change at a network setting and its association with network evolution, in particular, the network configuration at different points in time; (2) to gain a deep understanding of relationship dynamics, which result from the arrival of technological change and which consist of network dynamics.

Regarding the first objective, this relates to the arrival of technological change and the impact of this arrival on network configuration. From an interaction perspective, technological development in a business network is a collective issue that can only be understood when taking into account the interplay between different types of resource entity (e.g. products, facilities, business units and business relationships) within and across the firm boundary (Håkansson and Waluszewski, 2002a). Technological development as well as network evolution should be viewed as an accumulative process. In this sense, technological change should be treated as a process consisting of episodes and events where individual achievements of technological development are put forth. And such a technological arrival can be seen as a transition period that connects two network structures based on an existing and a new technological path (Håkansson and Lundgren, 1997; Kash and Rycoft, 2000). As a result, the following two research questions are developed:

- What is the nature of the process of the arrival of technological change at the focal net?
- How is the configuration of the focal net affected by this technological arrival?

The second objective involves relationship dynamics, particularly their radical side. Existing evidence shows that the arrival of technological change usually begets radical changes in a firm's cooperative relationships (e.g. Afuah, 2000). This only reveals one facet of the impact of technological change. From perspectives of business interaction (Håkansson *et al.*, 2009) and value-creating systems (Parolini, 1999), the successful arrival of technological change at a network setting requires the creation of an appropriate interdependence structure, implying that other radical changes of relationships are possible, including the establishment of new relationships or even the reactivation of previously ended relationships. The research on radical changes of interfirm relationships has received increasing attention, such as: Halinen and Tähtinen

(2002); Havila and Wilkinson (2002) and Tähtinen and Halinen (2002), but there are only a few places where their attention is focused on a technology-intensive network setting. As a result, the following research question is developed:

- How the arrival of technological change impacts on the relationship dynamics of the focal net, particularly the radical changes of relationships?

In addition, being able to deal with relationship dynamics, namely, to establish, maintain, enhance, end or reactivate relationships has been emphasized as an important means to alter or adjust a firm's interdependence structure in order to stay competitive in rapidly changing environments (Möller and Halinen, 1999; Ritter and Gemünden, 2003b; Wilkinson and Young, 2002). However, this ability to handle relationship dynamics is paradoxically enabled, and simultaneously, constrained by relationships to which a firm is connected (Håkansson and Ford, 2002). Achieving this ability is especially crucial in the face of the arrival of technological change because it may involve the exploration of new resources that are controlled by new actors or the elimination of existing resources of current partners (Afuah, 2000; Harryson *et al.*, 2008; Kash and Rycroft, 2002). Thus, the following research question is developed:

- How is a firm able to cope with relationship dynamics caused by the arrival of technological change at a business net?

With the above research objectives and questions, a longitudinal (also recognised as "processual analysis"), qualitative single-case study approach is employed to examine the evolution of the focal net, which is driven by the arrival of technological change (Halinen and Törnroos, 1995; Pettigrew, 1997; Silverman, 2005; Van de Ven and Huber, 1990; Yin, 2003). This methodological choice is based upon two considerations. Firstly, the dynamics derived from the evolution of the focal net can be revealed by taking into account of the influences of time and temporality (Halinen and Törnroos, 1995). Secondly, the processual analysis is built on an "input-process-output" model (Van de Ven and Huber, 1990), in which "the arrival of technological change", "the evolution of the focal net" and "the reconfiguration of the focal net" respectively refer to "input", "process" and "output". Moreover, retrospectively this research follows an "abductive" logic (Dubois and Gadde, 2002), which is characterised by iteration between theoretical framework and empirical fieldwork during the research process. Such an abductive logic not only enables the researcher to provide a valid description of network evolution triggered by technological change but also allows both the investigator and readers to learn from the case.

Delimiting the boundary for a network study is pivotal but problematic (Halinen and Törnroos, 2005). The boundary of this research is drawn using a focal net perspective. Theoretically, a focal net, which comprises different economic players and which emphasizes value co-creation, is able to seise "embeddedness" and "connectedness" that characterize business networks (Anderson *et al.*, 1994; Blankenburg and Johanson, 1992; Parolini, 1999; Ritter *et al.*, 2004). More importantly, technological change cannot be understood in a single event or within a firm's activities but via a broader combination of resources and connection of activities among firms (Ford and Saren, 2001; Håkansson and Waluszewski, 2002a), which can be conceptualised as a "value net" (Parolini, 1999) or a technology-bundled net. Methodologically, employing a focal net allows the researcher to efficiently delimit the boundary of the study; it is an intermediary option between the use of focal organisations as sampling units and the adoption of the overall network as unit of analysis (Brito, 1999).

In light of this focal net perspective, the optical recording media industry is chosen as the empirical setting. This industry is characterised by rapid technological change, in which major change has taken place three times. Apart from using this perspective, the accessibility to informants and identifiable arrivals of technological change are additional criteria for the selection of the case. As shown in Table 1.1, a focal (or value) net that consists of a focal actor, three of its suppliers, three of its business customers and a complementor is considered, mainly based on the focal actor's (company F's) points of view. This focal net, which is based on CD-R technology (the first generation of optical recording technology), provides a basis for tracing the subsequent net evolution triggered by the arrivals of technological change, including DVD, DVD Double Layer, and Blu-ray recording technologies. In order to achieve a near-realistic picture of focal net evolution, informants are not merely from the focal actor but also from its interacting parties (e.g. other focal net members) and even its rivals. Archival materials, e.g. market research reports and company documents, were also consulted.

This research has two limitations. Firstly, although extensive interviews were carried out with a number of companies in the optical recording media industry and archival materials were consulted, the picture depicted in this research is subjective. It would be difficult to generalise the findings to other network settings. Secondly, despite using an artificial boundary, the focal net perspective, to facilitate the examination of the net evolution triggered by the arrivals of technological change, this delimitation of network boundary simultaneously constrains our understanding of the reality in the empirical world. This is due to that a network can extend boundlessly and the change influences of interaction episodes and events may flow among interconnected relationships that

constitute this network.

Table 1.1 The focal net under empirical investigation

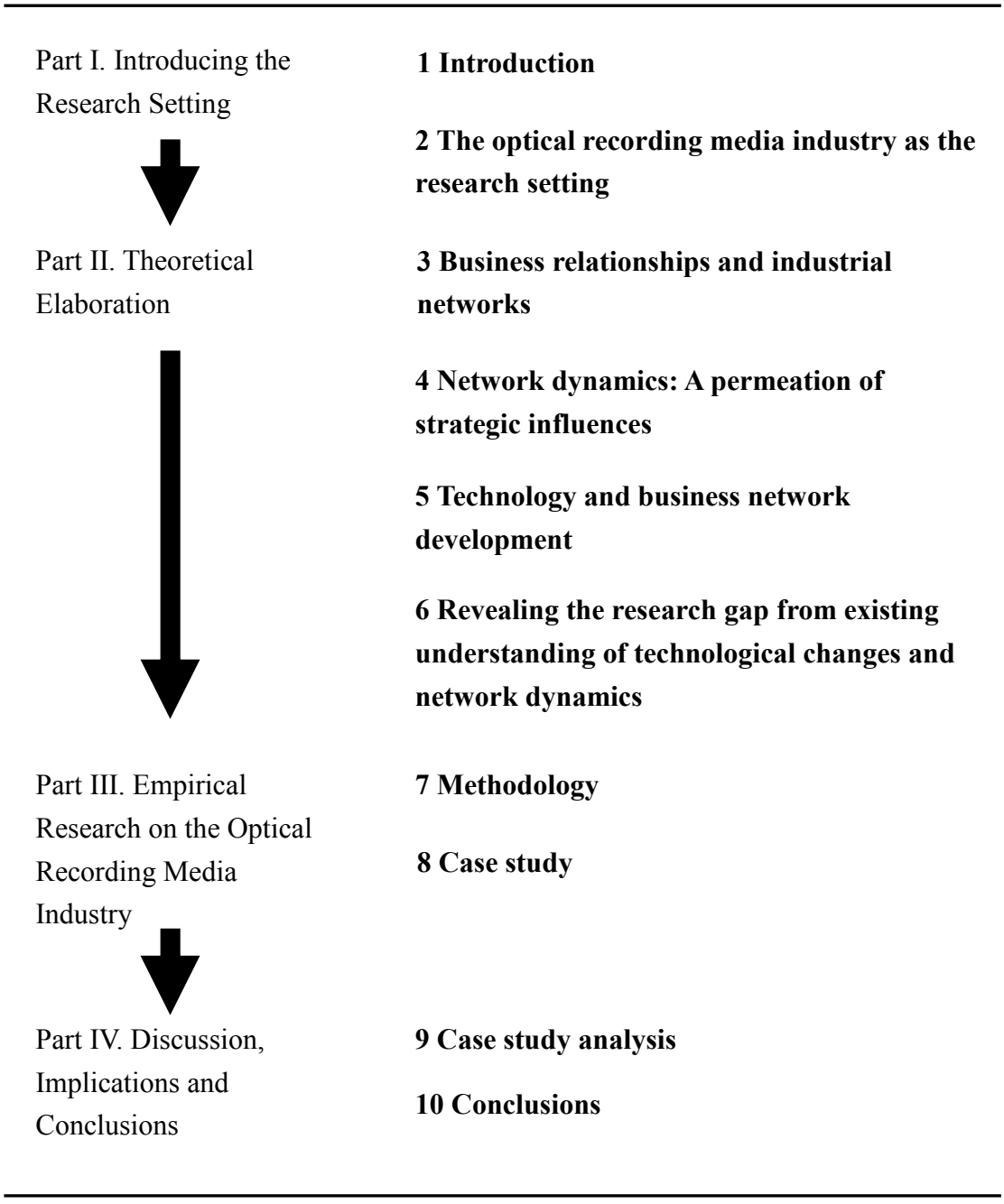
Net member	Description
The focal actor (F)	A Taiwanese manufacturer of optical recording media/discs (e.g. CD-R)
S1	A Swiss-based supplier of dye materials used in media production
S2	A Taiwanese supplier of sputtering targets used in media production
S3	A Taiwanese supplier of packaging materials and a provider of packaging service
C1	A Japan-based business customer (also a technology vendor)
C2	A Japan-based business customer (also a technology vendor)
C3	A Japan-based business customer (also a technology vendor)
D1	A Taiwanese maker of optical recording drives (or burners or recorders)

Note: For confidentiality, company names are disguised throughout the thesis.

1.3 Organisation of the thesis

This thesis is structured in ten chapters, which are categorised into four parts, as illustrated in Figure 1.1. To assist the reader in reviewing this scholarly work, a short summary of each chapter is offered below.

Figure 1.1 The structure of the thesis



Chapter 1 introduces the reader to the justification for this research which focuses on the interrelationship between technological change and the evolution of business networks. Moreover, the research objective, problem area, methodological approach and limitations are briefly presented.

Chapter 2 introduces the reader to the background of the empirical setting: the optical recording media industry. This introductory background covers a short history of industry development, product technologies, different manufacturing processes and the cooperation and competition in the industry.

Chapter 3 elaborates on the IMP Group's Interaction and Network Approach, namely the interaction model and ARA model, which lays the theoretical foundation for this research. In the remainder of this chapter central concepts based on an interactive perspective and relevant to the interest of this research are introduced.

Chapter 4 contains a review of literature on network dynamics which arises from the interplay between change and stability forces. From an interaction perspective, these two main types of forces can be seen as actors' respective strategising that aims to favour their own network positions.

Chapter 5 gives a theoretical elaboration on the role of technology in the development of business networks. In particular, the IMP's resource interaction that facilitates understanding technological development in networks is introduced. Furthermore, a value-creating and technology-bundled business net or system is discussed. Existing knowledge of managing technological change is also included.

Chapter 6 reveals the research gap from the existing understanding of technological changes and network dynamics. Two main research problems are developed from this understanding: 1) the process of the arrival of technological change and its impact on network configuration, and 2) relationship dynamics derived from this technological arrival. Under each problem, research questions are also developed.

Chapter 7 describes and justifies the employment of a qualitative, longitudinal research method to conduct the empirical investigation. In particular, a processual design which is characterised by the adoption of an input-process-output model is presented. This chapter also describes how an abductive logic emerged from the research process, which is characterised by iteration between theory and the empirical setting. Then, the rationale of case selection, data collection and data analysis is offered. The chapter is ended with an assessment of data quality.

Chapter 8 presents the evolution of a focal net in the optical recording media industry. This presentation is built on the reconstructions of the formation of the focal net before and after technological change. Along a time dimension, four reconfigurations of the focal net triggered by technological changes have been reconstructed.

Chapter 9 analyses the case and discusses the findings. The chapter firstly presents four empirical observations that deepen our understanding of technological development in networks. Then, the chapter addresses research enquiries with new insights developed from the empirical results. Finally, an integrated model towards understanding the evolution of a value net driven by technological change is presented.

Chapter 10 concludes this network research by offering both theoretical and managerial implications. Then, the limitations of this research are discussed. Finally, future research directions are suggested.

2 The optical recording media industry as the research setting

2.1 Introduction

The purpose of this chapter is to provide the background to the empirical setting: the optical recording media industry. This chapter consists of four parts: the development of the industry, product technologies, the manufacturing of the optical recording media, and cooperation and competition in the industry. The first part provides an overview of the development of the optical recording media industry which reveals the dynamic aspect of the evolution of the industry. The second part gives a brief introduction to optical recording media technologies, with a particular attention on write-once media. The third part is concerned with manufacturing processes for different types of write-once optical recording media. The final part of this chapter focuses on the cooperation and competition within this dynamic industry.

In the past 20 years, several types of optical recording media have been commercialised based on two main technologies respectively: organic-dye-based technology (e.g. CD-R, short for CD Recordable) and phase-change-based technology (CD-RW, short for CD Rewriteable; and DVD-RAM, short for DVD Random Access Memory). Within each technological domain, several major technological changes have taken place, such as the changes from CD-R to DVD-R and from DVD-R to DVD-R DL (double layer). Moreover, the format rivalry between "dash" camp (e.g. DVD-R/RW) and "plus" camp[6] (e.g. DVD+R/RW) not only marked the development of the optical recording media industry but also complicated the cooperation and competition between firms. In order to suit the needs and interest of this research, the following introduction of the optical recording media industry will focus on organic-dye-based technology.

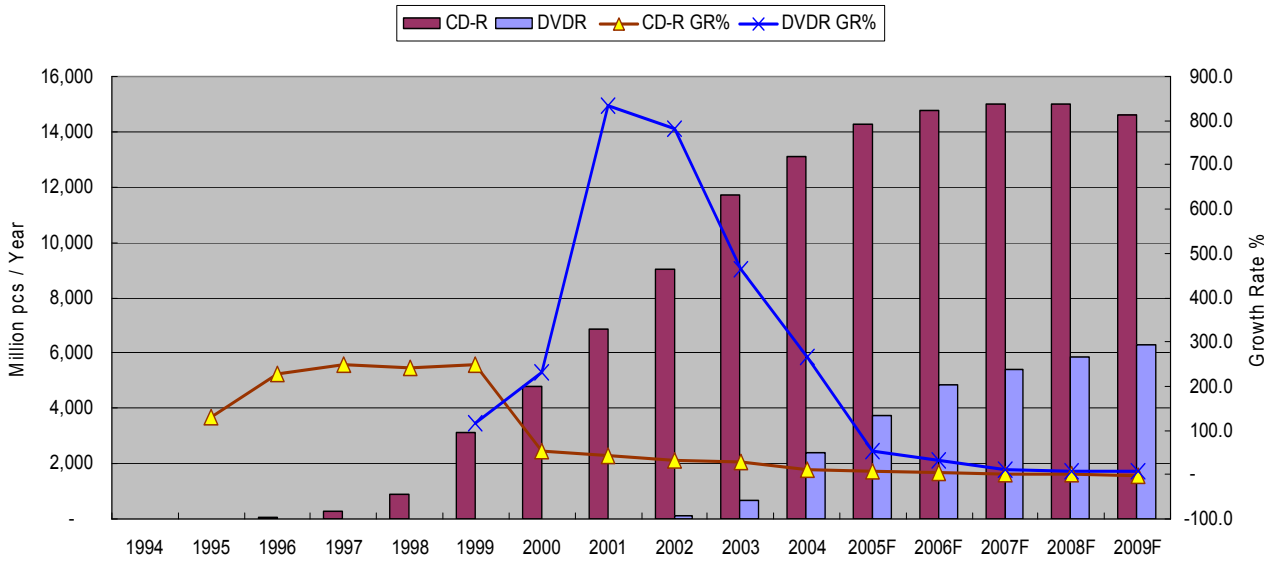
2.2 The development of the industry

A remarkable event that initiated the era of the optical recording media industry was the finalization of the CD-R specification (also called "Orange Book Part II") by Sony and Philips in 1990. In the early 1990s, manufacturing, marketing and research and development of the optical recording media and hardware (recorder or burner) were mainly performed by companies based in the US, Europe and Japan, particularly the

[6] The "dash" DVD format is (e.g. DVD-R) developed by the DVD Forum while the "plus" DVD format is invented by the DVD+RW Alliance. Although there are a number of technical differences between these two DVD formats, most consumers would not notice the difference, especially when many recorders (also called "hybrid" drives) can handle both formats.

latter. In 1993 Taiyo Yuden, a Japanese media maker, was the first company to mass produce CD-Rs. Due to their write-once characteristic, CD-Rs had gradually widened their acceptance (such as for the backup of official documents and medical data), and in turn, market demands rapidly increased. The CD-R markets were also boosted by other factors including CD-R being a standard product, the availability of complementary products (burners), and the growing popularity of Internet and digital content. As a result, more and more companies joined the industry as optical media vendors and makers, including those manufacturers based in Taiwan. In 1997, the output of CD-Rs by manufacturers based in Asia accounted for 80 per cent of the global market share.

Figure 2.1 Market demands and growth rate of CD-R and DVD-R



Source: FRL (Fujiwara-Rothchild, Ltd.) annual report (2005)

The period from 1996 to 1999 can be seen as a high growth phase of CD-R in the development of the optical recording media industry. In addition to the above factors (e.g. the availability of hardware), another crucial factor that drove the increase in market demand for CD-Rs was the threat of the Y2K problem (the Millennium bug that resulted in a noticeable problem for digital, computer-assisted, and non-digital data storage and documentation). Using CD-Rs as a data backup medium was viewed as one of the best solutions to the Y2K problem due CD-R's high compatibility and high storage capacity with relatively lower price. In the face of this growing market, both new and old CD-R makers were encouraged to expand their production lines. As Figure 2.1 indicates, for four years straight from 1996 to 1999 inclusive, the CD-R market had a growth rate of over 200 per cent. During this period, the specification of the next

generation of the optical recording media, DVD-R, was finalized by the DVD Forum in 1997. The DVD Forum, established in 1997, is an international organisation that is composed of hardware, software, media and content companies, that aims to define, disseminate and verify DVD formats (e.g. DVD-R and DVD-RW) and to license DVD format logos. Before the Millennium, the attention of the optical recording media industry was focused on CD-R.

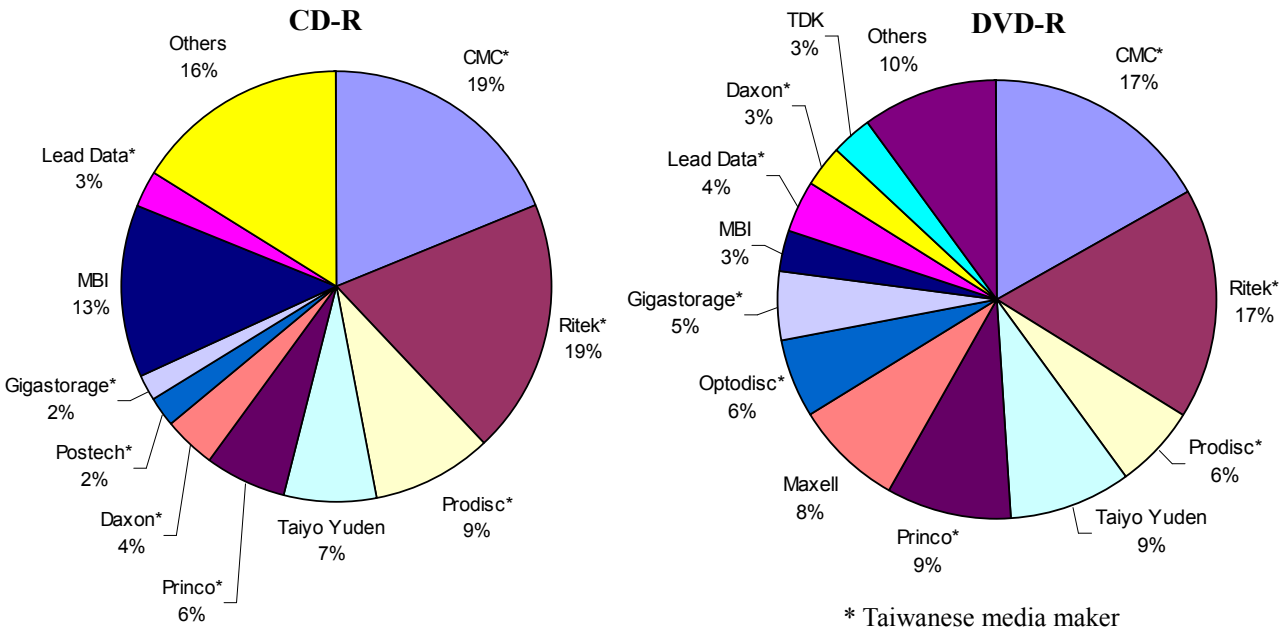
Due to the availability of materials, production equipment and even turnkey solutions, the entry barrier to CD-R manufacturing was low. Although the Y2K problem had been weathered, the fierce competition for CD-R production capacity continued, especially among those manufacturers based in Taiwan. Consequently, significantly falling prices made media vendors and makers suffer; their profit margins were drastically squeezed. The CD-R price fell from US$7 per disc without packaging in 1996 to US$0.18 per disc in 2001. In order to improve profitability, some companies developed niche products, such as 8cm CD-R, 90min CD-R and even business-card-sized CD-R. However, their contribution to profits was quite limited. Then, the focus of the industry was shifted from CD-R to DVD-R. In addition to installing new production lines, a few companies opted to transfer their CD-R lines into DVD lines by integrating with new machines, and some used both ways to produce DVD recordable discs. As shown in Figure 2.1, the growth rate of CD-R slowed down after the Millennium despite its steady increase in market demands; and, clearer demands for DVD recordable media appeared after 2002.

The fierce competition in CD-R prices, which was caused by oversupply, urged major optical recording media vendors and makers to introduce DVD recordable products in order to increase their profit margins. In late 2002, following on from the Japanese-based media makers, leading Taiwanese media makers started volume-producing DVD media. In the meantime, the DVD+RW Alliance, the rival camp of the DVD Forum, was formed in early 2002, aiming to promote “plus” formats (e.g. DVD+R and DVD+RW). The key members of the DVD+RW Alliance were IT and consumer electronics companies, including Dell, Philips, Sony and Ricoh. Because of the uncertainty about the result of the format rivalry, most of the Taiwanese media makers played safe by producing discs for both camps. Major media makers were glad to see this format rivalry because they had more resources than other small and medium sized makers to better manage different types of optical recording media in terms of stable quality and large production capacity.

By increasing the volume of DVD recordable products, the profitability of both media vendors and makers was improved. However, the favourable situation was short-lived, lasting for about a year from 2002 to 2003. When DVD recording technologies were

introduced in their production, the leading Taiwanese manufacturers tried their best to expand DVD capacity, including DVD-R and DVD+R. They hoped the higher technical barrier to DVD production and the economies of scale could drive those companies with few resources (e.g. technical know-how, management knowledge and capital) out of the industry. Indeed, many companies based in Taiwan stopped operating, but still some survived. The number of Taiwanese media makers decreased from a little over 40 in 1999 to about 10 in 2003. Even so, the manufacturing of optical recording media, including CD-R, DVD-R and DVD+R, was still dominated by Taiwanese makers (see Figure 2.2 for example). Those surviving second- and third-tier media makers were eventually able to volume produce DVD recordable media due to their own efforts and the technical support from their material or equipment suppliers.

Figure 2.2 CD-R and DVD-R global market share in 2003 (by maker)



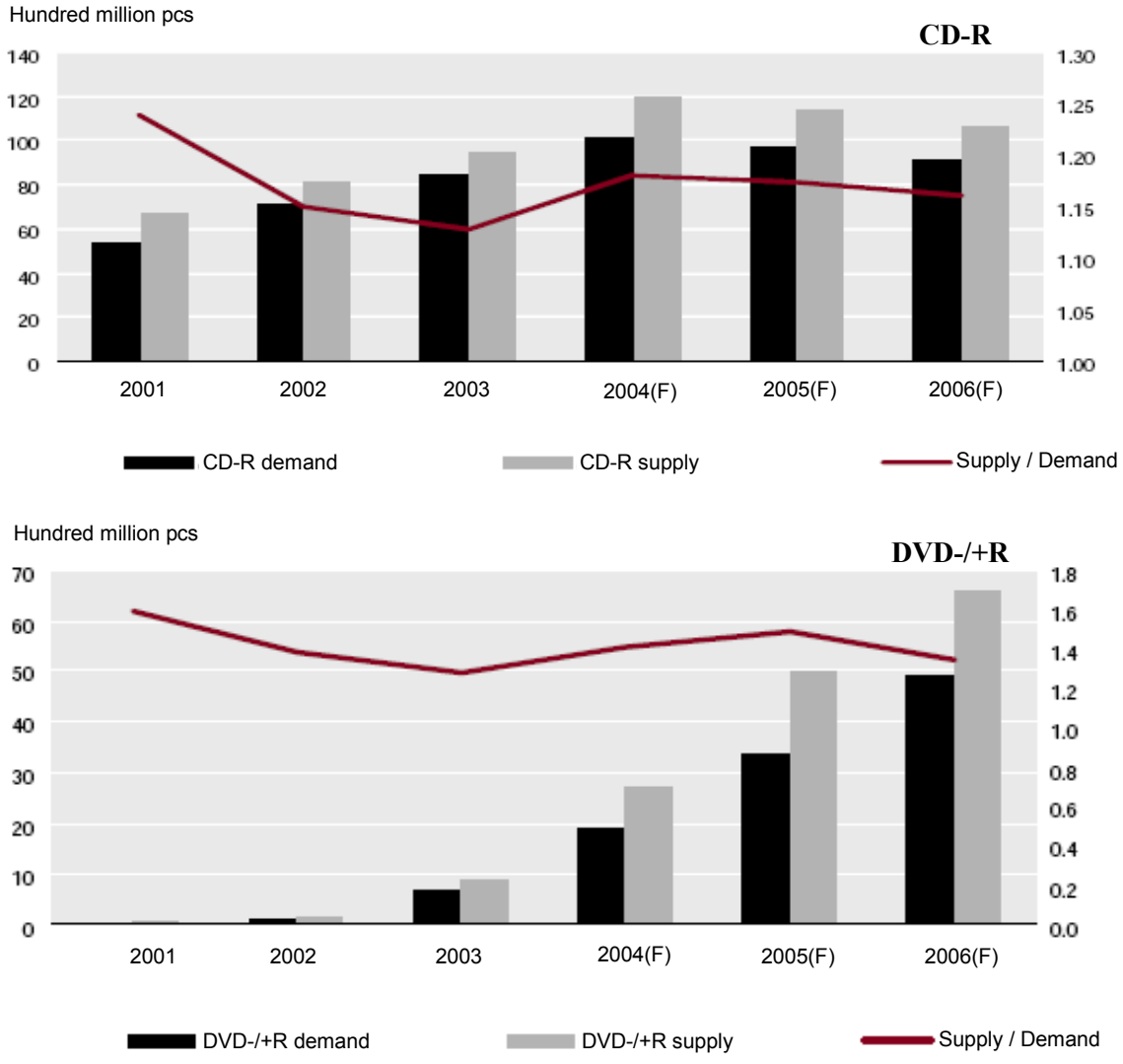
* Taiwanese media maker

Source: www.iek.itri.org.tw

Owing to the continuous competition in production capacity between major media makers (e.g. CMC vs. Ritek in Figure 2.2) and the additional capacity provided by small and medium sized makers who survived technological change from CD-R to DVD-/+R, the supply of DVD recordable products soon exceeded their demands, particularly after 2003. As Figure 2.3 shows, the similar story of CD-R oversupply was repeated on the stage of the DVD generation. This situation of oversupply became the nightmare for optical recording media vendors and makers, directing the industry to "unhealthy" development: the price war. As a result, the DVD-R price fell from US$13 per disc in

1999 to US$0.2 per disc in 2005. Amazingly, from Q3 2003 to Q3 2004, the price of a DVD-R disc dropped 80 per cent (from US$1 to US$0.2). The DVD+R price also exhibited a similar trend. Being in such an intensely competitive environment, the closure of production factories and even withdrawal from the industry among optical recording media vendors and makers continued to happen.

Figure 2.3 CD-R and DVD-/+R global supply and demand

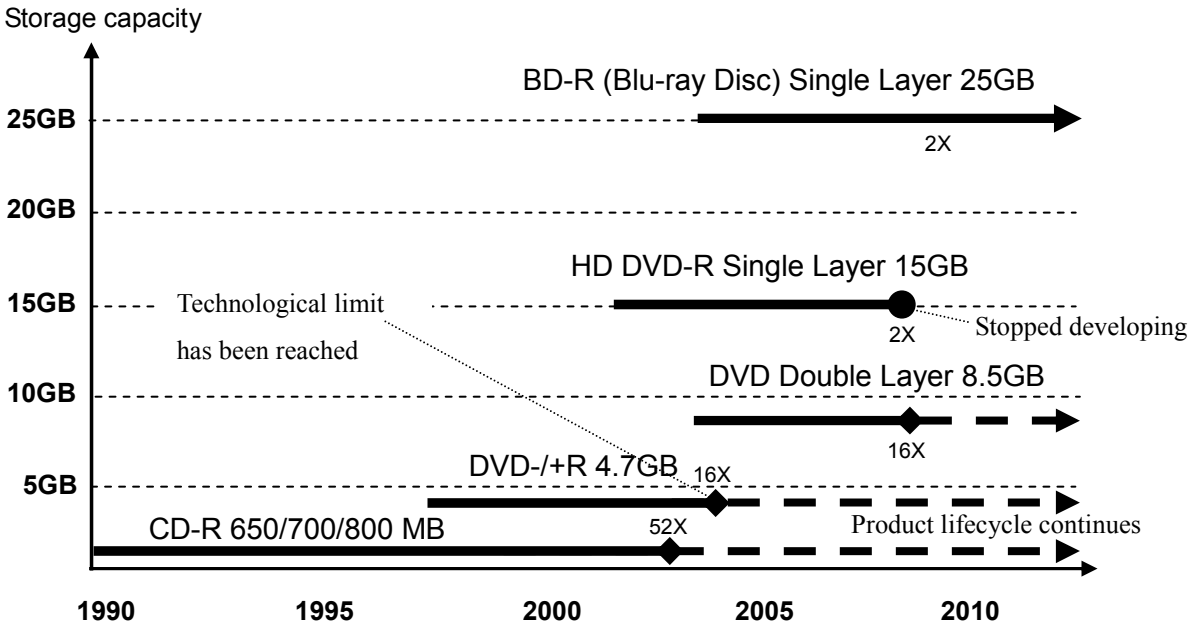


Source: www.iek.itri.org.tw

In order to gain higher profitability, the players in the industry focused their attention on driving down the costs of existing products and releasing new products. With regard to new products, these included a new product based on a new product technology, an existing product with new disc label-printing and packaging designs, and a new product based on the existing product technology but with higher (or enhanced) recording speed

(e.g. from DVD-R 4X to DVD-R 8X). The higher the recording speed of a disc, the less time is required to burn this disc. Being able to enhance the recording speed of such media has become a must for a producer to survive in the industry. Moreover, releasing a new product with enhanced recording speed ahead of competitors, allows the producer some breathing space and to enjoy higher profit margins. Consequently, the evolution of the optical recording media industry is marked by rapid technological changes and shorter lifecycle of product technologies. As Figure 2.4 shows, in the optical recording media industry, technological development is moving rapidly towards high storage capacity for a 12cm disc, due to the increasing need to backup high-definition content. Also Figure 2.4 indicates that the lifecycle of a new product technology is getting shorter. Take CD-R and DVD-R for example, it took about 14 years for the development of CD-R to reach its technological limit; but for DVD-R, it just took about seven years.

Figure 2.4 The development of write-once optical recording media



Source: prepared by the author

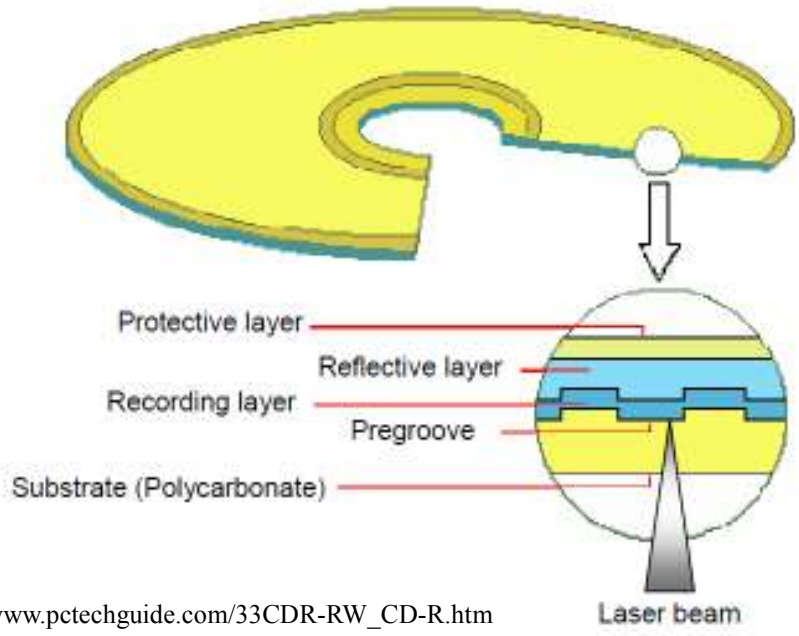
When the development of DVD recordable technology was near its technological limit towards the end of 2004, migrating to DVD DL (a DVD double-layer disc has a double storage capacity of a DVD single-layer) or high-definition optical recording technologies (either HD DVD or Blu-ray Disc) became an option for media vendors and makers to strengthen their competitiveness. However, the high technical barriers (much higher than CD-R and DVD-/+R due to the requirements in product precision) and the format battle between the HD DVD camp led by Toshiba and the BD camp led by Sony deterred most media makers from moving into this new field. Even after Toshiba's

decision to discontinue HD DVD in early 2008, few players actually entered into the BD field. In addition to technical issues, the manufacturing of BD-R discs requires media makers to have enough capital to install new and expensive production lines. Thus, many media makers have started developing new businesses which have no relation to optical recording media, in order to reduce the burden of existing businesses.

2.3 Product technologies

Following the commercialisation of CD-R in the early 1990s, several write-once optical recording media technologies have been introduced: DVD-R, DVD+R, DVD+R DL, DVD-R DL, HD DVD-R and BD-R. The standard products based on these technologies are the same thickness (1.2mm) and diameter (120mm), but this is where similarities end. These product technologies can be distinguished from their product designs (disc structures which determine the capacity of data storage), key production materials (which are decisive to product quality) and production processes (including production machines and apparatuses for quality control).

Figure 2.5 The physical structure of a standard CD-R

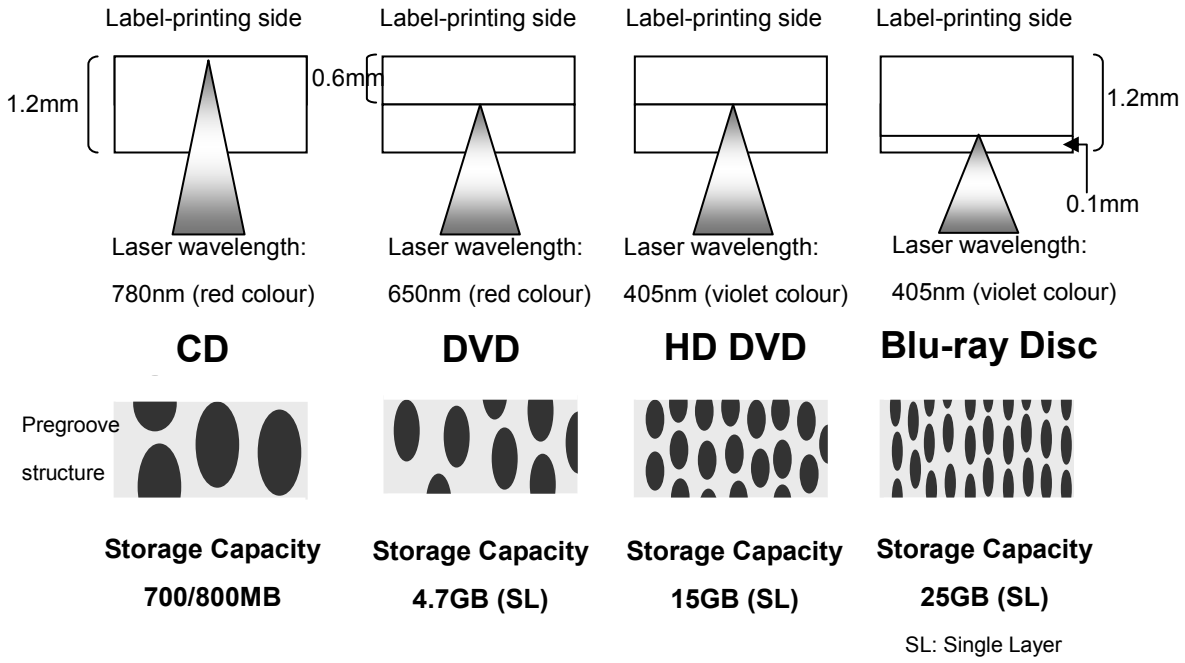


Source: www.pctechguide.com/33CDR-RW_CD-R.htm

As shown in Figure 2.5, a standard CD-R is made of polycarbonate (called “substrate”). The top side of a substrate (the bottom side faces the laser beam) is molded with a spiral groove (called “pregroove”, extending from the inside to the outside diameter of the

substrate) which guides the laser beam in a writer (or burner or drive) to write data and read information after recording. For data to be recorded on the substrate, a recording layer (which is a thin layer of organic dye) has to be coated on the pregroove side. During the recording process, pits and lands are created where pits are areas burned by laser beam in a writer. In this way, digital signals are created and stored. Then, on the recording layer is a thin metal reflective layer (gold, silver or silver alloy) followed by a protective lacquer coating which is cured by ultraviolet light. When a substrate is coated with a recording layer, reflective layer and protective layer, normally a CD-R can function in a writer. Finally, a label which contains the product information (e.g. brand name, type of media and storage capacity) is printed on the top of the protective layer. This is what consumers see as a CD-R disc.

Figure 2.6 A comparison of write-once optical recording media technologies



Source: Topology Research Institute (www.topology.com.tw)

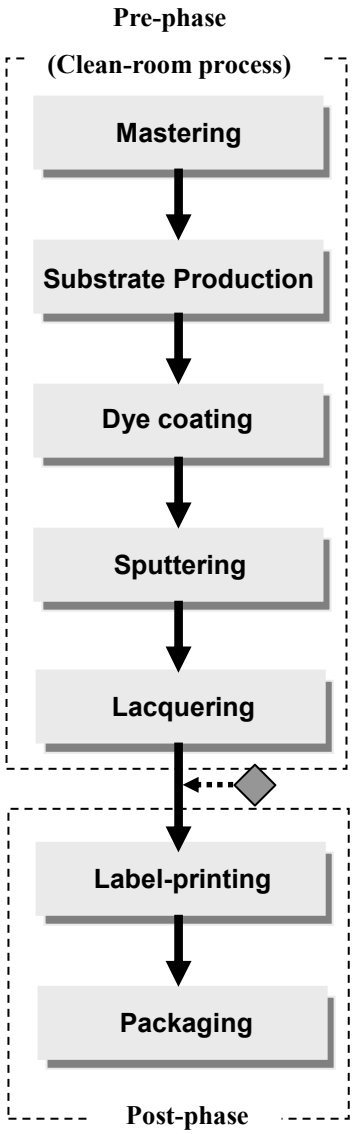
In comparison with CD-R, as shown in Figure 2.6, three distinguishing characteristics can be identified in the advancement of optical recording media technologies. These characteristics are shorter laser wavelength that is required to burn pits into recording layer, higher density of groove structure on the top of the substrate, and higher storage capacity which is the result of using shorter laser wavelength to burn finer pits into the pregroove. In the recording process in a writer, burning a CD-R or DVD recordable disc employs a red laser while burning a HD DVD or BD recordable disc, a blue laser with

shorter wavelength (405nm) is required. Moreover, a DVD or HD DVD recordable disc is made of two 0.6mm substrates that have been bonded together. For a DVD single layer, the upper substrate is called “dummy substrate” because no pregroove is on the top of this substrate. Unlike HD DVD, Blu-ray disc is made of a 1.1mm substrate with a 0.1mm recording layer (also called “cover layer”). The most challenging issue of producing a BD-R disc is how to control the evenness of this cover layer.

2.4 The manufacturing of optical recording media

The manufacturing of optical recording media generally consists of two phases: a pre-phase in which the production is performed in a clean-room area and a post-phase which mainly comprises the activities of disc label-printing and packaging. Take CD-R mass production for examples, as shown in Figure 2.7, the pre-phase is divided into seven stages, from the mastering of stampers to disc lacquering. The purpose of each stage and what main material and machine are used in this stage are briefly described in Figure 2.7. Prior to the process of disc label-printing, each production lot has to be tested by several types of testing apparatuses based on sampling inspection methods.

Figure 2.7 The process of CD-R production



This stage is done to make stampers on which pregroove geometry is laser-engraved. The stampers are used in molding machines to duplicate substrates.

In this stage polycarbonate materials and stampers are used in the molding machines to produce plastic substrates.

In this stage a thin layer of dye is applied on each substrate using spin-coating machines.

This stage is performed to sputter a thin metal layer on the top of the dye layer of each substrate using silver or silver alloy targets on sputtering machines.

This stage is done to spin-coat a layer of lacquer on the top of the reflective layer of each substrate using lacquering machines. This protective layer is then cured by ultraviolet light.

In this stage each semi-finished disc is ink-printed with the company logo and production information.

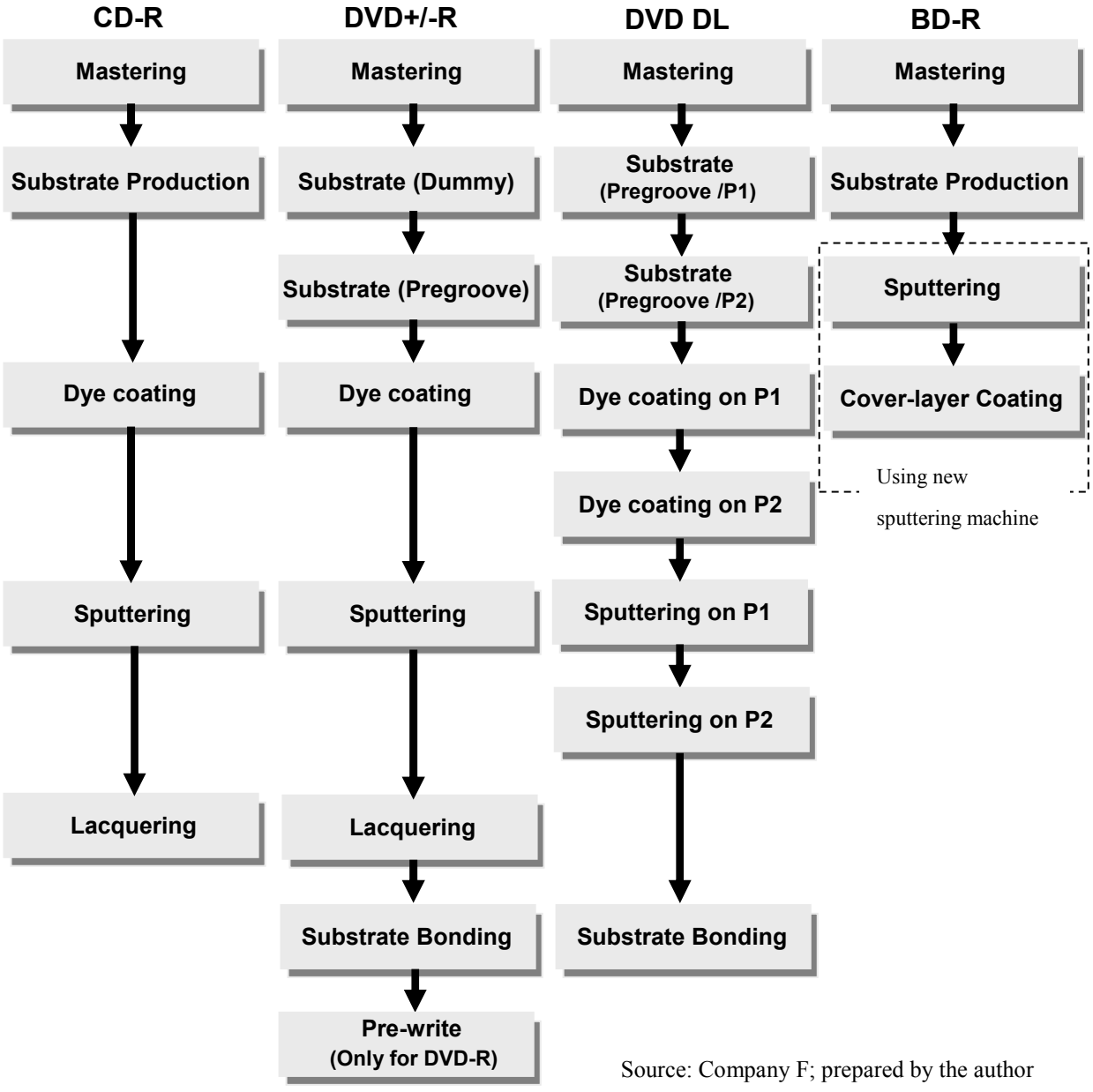
In this final stage discs are packaged according to customers' requirements.

◇ Disc quality inspection

Source: Company F; prepared by the author

Due to the variation in optical disc structures (see Figure 2.6 for example), the manufacturing of CD-R, DVD+/-R, DVD DL and BD-R requires different production processes, as Figure 2.8 shows. The differences in these production processes can be distinguished in terms of process engineering, new production equipment (e.g. bonding machines are needed in the production of DVD recordable products), materials (e.g. dye materials for these types of optical recording media are incompatible with each other) and apparatuses for quality control. As Figure 2.8 shows, although the production process of BD-R looks simpler than other types of media, it requires the manufacturers to install new and expensive production lines and to develop know-how in controlling the coating of the cover-layer which is merely 0.1mm in thickness.

Figure 2.8 A comparison of optical recording media production processes



Source: Company F; prepared by the author

In order to produce good quality discs, it is crucial for manufacturers to develop a best combination between dye thickness, reflectivity thickness and groove structure (e.g. its depth and width) through fine-tuning their production parameters, while maintaining productivity (e.g. yield rate). The thickness of dye and reflectivity layers will determine how much recording power from a laser pick-up in a drive is required to burn a disc (to guarantee data will be precisely recorded without loss) and the longevity of data storage after recording. Thus, possessing the knowledge of materials (in particular, stampers and dye materials) and production equipment becomes very important. This also highlights the importance of the communication between media makers and drive makers over technical specification, so as to assure product compatibility.

Noticing the importance of stampers and dye materials, some major manufacturers have installed expensive mastering machines and developed their own dye materials (which are chemical compounds), although this required considerable R&D investments. Due to these companies' respective development of dye materials, the colours of their discs on the recording side slightly vary, reflecting the colours of dye materials (because the substrate is transparent). In addition to product compatibility which is closely related to the dye material, the colour on the recording side becomes anther selling point. For those companies with few technical resources, they rely on sourcing stampers and dye materials from other companies, including turnkey providers (such as a production equipment provider who bundle their sale of equipment with some know-how of media manufacturing). Because of the existence of turnkey providers, the barrier of entering into the optical recording media industry is lowered. These providers could offer basic manufacturing processes (including parameters on the production machines and procedures for the quality control) in light of what types of equipment installed and what materials used.

2.5 Competition and cooperation in the industry

The evolution of the optical recording media industry in the last 20 years exhibited quite dynamic characteristics, in which the industry was characterised not only by rapid technological changes but also by entry and exit of players (Kuo, 2006). Around the Millennium, the number of players reached a peak, mostly new entrants of Taiwanese media makers. Those new media makers forced many Japanese-based media vendors to give up their manufacturing of optical recording media and turn to focus more on marketing and R&D activities. Additionally, some entrants joined the industry as equipment and material suppliers; the latter included the suppliers of stampers, polycarbonate materials, dye materials, sputtering targets, printing inks and packaging materials. Then, a clearer division of labour gradually appeared in the industry. However, the subsequently intensified competition made a number of media makers exit from the industry mainly due to their failure to survive the price war and technological change. When coming to BD generation, few players were able to enter into the battlefield, as the result of huge capital requirement to install new BD production lines and high technical barrier to maintain these lines.

In the face of intensified competition, some companies sought for interfirm cooperation to acquire complementary resources while some started to pursue vertical integration or a combination of both. Interorganisational alliances even became crucial when format rivalry persisted, such as the competition between the DVD Forum and the DVD+RW Alliance. Consequently, the development of the optical recording media industry was marked by the emergence, restructuring and even the dissolution of interfirm groupings. Generally, in a value chain from upstream to downstream activities in the industry, high value-added activities (at the upper and down stream) were mostly controlled by Japanese-based firms, including standardisation, key materials, production equipment and media branding; while lower value-added activities (at the middle stream), e.g. media manufacturing, were mainly performed by firms based in Taiwan, China and Korea (Ogawa, 2005). A common way of grouping was based on OEM (Original Equipment Manufacturer) partnerships between Japanese-based media vendors and Taiwanese-based media makers, in which some vendors provided key materials (e.g. dye materials) and technical support to the latter while some makers were permitted to develop their own brand businesses (Shintaku *et al.*, 2006). As a result, the cooperation and competition between and within groupings co-existed.

Part II
Theoretical Elaboration

3 Business relationships and industrial networks

3.1 Introduction

No business is an island. (Håkansson and Snehota, 1989)

The purpose of this chapter is to provide the theoretical underpinnings, the IMP Group's Interaction and Network approach, in which this research is grounded. The core of the IMP approach lies in that each business actor is dependent on others' resources to perform productive activities so as to achieve economic goals. This approach comprises two models: the interaction model and ARA model, in which the former deals with the interaction process between two interacting parties while the latter emphasizes an actor's relatedness to others in a larger aggregation in terms of resources combined and activities carried out. Apart from the interaction model and ARA model, this chapter also introduces central concepts that are built on an interaction perspective and that are related to the interest of this research.

3. 2 The IMP's Interaction and Network approach

3.2.1 Interaction in a resource-dependent business environment

Business actors are heterogeneous by nature and resource-dependent (Håkansson and Snehota, 1989; Håkansson and Waluszewski, 2002a). An important aspect driving an actor to interact with others is that it has its own problems, needs, abilities, knowledge and limited resources. It is this interdependence that urges actors to form relationships. Just as Pfeffer and Salancik (1978, p. 40) indicate:

> In social systems and social interactions, interdependence exists whenever one actor does not entirely control all of the conditions necessary for the achievement of an action or for obtaining the outcome desired from the action.

Some problems that an actor has come from the environment it faces, such as the market uncertainty (Ford *et al.*, 1998). Particularly in technology-intensive industries, which are characterised by rapid technological changes (Mohr *et al.*, 2004), the extant evidence (e.g. Moore, 1991) suggests firms utilize interfirm relationships to minimize the application uncertainty and create market demands. The perspective of heterogeneity reveals that an actor not only controls limited resources but also possesses

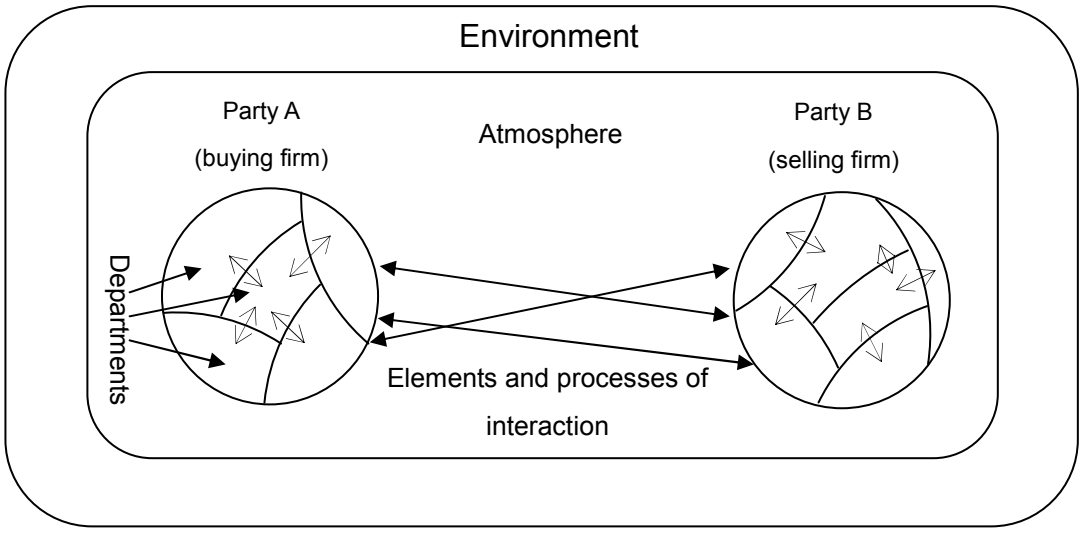
incomplete knowledge (Ritter and Ford, 2004). Another sense of interaction we can make from this is that interfirm relationships enable firms to gain complementary knowledge "through their own experiences or through the experiences of other organizations" (Håkansson *et al.*, 1999, p. 443). Thus, a firm's being engaged in a web of "interactive" relationships is to gain access to both tangible and intangible resources controlled by others, so as to solve problems, minimize uncertainties and enhance knowledge base through a form of collective learning (Johnston *et al.*, 2006). Due to the importance of business interaction, the IMP's interaction model and ARA model which lay the central theoretical foundations of this doctoral research are presented in the following sections.

3.2.2 The interaction model

The interaction model (or interaction approach) has gained growing interest and recognition from both researchers and managers since its first dissemination by the IMP Group (Håkansson, 1982). The approach is built on the theory of the new institutional economists, such as Williamson (1975) whose work revealed that relationships could be regarded as the governance structure which was determined by a dichotomy of a market and an organisational unit (a hierarchy). This approach, which regards a relationship as a vital means to understand the complexity and dynamics of business markets, has replaced the traditional transaction oriented approach (Hedaa and Ritter, 2005; Sheth, 1996; Turnbull *et al.*, 1996). It also acts as an underlying platform for us to look at the contemporary business environment more realistically and deeply than the classical marketing approach (known as "four Ps" or marketing mix) (Håkansson *et al.*, 2004).

The Interaction Approach views the marketing and purchasing of industrial goods as "an interaction process between two parties with a certain environment" (Håkansson, 1982, p. 15). The model comprises four main components: the participating parties in interaction, the interaction process, the relationship atmosphere and the environment, as shown in Figure 3.1.

Figure 3.1 The interaction model



Source: Håkansson (1982), p. 15

The Participating Parties – The content of a relationship hinges on what is involved in the interaction. This basically includes the individuals (e.g. a buyer and a salesman), the organisations they represent (e.g. a buying firm and a selling firm), and the characteristics of organisations (e.g. size, structure and experience). An organisation is the very vital element in business interaction. Without the participation of two parties, what each party possesses (e.g. physical resources or knowledge) cannot be exchanged. As indicated by Wilkinson and Young (1997) who use a "dance metaphor" to describe relationships in business markets, it always needs two to make interaction come into existence.

The Interaction Process – This process concerns the episodes which take place in an interactive relationship and may involve one or more of four types of exchange between two participating parties: they are 1) product or service exchange; 2) information exchange; 3) financial exchange and 4) social exchange. The involved actors will develop their own understanding and interpretations towards exchange episodes, which in turn may affect the direction of their relationship development and the atmosphere within the relationship (Ford, 1997; Ford and Håkansson, 2006).

The Relationship Atmosphere – The atmosphere mainly deals with five dimensions: power/dependence, trust/opportunism, closeness/distance, conflict/cooperation and expectations. Business relationships as well as the atmosphere within the relationships accrue through the interaction between parties over time (Holmlund and Törnroos, 1997). The atmosphere, in this sense, can be viewed as a product of interaction. But it is

also a factor that influences the interaction. For example, a high level of conflict in a working relationship (if it can be managed) could serve as a breeding ground for creativity (Gadde and Håkansson, 2001); but on the other hand, a close relationship may bring about a lock-in effect, preventing the actor from working with others (Håkansson and Snehota, 1998). These dimensions should not be treated in isolation, they are interconnected. As Welch and Wilkinson (2005) have found that the exercise of power is related to the conflict in relationships in a business network.

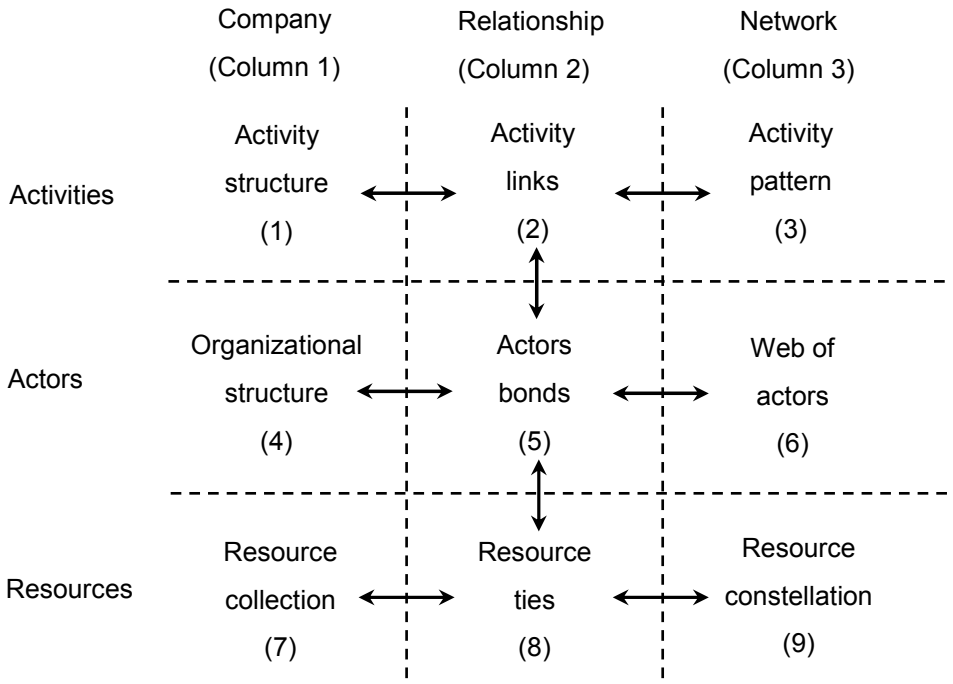
The Environment – The interaction between two participating parties is not only influenced by the relationship atmosphere but also by a wider context in which the relationship is embedded (see Figure 3.1), that is, the environment, which comprises five subsets: 1) market structure; 2) dynamism; 3) internationalisation; 4) position in the manufacturing channel and 5) the social system. When the market structure is brought into consideration, it is to understand the constituent members or players (both national and international) in the same market, attempting to gain a picture of co-opetitive stance (the co-existence of cooperation and competition) within it (Brandenburger and Nalebuff, 1998; Ritter *et al.*, 2004). Understanding the market structure also allows an actor to know it position in the manufacturing channel or production system (Johanson and Mattsson, 1997). In turn, the actor could improve its position by altering the relationship atmosphere (e.g. to increase commitment or wield power). However, this change could be constrained by the knowledge acquired from the interaction and the norms or regulations in the social system.

3.2.3 The ARA model

The interdependencies between actors are manifested by a network structure which consists of interconnected relationships where productive activities are carried out using resources controlled by these actors (Anderson *et al.*, 1994; Ritter, 2000; Uzzi, 1997). To study how interaction connects resources and activities across firm boundaries and to investigate the connectedness and embeddedness of relationships, the ARA model (or the network approach), as shown in Figure 3.2, acts as a fundamental platform. This model comprises three interrelated layers of variables: actors, activities and resources, which can be defined as:

> Actors are defined as those who perform activities and/or control resources. In activities actors use certain resources to change other resources in various ways. Resources are means used by actors when they perform activities. (Håkansson and Johanson, 1992, p. 28)

Figure 3.2 The ARA model



Source: Håkansson and Snehota (1995), p. 45

This heuristic ARA model, which is put forth by Håkansson and Snehota (1995), deals with the functions of business relationships and the interplay between actor bonds, resource ties and activity links. Business relationships have functions for individual companies, dyads and third parties. With the development of relationships, mutually committed bonds between actors arise, serving as important channels for the "learning" and "teaching" of counterparts about opportunities and solutions (Ford *et al.*, 2010). Through relational linkages a single resource can be combined with other resources as a "resource collection" within a company or as a "resource constellation" in a business network. Combination of resources can also be carried out with a specific counterpart in a business relationship. In addition, the layer of activities illustrates that each individual actor's activity structure links to structures of others in a way of coordination and integration to form activity patterns in networks. The consequence of the interplay between these three layers of variables brings about the complexity of business interaction, as Ford *et al.* (2010, p. 89) point out:

> Activity links may limit or facilitate resource adaptations; resource ties may limit or favor the possibility of activity co-ordination and actor bonds may open up the possibility of developing activity links and resource ties.

The ARA model emphasizes interaction between interdependent organisations over time (Håkansson and Snehota, 1995; Mattsson, 1985). An actor's cooperation with others in a network can be related to what resources are used or combined through what transformation and transfer activities performed by these actors (Håkansson and Johanson, 1992). The appearance of a network that is structured by these three classes of variables implies that the elements of each dyad's relationship atmosphere (e.g. power, dependence, knowledge and experience) are being connected, generating positive and negative influences (Håkansson and Ford, 2002). This interconnected nature reveals that one relationship can "hinder, weaken, strengthen or enforce another relationship" (Ritter, 2000, p. 321) and interaction itself is also the source of network dynamics.

The above discussion shows that relationship acts as a key unit of analysis in network research. It not only connects the activities and resources at an aggregate level, working as a quasi-organisation, but also links the influences of actors' acting and reacting together. It can also be interpreted that an actor can adjust the relational structure of this quasi-organisation to enhance its performance (Håkansson and Snehota, 1989; Baraldi *et al.*, 2007). Network dynamics are thus the results of the interplay between actor bonds, resource ties and activity links. Prior to ending this chapter with a discussion about management of interfirm relationships in a network, the following sections will cover some key concepts which are built on an interaction perspective and which are related to network dynamics.

3. 3 Central concepts built on an interaction perspective

3.3.1 Connectedness and embeddedness

As an actor is engaged in a web of exchange relationships, this relational structure in which it is involved is viewed as a network and is characterised by connectedness and embeddedness (Anderson *et al.*, 1994; Håkansson and Snehota, 1989; Mattsson, 1997; Halinen and Törnroos, 1998). These two characteristics are vital concepts of understanding and analysing network dynamics. They are also closely related to a firm's technical development, business marketing and business strategy (Blankenburg and Johanson, 1992).

The network approach considers business networks as "sets of connected business relationships rather than as sets of connected firms" (Anderson *et al.*, 1994, p. 13). Cook

and Emerson (1978) view the social exchange structure as "network connections" and defined it as:

> Two exchange relations are connected to the degree that exchange in one relation is contingent upon exchange (or nonexchange) in the other relation. (1) The connection is positive if exchange in one is contingent upon exchange in the other. (2) The connection is negative if exchange in one is contingent upon nonexchange in the other. (p. 725)

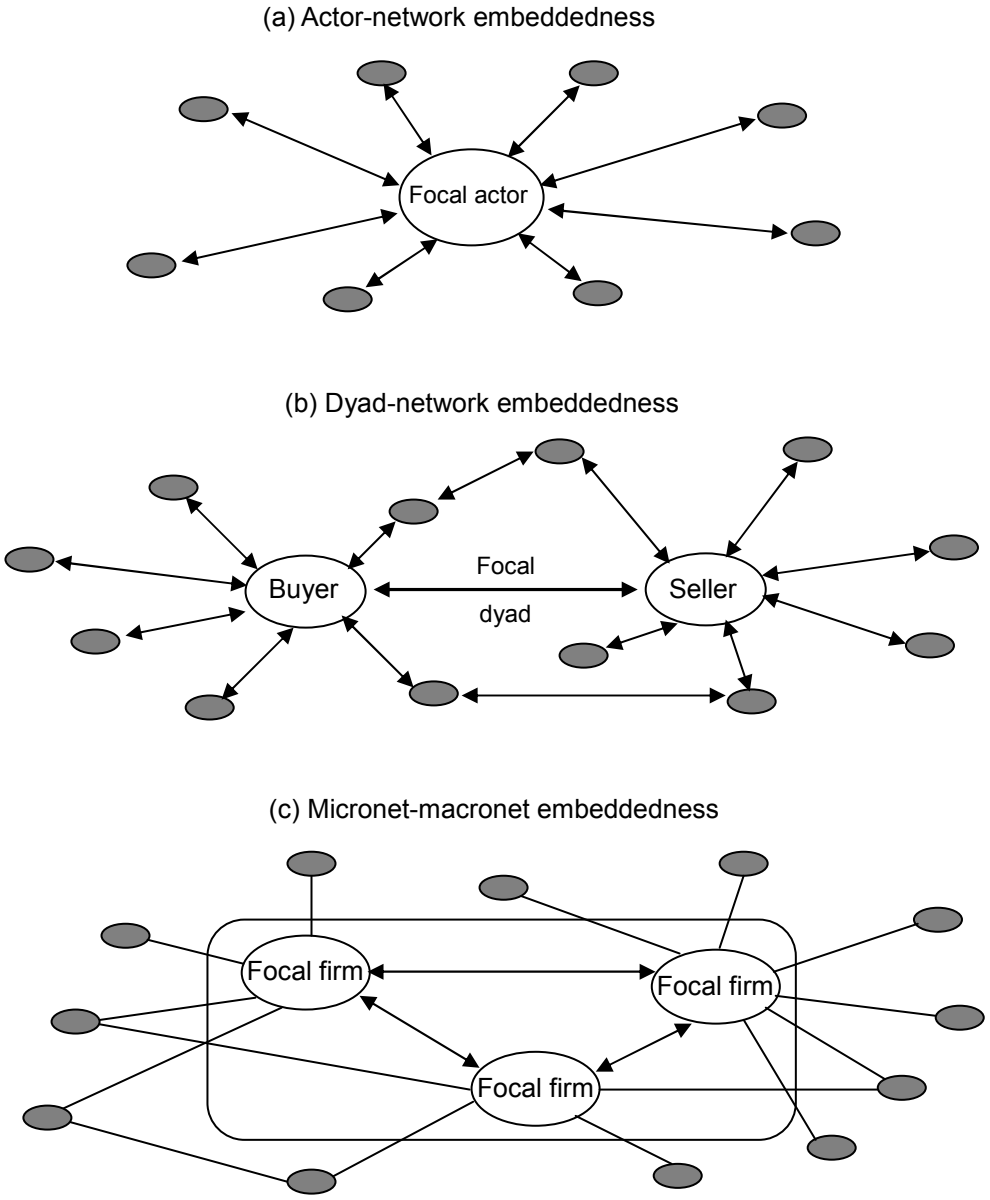
Anderson, Håkansson and Johanson (1994) make a distinction between primary and secondary functions of relationships. By primary functions they mean "the positive and negative effects on the two partner firms of their interaction in a focal dyadic relationship" (p. 3). The secondary functions concern indirect effects of a relationship on connected parties. A consideration of connectedness of relationships enables a firm to look at its network environment from a more accurate angle especially when it is about to initiate a strategic move (e.g. mergers and acquisition) or to counteract to changes initiated by other connected parties (Anderson *et al.*, 2001; Halinen *et al.*, 1999; Ritter, 2000).

Another facet to understand the change and development in business networks is to study embeddedness of relationships. Based on the work by Halinen and Törnroos (1998), the concept of embeddedness refers to "companies' relations with, and dependence on, various types of network" (p. 189). They argue that embeddedness could be investigated, at least, from three different angles: the actor-network, the dyad-network and micronet-macronet, as shown in Figure 3.3. The actor-network perspective focuses on using a single company's point of view to delineate the networks it is involved. The dyad-network perspective stresses the importance of dyadic relationships as transmitters and transformers of network change while the micronet-macronet perspective views using triads as a vital means to examine the mechanisms of changes in networks.

Halinen and Törnroos (1998) also point out several types of embeddedness that characterises a business network, including temporal, technological spatial, social political and market embeddedness. With regard to temporal embeddedness, they contend that "companies are bound to past, present and future modes of time" (p. 195). Particularly in technology-intensive industries, the importance of the time influence in the technical development has been accentuated. As Håkansson and Lundgren (1997) argue, "[…] the relationships cannot escape from the pattern created by their own development. There is a path dependence in the development of relationships and networks" (p. 122). In addition, the technological embeddedness is another crucial

aspect of studying how the division of labour in a technology-based network is defined. This concept helps researchers to investigate how a firm's technology is combined with others in order to satisfy the demands from markets (Ford *et al.*, 1998; Moore, 1991).

Figure 3.3 Three perspectives on network embeddedness



Source: Halinen and Törnroos (1998), p. 192

3.3.2 Position, role and power

Industrial buyers and sellers are immersed in a network of interconnected relationships in which each actor occupies an incompatible and unique position (Johanson and Mattsson, 1992). Network position is at the heart of the network research. It epitomizes a firm's bargaining position, organisational power and strategic identity in the network, and thus, concerns the firm's performance (Håkansson and Snehota, 1989). The concept of network position is inseparable from role and power since "[…] there are no positions without roles and no roles without positions" (Anderson *et al.*, 1998, p. 171) and a position is "a location of power to create and/or influence networks" (Thorelli, 1986, p. 40).

Entrenched relationships in the network demonstrate that each involved member occupies a position relative to its counterparts. The definition of network position, in this sense, can be divided into four aspects: 1) the function performed by the firm for the other firm; 2) the relative importance of the firm in the network; 3) the strength of the relationships with other firms and 4) the identity of the firms with which the firm has direct relationships (Mattsson, 1987). Based on this relative concept, Johanson and Mattsson (1992) further distinguish between *micro-positions* and *macro-positions*. The former refers to an actor's relationships with individual organisations while the latter takes into account the roles performed by the actor and its counterparts in a value-creating system, that is, relations to a network as a whole.

Network positions are socially and historically constructed (Håkansson and Snehota, 1995). Time, dependence, trust and commitments are necessary ingredients to nurture and maintain business relationships as well as network positions (Blois, 1997; Holmlund and Törnroos, 1997). A firm's continuous investments in its position by adapting to counterparts through interactive relationships reveal not only the intention to design its portfolio of relationships but also the desire to create a stable network, attempting to exploit the collective resources and pursue economic goals. Network position thus can be viewed as a stable dimension of network development and such a relatively stable network can be then described as follows,

> The existing network structure and the positions occupied by these actors in the network are therefore a result of mutual cooperation and adaptation aimed at finding a "solution" to these combinations. In this context, the structure of the network and the positions in the network exhibit a remarkable degree of stability and continuity. (Low, 1997, p. 190)

According to Anderson *et al.* (1998), it is difficult to examine the network dynamics

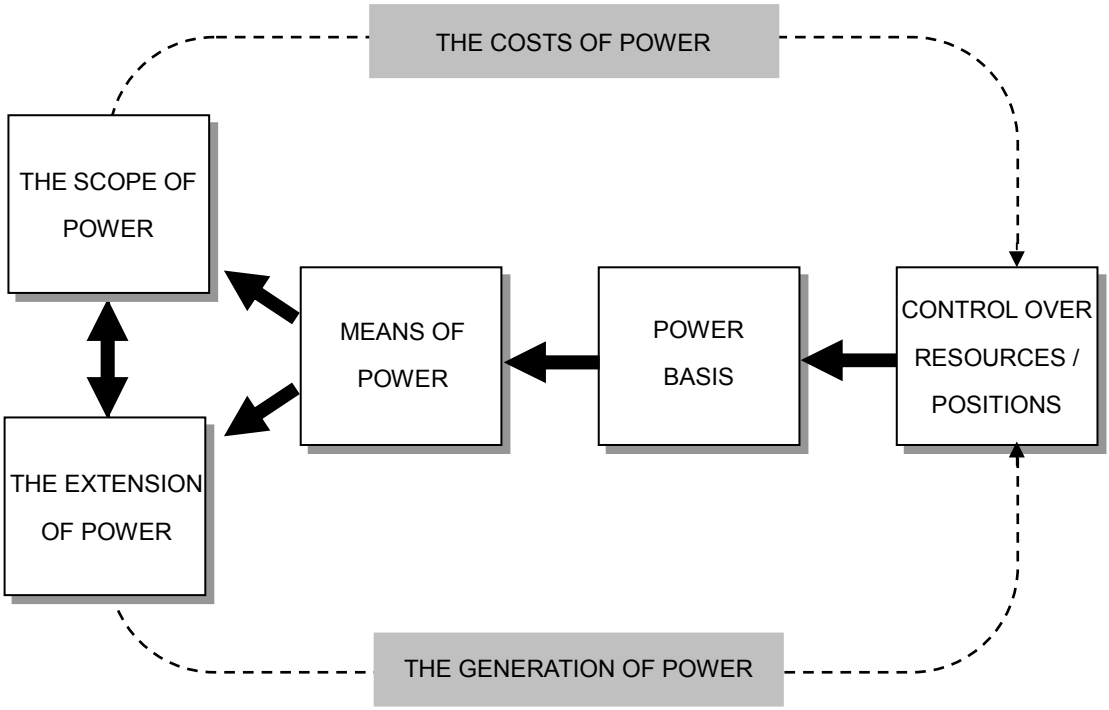
without relating the position concept to the role aspect. They argue that the role, acting on a change-process dimension, is an actor's intended and created behaviour which is expected by its counterparts. Since the role concept involves "function, adaptation, process", an actor is said "to occupy or have a position, but to perform the role or roles that come with the position" (Anderson *et al.*, 1998, p. 170). The roles performed by actors based on established resource ties and activity links in an aggregated structure not only contain the adaptive and learning nature but also reflect the industry logic, that is, the network structure as organisational form (Johanson and Mattsson, 1992). Actors' roles in the division of labour of a production system thus become strategically important. Andersen (2008) contends that a firm could achieve positional advantages and gain competitiveness by adjusting or changing its role sets in relation to others. Thus, a general notion of a firm's strategic actions can be made by the network approach as "efforts by actors to influence (change or preserve) their positions(s) in network(s)" (Johanson and Mattsson, 1992, p. 214).

When the dynamic aspect of network position is considered, an underlying issue is why a firm is able to defend or change its position, such as strengthening existing relationships, building a new relational tie or terminating an old one. The issue lies in the "power" a position is equipped with. According to Emerson (1962) it is the relational structure of interdependence among actors that an individual actor has a certain degree of power to influence the actions of others. The more dependent an actor is on the other, the more power the latter has. Drawing on Dahl's (1957) concept of power, Kutschker (1985, p. 396) stresses: "A has power over B to the extent that he can get B to do something that B would not do otherwise." Nevertheless, without interaction an actor's power is illusory. Only by relating its resources and activities to others, a firm's power is said to be exercised in a form of mutual dependence, as emphasized in the interaction approach (Håkansson, 1982). And network position, much like power itself, is inherently a relational, relativistic concept (Thorelli, 1986).

Built on the work by Kutschker (1985), Axelsson (1992a) puts forward a conceptual framework that takes into account the impact of power within a network on corporate strategy, see Figure 3.4. He views the scope of power as sets of activities which a company can get another company to perform while the extension of power is the number of companies that a firm can influence. Both scope and extension of power are derived from a firm's control over resources (e.g. technical or financial), its power base (e.g. reward, coercion or legitimacy) and the means it uses to exercise power (e.g. sales, promotion or threats). With empirical findings from the UK National Health Service (NHS), Zolkiewski (1999) points out that an actor's positional power can be further distinguished between three levels: micro (inter-personal) level, meso (relationship)

level and macro (network) level. She finds that the complexity of power in a network is a result of intertwined direct and indirect influences travelling through interconnected linkages; which in turn, alter scope and extension of power of an actor.

Figure 3.4 Inter-organisational power in a network context



Source: Adapted from Axelsson (1992a), p. 190

3.3.3 Five important issues in business interaction

No single business organisation can evade interacting with others; interaction itself is an enabling factor but also a constraining factor of a company's development of interfirm relationships which is closely related to its long-term sustainability (Håkansson and Snehota, 1989). In the face of a heterogeneous environment where actors differ in resources, problems, aims and the ways of interaction, it is crucial to examine the essential issues pertaining to business interaction in a network context. As Ford and Håkansson (2006) indicate, these issues include time, interdependence, jointness, relativity and subjective interpretation.

Time – Time has been regarded as one of the most important dimensions in the study of social interaction evolution (Halinen, 1998; Halinen and Törnroos, 1995; Pettigrew, 1995). It is difficult to use the concept of time to delimit business interaction because it has "no easily identifiable beginning or end" (Ford and Håkansson, 2006, p. 7). Nevertheless, researchers still can describe the interaction process by studying the interrelationship between interaction episodes, including significant events or critical incidents, along a time line. In this way, we are able to identify something different or new from its previous state in the development of a business network, e.g. the evolution of technology-based networks (Lundgren, 1995).

Interdependence – Business organisations have to be involved in interfirm interaction because they are not self-contained or self-sufficient (Pfeffer and Salancik, 1978). Firms rely on transforming the aggregated resources into valuable assets (e.g. capability, knowledge, physical product or service) which are important to its resolution of problems as well as economic success. Interdependence implies that a firm is in an atmosphere of trying to influence, but simultaneously, being influenced by counterparts (Håkansson, 1982). In such an interactive and interconnected environment, one of the most challenging tasks for managers is how to access and use resources to achieve immediate goals, and at the same time, protect and develop these resources for future use (Wilkinson, 2006).

Jointness – Once a firm is engaged in interaction, it has no absolute freedom to develop its individual activities; that is, these activities need to be aligned with the counterparts. Thus, the jointness, or mutuality, "reduces the importance of an actor's own intensions and increases the importance of the combined intentions of interacting parties in relation to others" (Ford and Håkansson, 2006, p. 13). In order to exploit the aggregated resources and pursue effectiveness and efficiency, firms involved will attempt to adapt to each other in the process of ongoing exchange; and this process is also viewed as a

mutual investment process (Blois, 1997; Brennan and Turnbull, 1999; Halinen, 1997; Hallén *et al.*, 1991).

Relativity – Relativity is another obvious characteristic of business interaction that comprises interdependence and the time influence. First of all, relativity is derived from the heterogeneity in the interaction. A firm's position in a network is defined by its relationships in which the resources it uses and activities it performs can be related to other involved parties. In other words, the aspect of relativity emphasizes a party's domain which is complementary to others in a wider environment. The domain of an organisation can be distinguished from others in terms of product (or service) offered, clientele served or functions performed (Thorelli, 1986). Secondly, the concept of relativity reveals the dynamic aspect of interaction when time is taken into account. A firm may change its network position or alter the content of its domain based on its own interpretation of past interaction, the subjective interpretation, so as to enhance its performance or adapt to the changing conditions.

Subjective interpretation – An actor's actions, re-actions and re-reactions are the consequences of its interpretations of surroundings, including previous interaction experience. Such an interpretation is subjective; there will be "multiple and different interpretations within the same company and between different actors in the wider network" (Ford and Håkansson, 2006, p. 15). This subject interpretation is analogous to *network horizons and network pictures*. Given that the network horizon of a firm is defined as "how extended an actor's view of the network is" (Anderson *et al.*, 1994, p. 4), Holmen and Pedersen (2003) distinguish network horizon from network context and network environment by arguing that a firm's network context is part of network horizon which the firm considers relevant and that what is beyond the network horizon can be viewed as the firm's network environment. According to Henneberg and his colleagues (2006), network pictures are defined as "the mental representations of network properties […] can be interpreted as a sign of what specific managers feel is important about the environment in which their company is operating" (p. 413). An actor can develop its relationship strategy in light of its network picture.

3. 4 Managing business relationships in industrial networks

3.4.1 Levels of relationships and network management

Ample evidence has shown that no firm can operate without developing interactive relationships with other organisations (Araujo and Easton, 1996; Håkansson *et al.*, 2004b; Hedaa and Ritter, 2005; Mattsson, 1997; Sheth and Sharma, 1997). Although each company has its own picture of the interactive environment which may be different from its counterparts' (Ford and Håkansson, 2006; Henneberg *et al.*, 2006), there are fundamental elements that can relate one company to another; these include each actor's unique network position and their interaction in terms of actor bonds, resource ties and activity links (Håkansson and Johanson, 1992; Håkansson and Snehota, 1995). In this thread, therefore, a firm's relationships and network management can be distinguished between four levels (Möller and Halinen, 1999; Ritter and Gemünden, 2003a; Ritter et al., 2004): the interaction (the episode), the individual dyad, the net of an actor and the network (or industries).

The first level of management: the interaction (the episode)

The interaction process is pieced together by individual episodes, such as product, service or information exchange (Håkansson, 1982). However, the analysis of each episode needs to take into account the influence of the past and expected future. For example, a buyer's cancellation of a purchase order may result from the seller's previous performance (e.g. unstable product quality); or a buyer's increase in shipping quantity may reflect a strong demand from the buyer's customers (e.g. retailers). Thus, the episode is a key component of interaction but cannot be analysed in isolation.

The second level of management: the individual dyad

The attention of this level of management is focused on individual relationships between two actors over time. It mainly concerns the management of micropositions in networks (Mattsson, 1987). However, since relationships are interconnected forming networks (Anderson et al., 1994), it is pivotal to consider the management within and between relationships. Moreover, the value of a relationship and the cost to serve that relationship (e.g. a customer relationship) will change over time (Turnbull and Zolkiewski, 1997; Zolkiewski and Turnbull, 2002). How a company manages its relationship portfolio by allocating its internal resources becomes a critical issue. Overall, this level of management emphasizes a firm's capability of building, enhancing or even dissolving a relationship to more efficiently manage episodes within the relationship and to more profitably manage relationship portfolio.

The third level of management: the net of an actor

The third level of management stresses a firm's relation to its environment in which the firm occupies a unique position and plays role(s) performing activities valued by counterparts (Johanson and Mattsson, 1992). In other words, the firm is embedded in a value-creating business net or system, the subset of network (Hertz, 1992). In this sense, a firm's performance will not only be influenced by its direct relationships but also by indirect relationships embedded in the same system. A crucial aspect of management at this level is how a firm defends its position by strengthening its portfolios of relationships (e.g. customer and supplier relationships) or how a firm changes its position to enter a new business net by mobilizing its network resources (Ford *et al.*, 1996; Lundgren, 1992).

The fourth level of management: the network (or industries)

The industries, the markets-as-networks (Mattsson, 1997), are the broadest and the most complicated level of management. The complicatedness results from networks' evolving natures and their configuration. A firm may participate in one or more nets (or systems) embedded in networks, facing the issues of cooperation and competition within and between nets simultaneously (Bengtsson and Kock, 2000; Brandenburger and Nalebuff, 1998). Instead of taking the individual firm as point of departure, this level of management emphasizes the analysis of the whole network and the development of valid view of relevant networks.

3.4.2 Relationship development

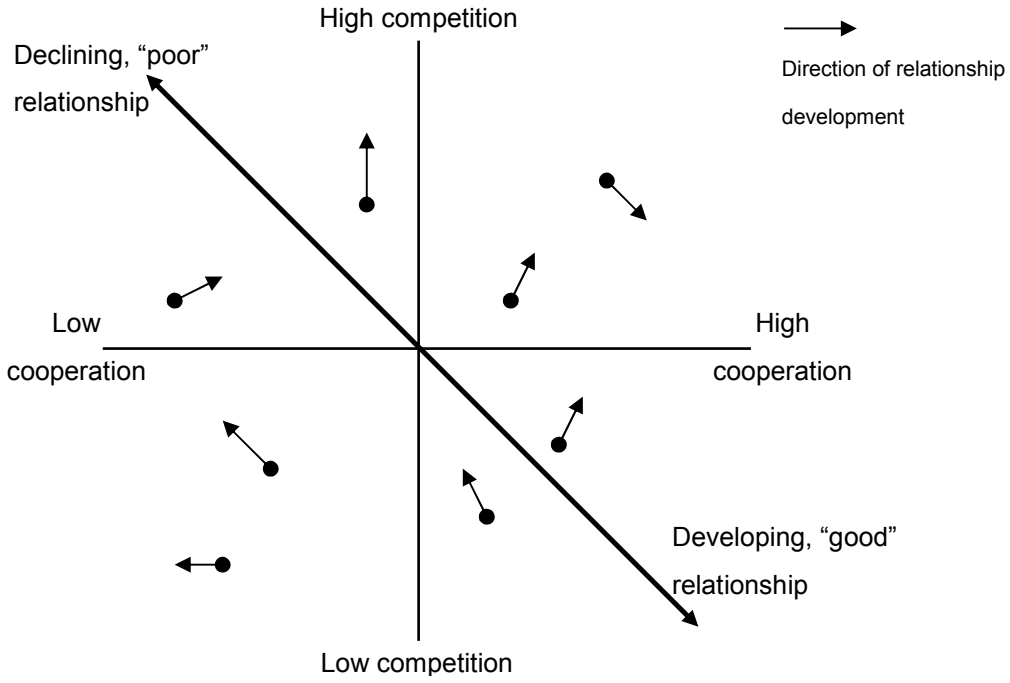
A number of studies have suggested that business relationships should be considered as ongoing exchange processes which consist of a series of episodes (Dwyer *et al.*, 1987; Håkansson, 1982; Wilson, 1995; Turnbull and Valla, 1986). Firms, embedded in a relational structure of interdependence, can achieve greater value in a continuous interaction process in which each party involved is able to develop complementary capabilities and become competitive through increasing commitments and coordination between parties (Holm et al., 1999). Thus, business relationships are also viewed as one of the important network resources (Håkansson and Waluszewski, 2002a); and they can be the sources of competitiveness (Baraldi *et al.*, 2007; Håkansson and Snehota, 1989).

Business relationships are not static, they evolve over time. With regard to relationship development, both Dwyer *et al.* (1987) and Ford (1980) propose life cycle models in which the former agues that relationships may evolve though an awareness phase, exploration phase, expansion phase, commitment phase and dissolution phase while the

latter suggests that the relationship development can be divided into five stages: pre-relationship stage, early stage, development stage, long-term stage and final stage. However, this development is not deterministic, implying that a relationship may not exactly follow the order of the stages or reach certain phases at all. The heuristic meaning of such a life cycle model lies in how a firm can obtain the best possible value from the careful management of relationship development (Ritter and Gemünden, 2003; Turnbull *et al.*, 1996).

One of the most challenging tasks in relationship development is to achieve a balance between the cooperativeness and competitiveness that co-exist in relationships. Using the dancing metaphor, an attempt to contest the marriage metaphor (e.g. Dwyer *et al.*, 1987), Wilkinson and Young (1997) accentuate the process view of relationships and the role of cooperation. They argue that the development of a relationship can be delineated in terms of cooperative and competitive characteristics, as shown in Figure 3.5. Based on the level of cooperation and competition, an interfirm relationship can be mainly classified into one of four types (quadrants). For a relationship to become a "good" relationship which is characterised as low competition – high cooperation, the parties have to dance in a coordinated way.

Figure 3.5 Types of interfirm relationship development



Source: Wilkinson and Young (1997), p. 90

A number of studies, e.g. Håkansson and Snehota (1995) and Mattsson (1997), have demonstrated that business organisations have to rely on a variety of relationships to achieve economic goals. Another critical issue of relationship development here is: Are all relationships of a firm worthy of maintaining? This issue is addressed by the concept of relationship portfolios advocated by Turnbull and Zolkiewski (1997) and Zolkiewski and Turnbull (2002). Their findings can be concluded by three interlinked aspects. First, there are variations in values of similar relationships of a firm (e.g. customer relationships) and the variations can be calculated using variables of *cost to serve*, *net price* and *relationship value*. Second, relationship portfolios involve "choice", the selection of profitable customers (or suppliers); that is, relationship termination, if necessary, can be a choice. Third, the portfolio analysis enables a company to identify key relationships and allocate its resources accordingly.

3.4.3 Relationship ending and reactivation

Terminating, ending or exiting a relationship has been argued to be a strategic option (Möller and Halinen, 1999; Tikkanen and Halinen, 2003; Törnroos, 2004). In recent years there has been a growing interest in the research of this so-called "dark" or "dysfunctional" side of relationships (Anderson and Jap, 2005; Morgan and Hunt, 1994; Tähtinen and Halinen, 2002). According to Anderson and Jap (2005), the dark-side phenomenon that endanger or undermine relational continuations may accrue from close relationships rather than dysfunctional relationships. In a similar vein, Håkansson and Snehota (1998) contend that a good relationship at a certain point in time could become a burden through the development within the relationship and through the development of other relationships. They identify five different quandaries that can bring about a relational burden, including: unruliness (the loss of control), undeterminedness (the uncertain bet), energy (resource demanding), exclusiveness (the preclusion of others) and stickiness (unpredictable requests). Despite its dark-side or burden, relationship ending or dissolution need not necessarily be negative (Alajoutsijärvi *et al.*, 2000); it could be an important means of gaining competitive advantage (Ritter and Gemünden, 2003; Zolkiewski and Turnbull, 2002).

Despite increasing awareness of its importance, relationship ending remains under-examined, particularly its impact upon the wider network when multiple relationships are involved (Harrison, 2001). As Tähtinen and Halinen (2002) point out, the existing research in this area is still diverse in terms of disciplinary background (e.g. a services marketing approach or marketing channels approach) and terminology used (e.g. switching, ending, exit or dissolution). The attention of these studies is mainly

focused on factors affecting relationship ending (e.g. Ping, 1995; Stewart, 1998) and the ending process; in which the model of relationship ending process developed by Halinen and Tähtinen (2002) and Tähtinen and Halinen-Kaila (1997) can be see as the seminal work. Moreover, based on Hirschman's (1970) typology of voice, exit and loyalty, some researchers propose a number of communication (or intervening) strategies that could achieve different consequences of relationship ending (e.g. Alajoutsijärvi *et al.*, 2000; Hibbard *et al.*, 2001). A summary of important studies relevant to relationship ending is presented as Table 3.1.

Table 3.1 The studies dealing with relationship ending

Categorization	Studies
Research approach	Tähtinen and Halinen (2002) identify four research traditions on business relationship ending: business marketing approach, services marketing approach, marketing channels approach, and advertising industry approach
Terminology	A number of terms are used to describe relationship ending: dissolution, termination, exit, switching behaviour, divorce, ending, failure and fading relationship (Tähtinen and Halinen, 2002).
Antecedents	Factors affecting relationship ending include: satisfaction (Ping, 1993, 1995, 1997, 1999), availability of alternatives (Ping, 1993; Stewart, 1998), switching cost (Ping, 1993; Stewart, 1998; Ping, 1997), quality decline (Stewart, 1998), profitability (Ping, 1995; Tuusjärvi and Blois, 2004) and organisational learning capability (Grønhaug *et al.*, 1999)
Ending process	The model of relationship ending process proposed by Halinen and Tähtinen (2002) comprises the following stages: assessment stage, decision-making stage, dyadic communication stage, relationship restoration (depending on dyadic communication), disengagement stage, network communication stage and aftermath stage.
Relationship restoration	The work by Stewart's (1998) has indicated the possibility of relationship recovery. Tähtinen and Vaaland (2006) argue that an analysis of attenuating factors could prevent the relationship from ending. These factors are lost relational investments, dissolution process costs, possible sanctions for future business, network limitation and set-up costs.
Quality of ending a relationship	The exercise of proper termination strategies can achieve a satisfactory result (Giller and Matear, 2001) or a beautiful exit, leaving a good image in the network (Alajoutsijärvi *et al.*, 2000) or save the face of disengaged party (Pressey and Qiu, 2007).

The stage model of relationship ending proposed by Halinen and Tähtinen (2002) shows that the ending process initially takes place at the intra-company level, in which the future of the dissatisfactory relationship is discussed and assessed. When an exit strategy is formed, the ending process moves to the dyadic stage; and unless restoring actions are taken, the process is likely to enter the disengagement stage, which is followed by the network communication stage, getting third parties involved in the ending process. Halinen and Tähtinen (2002) point out that the reasons which result in relationship ending can be divided into predisposing factors (e.g. corporate culture) and precipitating events (e.g. conflicting goals). They also emphasize that it is the response of partners that determines whether the relationships continue to move towards dissolution. In the aftermath stage where business activities are ceased, the parties involved create a post-hoc account of relationship ending and disseminate it to the network.

It needs to be heeded that the ending process may be interrupted due to successful recovery strategies (Halinen and Tähtinen, 2002; Harrison, 2001). In their recent work, Tähtinen and Vaaland (2006) provide a practical framework for restoring a business relationship based on the attenuating factors. By identifying and analysing attenuating factors they suggest that the value of a troubled relationship can be clarified and thus this relationship can be saved from dissolution. The attenuating factors are categorized into five groups: 1) lost relational investments (e.g. lost value from technological or knowledge bonds); 2) dissolution process costs (e.g. legal battles); 3) possible sanctions for future business (e.g. lost reputation in the network); 4) network limitation (e.g. inability to replace a partner due to lack of alternative partners); and 5) set-up costs (e.g. search costs of finding a new partner).

Existing evidence has shown that it is possible for an ended business relationship to be reactivated. Håkansson and Snehota (1998) have indicated that continuous business interaction would produce a “relationship burden” that may imperil a relationship. On the other hand, Havila and Wilkinson (2002) argue that the interaction between two actors via a relational linkage would produce “relationship energy” that could make an ended relationship reinstatable. Based on the work by Havila and Wilkinson (2002), interaction will result in a certain level of energy or sediments that can be conserved in some forms, e.g. personal bonds. They also note that relationship energy can be transformed or transferred to other relationships but cannot be destroyed. That is, relationship energy may lead an ended relationship to a dormant or sleeping state (Giller and Matear, 2001), leaving the chance for the relationship to be reactivated some time in the future. However, up to now, our knowledge of why and how an ended relationship

can be reactivated is quite limited.

The establishment of a new relationship as well as relationship ending and relationship reactivation, which are viewed as radical changes of relationships, will result in changes to the network dynamics where resources are mobilised and reconfigured (Halinen *et al.*, 1999; Möller and Halinen, 1999). Therefore, these radical changes of relationships are strategically important and they can be planned strategies (Ritter *et al.*, 2004; Tikkanen and Halinen, 2003). In the following chapter, a literature review of the IMP's perspective on network dynamics and its relationship with actors' strategising in networks is provided.

4 Network dynamics: A permeation of strategic influences

4.1 Introduction

[S]trategic actions are efforts by actors to influence (change or preserve) their position(s) in network(s).
(Johanson and Mattsson, 1992, p. 214)

This chapter aims to examine the forces of stability and change which can be understood in terms of adaptation, mobilisation and integration between actors and which are initiated by individual actors' intentions to enhance their performance (their strategising), and to discuss how a business actor can cope with network dynamics which arise from the interplay of these forces. Business networks consist of actors (nodes) and relationships (threads) in which resources are created, used and combined through transfer and transformation of activities (Håkansson and Snehota, 1995). Within each individual relationship, episodes (e.g. product or information exchange) have to take place so as to continue the relationship. Each episode taking place mirrors the actor's action or reaction to its counterpart based on its interpretation of the past and the present state and the expectation for the future (Ford and Håkansson, 2006). This judgment is also affected by other relationships of the actor due to the characteristic of connectedness. In this sense actors are engaged in a paradoxical environment of influencing and being influenced. And, interaction within and between relationships contains strategic significance; and interaction itself is the source of network dynamics, such as the establishment of a new relationship, the dissolution of an old tie or such changes in indirectly connected relationships.

4. 2 Stability and change in business networks

4.2.1 The interplay between stability and change

An underlying question concerning network dynamics is why changes take place in interfirm relationships that constitute business networks. As Håkansson and Henders (1995) point out, changes (e.g. improvements of routines and procedures) are derived from long-term oriented interaction between actors, which are profit-seeking and whose resources and activities are linked to others in a wider context. Gadde and Håkansson (1992) also indicate that a change is initiated by an organisation to act (or react) to the changing conditions generated from its interface with the environment, the network structure. This structure is influenced by exogenous factors (at the whole system level,

e.g. general economic conditions) as well as endogenous factors (at the company level) in which relationships function as transmitters and transformers of change (Håkansson and Snehota, 1995; Halinen *et al.*, 1999; Knoben et al., 2006; Halinen and Törnroos, 1998). Furthermore, an actor's changing activities are its purposeful actions based on its interpretation of the environment in a continuous process of improving operational efficiency and pursuing competitiveness (Easton, 1992; Ford and Håkansson, 2006).

A business network usually remains stable but not static, and the configuration of such a network is never optimal although actors are striving to enhance effectiveness and efficiency (Easton, 1992; Håkansson and Waluszewski, 2002a; Johanson and Mattsson, 1992). Gadde and Mattsson (1987) suggest that the research into stability in a network, which consists of interfirm relationships, needs to take into account other dimensions, such as network position change. Easton (1992), in a similar vein, contends that "[e]volution is the main mode; revolution is possible but unusual […] Stability also provides a platform for change" (p. 24). Networks dynamics are thus the consequences of the interplay between stability and change. As a result, network dynamics can be revealed when a comparison of actors' network positions between two different time periods is made with a consideration of a stable and a change dimension (Anderson et al., 1998), such as drifting closer or drifting away between business nets (Hertz, 1996) or identifying something new in the technological development (Håkansson and Lundgren, 1995).

4.2.2 Forces affecting the network evolution

Change is a central feature in network evolution and it cannot be investigated in isolation from stability (Easton, 1992; Anderson *et al.*, 1998). Changes in networks can be seen as business actors' efforts to improve their positions, reflecting their learning and heterogeneous natures of maximising the value of their resources (Håkansson and Snehota, 1995; Johnston *et al.*, 2006). Change, in this sense, can only be better understood in a continuous process. This process is driven by power and self-interest (Easton, 1992), containing actors' own theories or pictures of attaining economic goals (Ford and Håkansson, 2006; Henneberg *et al.*, 2006). Thus, the network evolution can be described as what Pittaway *et al.* (2004, p. 147) note:

> All types of network configuration constantly change and adapt, depending on the requirements of partners and the context within which the network operates.

Forces affecting the network evolution can be categorized mainly as stabilizing forces

and changing forces in which the former are also conceptualized as incremental changes that are created to maintain the established structure while the latter are seen as radical changes that transform the existing structure by dissolving an old relationship or introducing a new relational tie (Halinen *et al.*, 1999). Similarly, Easton and Lundgren (1992) put forward network working (or adaptation) and network change (or restructuring) in which the former refers to changes within existing relationships while the latter involves the formation of new relationships.

Håkansson and Henders (1995), on the other hand, argue that network dynamics arise from "the interaction of actors using certain resources to perform specific industrial activities that initiate change activities in their own self-interest" (p. 142). They contend that there are dependencies between different changes which can be described in terms of actor, resource and activity dimensions and where change in one dimension instigates changes in other dimensions. Using the concept of vector to indicate the direction and strength of change forces, they distinguish three types of change vector: structuring vs. heterogenizing; hierarchization vs. extrication; and specialization vs. generalization, as shown in Table 4.1. They also emphasize that there are "new actor/resource/activity vectors "intersecting" the existing trajectory at all times" (p. 146). And, the evolution or revolution of business networks depends on the direction and relative strength of these colliding vectors.

Table 4.1 Change vectors

Basic Factor	Change Variable	Definition
Activities	Structuring	Attempt to perform old activity better
	Heterogenizing	New ways of combining activities and resources
Resources	Hierarchization	Consolidating access to the resources needed to execute activities
	Extrication	Relinquishing control of some resources
Actors	Specialization	Focusing more narrowly on executing a specific activity
	Generalization	Developing flexible competency

Source: Håkansson and Henders (1995), p. 143

The concept of friction developed by Håkansson and Waluszewski (2002a) provides another lens to probe into change forces in business networks. An actor's performance relies on developing a variety of interfaces with which resources are combined and recombined (Araujo *et al.*, 1999; Gadde and Håkansson, 2008). Once established, these interfaces are embedded in a network structure, and at the same time, exposed to tensions. According to Håkansson and Waluszewski (2002a), friction is activated through interaction; that is, the actors' attempts to move or change embedded resources.

Friction is incurred by resistance between two surfaces; in which the concept of friction can be applied to the metaphorical description of changes in resource interfaces. The movability between interfaces is determined by the heaviness and variety of resources in which the former refers to the importance of a resource to other resources while the latter is dependent on the resource constellation. Therefore, within a heavy structure, there is a strong need for stability and the degree of friction encountered by involved actors becomes greater.

4.2.3 Spread of change influences

The configuration of a business network is constantly changing mainly because actors are trying to manoeuvre their relationships in terms of resource combined and activity performed to improve their positions (Johanson and Mattsson, 1992; Pittaway *et al.*, 2004). Due to the characteristic of interconnectedness, the impact of a change action initiated by a party on other connected relationships hinges on how the change influence spreads (Anderson et al., 1994; Ritter, 2000). The work by Easton and Lundgren (1992) accentuates the phenomena of "nodes (actors) connecting flows (relationships)" and "influences flowing through nodes" in network changes. Their work exemplifies a network paradox that business actors are trying to influence others, simultaneously, they are being influenced by others (Håkansson and Ford, 2002; Ritter and Ford, 2004).

Easton and Lundgren (1992) further indicate that actors may respond to a change by reflecting, absorbing, transmitting and transforming it. *Reflection* implies that the nodal actor refuses or nullifies a change requested or initiated by its counterpart. *Adaptation* refers to the efforts made by the involved organisations, rather than by one party, to manage the change, e.g. the requested change is modified in negotiations between the dyad. *Absorption* refers to the nodal actor's acceptance of the change by absorbing the impact within the boundaries of the organisation, e.g. absorbing a price markup. *Transmission* means that the effects of the change are transmitted by the nodal actor to one or more other parties, implying that the change needs to be handled by the network and not the nodal actor. *Transmutation* occurs when the nodal actor accepts the requested change and is able to transform the activities to meet the requirements of that change, e.g. shortening the delivery time by re-designing the production process.

In business networks, stability and change coexist (Håkansson and Snehota, 1995). This dynamic view considers the evolution of the relationships in a business network as a process which goes through incremental changes and radical changes in which radical changes are regarded as possible but unusual (Easton, 1992; Halinen *et al.*, 1999;

Thomas and Ford, 1995). On the basis of an analytical framework proposed by Halinen and her colleagues (1999), the process of network change (or the spread of change influences) can be elaborated by three elements: the mechanism of change, the nature of network change, and the forces of change.

The mechanism of change – In a business network which is considered as an aggregation of relationships, single dyads function as the key units in the change mechanism of business networks. Two types of change in the network can be identified; they are *confined changes* and *connected changes*. Changes that take place within a dyadic relationship (e.g. change of key contact in a functional department) and that are not received or acted upon by other actors are viewed as confined changes while connected changes refer to those changes which are initiated from a dyad and spread their influences onto other connected relationships, such as domino effects (Hertz, 1998). The dyad, thus, acts as a receiver and transmitter of changes.

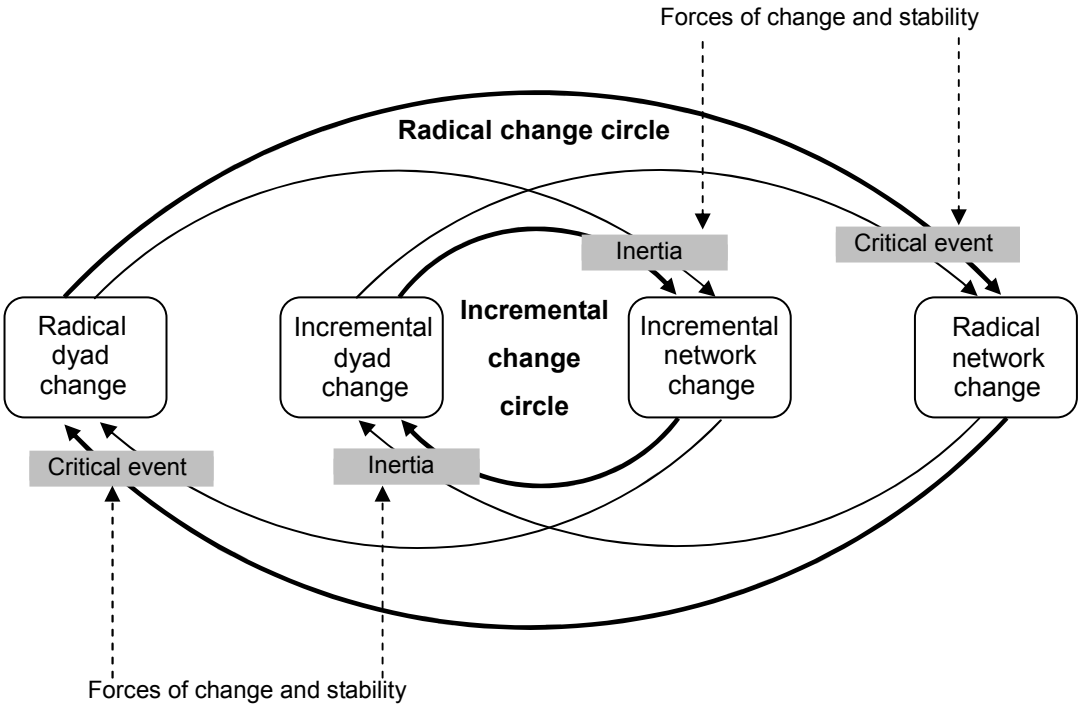
The nature of network change – Halinen *et al.* (1999) contend that the evolution of business networks involves both incremental and radical changes using the punctuated-equilibrium model which is characterised as a deep structure, with periods of stability and revolutionary periods. They point out that a deep structure is "the fundamental choices which sets of business actors have made concerning who they are connected to" (p. 784). The fundamental choices of actor bonds, activity links, and resource ties shape a business network (the deep structure) and lead to a process of continuous movement and adjustments (periods of stability) while a sudden and relatively brief period of revolutionary change alters the underlying structure. Their study accords with what Håkansson and Lundgren (1995, p. 298) argue:

> Major changes are […] more or less impossible to predict, but they are at the same time closely linked to stable evolutionary processes within the industrial network.

The forces of change – The stabilizing forces or lock-in effects in business networks are characterised as inertia, which may result from increased investments and interdependencies between actors (Håkansson and Waluszewski, 2002a; Halinen *et al.*, 1999; Thomas and Ford, 1995). The inertia creates periods of stability until it is broken by radical changes instigated by a trigger or a critical event. It has been suggested that a significant change in relationships is best studied from the perspective of a critical event or critical interaction episode that triggers revolutionary periods at some point in time (Halinen *et al.*, 1999; Schurr, 2007; Stewart, 1998; Törnroos, 2004; Knoben *et al.*, 2006).

Halinen and her colleagues' (1999) elaboration on change in business networks can be summarized in their analytical framework in which two types of change and two levels of change are distinguished, as shown in Figure 4.1. The two outer bold arrows signify the radical change circle while the inner two bold arrows represent the incremental change circle. In addition, the left and right halves of Figure 4.1 represent the change at the dyadic level and change at the network level respectively. With these two types and two levels of change, the change in business networks can be further categorized into four groups. Behind these network dynamics, there are two major types of force driving the change: inertia and critical events.

Figure 4.1 An analytical framework of change in business networks



Source: Adapted from Halinen *et al.* (1999)

4.2.4 Interaction episodes and critical events

Exchange episodes are at the heart of business interactions between actors in networks (Håkansson, 1982; Turnbull *et al.*, 1996). Interaction episodes are about transactions taking place between the supplier and customer firms, such as a joint development project or negotiation of a business contract. Episodes are vital components that not only give meaning to a relationship but also determine the strength and continuation of that relationship. As Grönroos (2004) points out, the interaction process of an on-going relationship consists of four levels of aggregation: act, episode, sequence and relationship level; in which an act can be viewed as the sub-component of an episode, e.g. the placement of an order by telephone in an episode of shipment, while a sequence contains interrelated episodes. Regarding each of interaction episodes as a business strand, Anderson (1995) argues that business actors are engaged in a web of interwoven business strands where structural and social bonds are created through conscious coordination between these actors.

Each episode, like a dance (Wilkinson and Young, 1997), requires at least two parties to perform. How the episode is handled hinges on the complexity of episode itself and the history of the relationship between the parties (Håkansson and Gadde, 1997). In other words, episodes form managers' respective memories and experiences, affecting the way of their acting and reacting later on (Anderson, 1995; Ford and Håkansson, 2006). Following this thread, each episode taking place contains a certain degree of change influence which can be positive, negative, neutral or indeterminate, depending on how the counterpart perceives it (Schurr *et al.*, 2008). In some cases, for example, a sequence of episodes within a relationship in a certain time period may generate a larger negative effect than positive effect, directing the development of the relationship towards a languishing stage. As a result, network dynamics are derived from relationship dynamics in which change influences generated from interaction episodes ripple through relational linkages (Easton and Lundgren, 1992; Hertz, 1998).

Apart from interaction episodes, it has been argued that critical events are decisive in relationship development and act as turning points that mark the transition period in the evolution of business networks (Halinen, 1997; Halinen *et al.*, 1999). Halinen *et al.* (1999) contend that critical events may arise from interaction in the dyad (e.g. strategic action) or from the business environment (economic or technological conditions), functioning as the impulse that allows the tensions to be released and the network to be configured. A range of critical events have been identified, including shifts in organisational structure, personnel changes, changes in marketing and purchasing strategies, bankruptcies, partner switching, acquisition and mergers, and changes in

technology (Knoben *et al.*, 2006). However, using critical events does not imply that researchers can ignore the non-critical interaction episodes; contrarily, relationship changes take place in combination of with larger of a series of non-critical episodes (Schurr, 2007). Moreover, these critical events may only be identifiable retrospectively. Thus, studying interaction episodes is a beneficial way to understand how dynamics take place in a network setting and how a firm manages these dynamics within relationships through interfirm adaptation and resource mobilisation (Awaleh and Harrison, 2009).

4. 3 Adaptation, mobilisation and integration in business networks

4.3.1 Interfirm adaptation

Previous research has revealed that business interaction is a long-term process leading to adaptation and institutionalization of roles and responsibilities between actors (Ford, 1997; Grönroos, 2004; Håkansson, 1982). This process contains a dynamic aspect, just as Håkansson and Snehota (1995, p. 273) argue:

> Changes aimed to stabilise or to change the networks are always a matter of two or more actors working together with or against others. The actors adjust to others as they know, from experience, that it is the only way to get others to adjust to them. Interactions thus lead to joint actions among actors that shape the structure of business networks and create the connected relationships and result in ties, links and bonds […] As a consequence no single actor alone is capable of maintaining or changing the structure of the network.

Mutuality, which is one of important features of the working and long-term oriented relationship (Ford *et al.*, 1997; Wilson, 1995), is manifested in interfirm adaptation. Adaptations reflect a need for coordination of activities between organisations (Laage-Hellman, 1997) and aim to "eliminate potential mismatches between their needs, resources and interests, their functions and procedures, and even between their attitudes and values" (Halinen, 1997, p. 194). More specifically, according to Brennan *et al.* (2003), adaptations can be defined "as behavioral or organisational modifications at the individual, group or corporate level, carried out by one organisation, which are designed to meet the specific needs of one other organization" (p. 1639). Based on the work by Håkansson (1982), they classify the adaptation between customer and supplier into production planning and scheduling, stockholding and delivery, product, information exchange, production process, financial or contractual terms and conditions, and organisation structure.

In a business network characterised by interdependence, an actor's adaptive behaviour mirrors its strategic thinking (Brennan and Turnbull, 1997; Hallén *et al.*, 1991). In the face of changing conditions in the environment, actors are encouraged to carry out adapting activities to meet the new requirements either from its counterparts (e.g. production process) or from a broader context (environment-friendly regulations), so as to minimize the uncertainties and create a better fit between interfaces with others. Adaptations in this sense can be regarded as stabilizing forces in maintaining the network structure. On the other hand, interfirm adaptation is a vital means for firms to achieve greater value (Holm *et al.*, 1999). Actors involved in the adaptation process are trying to gear their business domain, in terms of resource combination and transfer and transformation of activities, to other actors' domains at an aggregate level, that is, the production system. In other words, actors are attempting to make use of mutuality and interdependence existing in their relationships to co-produce competitive advantage (Campbell and Wilson, 1996; Holm *et al.*, 1999; Normann and Ramirez, 1993).

Actors which are engaged in business interaction cannot evade influences of power exerted by other parties (Emerson, 1962; Håkansson, 1982). The imbalance of power is a crucial factor accounting for actors' adaptive behaviour in which dyadic adaptation can be either unilateral or mutual (Brennan and Turnbull, 1999; Brennan *et al.*, 2003). That is to say, actors may be involved in asymmetric relationships, being forced to adapt to powerful parties' needs. Although some researchers view that power is alien to effective relationships or relationship quality (Kumar, 2005; Naudé and Buttle, 2000), each actor has to tolerate the existence of imbalance of mutuality and reward (Hingley, 2005). A more constructive thinking, therefore, lies not in resisting power but in how to strike a balance between managing others and being managed by others in the pursuit of economic goals (Wilkinson, 2006; Wilkinson and Young, 1997). In this sense, the adaptive process involves the mobilisation of resources (both tangible and intangible) between parties in order to satisfy the counterpart's needs. Especially when an actor is engaged in the adaptive process with a number of actors simultaneously, how to properly allocate (or re-allocate) resources and mobilise them between relationships is strategically important.

4.3.2 Network mobilisation

It is fair to say that for a change in the network to come into being, something must be mobilised in the existing relational structure on the basis of actor bonds, resource ties and activity links. This mobilisation may be initiated by a minor change (e.g. an

adjustment within the existing production process) or by a significant change (e.g. changing procurement policy by adding a new supplier). According to Lundgren (1992), mobilisation is a "process of forming crowds, groups, associations, and organizations for the pursuit of collective goals" (p. 159). He further indicates that the mobilisation process can be further categorized as *network integrative mobilisation* and *network changing mobilisation* in which the former refers to "the process of expanding or extending the network in accordance with existing activity cycles" while the latter refers to "the process of establishing new activity cycles or the breaking of old ones or the combining of two or more previously unrelated activity cycles" (p. 160). Mobilisation is thus a crucial phenomenon characterizing network dynamics, particularly when the influence of time and temporality is taken into account.

An actor's mobilisation in the network is associated with its strategic moves. A recent study by Mouzas and Naudé (2007) has indicated that network mobilisation is "the outcome of utilizing their relationships to move other organizations such as customers, suppliers, agencies, partners or even competitors to work within their own plans" (p. 62). They identify five different challenges in such a mobilisation that managers need to consider: developing network insight; introducing new business propositions; concluding the deal; developing the social contract; and achieving sustained mobilisation. It is pivotal to heed that the initiative of mobilisation (e.g. introduction of new business propositions into the existing network) is based on the actor's interpretation of its surroundings; that is, the actor's network pictures (Ford and Håkansson, 2006; Henneberg *et al.*, 2006; Johanson and Mattsson, 1992). Moreover, the creation of such network pictures is "the ongoing product of inter-organizational interactions and provide a credible depiction for past events and current positions" (Mouzas and Naudé, 2007, p. 63). Since each actor has its own interaction history that carries the relevant knowledge and experience, this network insight can lead to a differential advantage; however, it depends on if the actor is able to mobilise required resources to the desired state, otherwise disastrous results may occur. For example, Sony's being defeated by JVC in the VCR standard battle can be explained by its failure to mobilise sufficient resources from producers and channel members to support its Betamax format (Cusumano *et al.*, 1992).

4.3.3 Network integration

Interfirm adaptation, resource mobilisation and resource integration can be seen as three major driving forces in the evolution of business networks. The mobilised resources within relationships have to be integrated (or re-integrated) into exiting activity cycles

performed by interconnected actors, so as to form a basis for collective actions in the pursuit of efficiency and effectiveness. Johanson and Mattsson (1992) indicate that an actor's position and role(s) in the division of labour in the production system will become more distinct through continuous interaction with other parties if its domain (resource possessed and activities performed) can be integrated in the system. With a similar view, Lundgren (2000) regards a technology-based network as a technological system in which the relational bonds are not formed randomly but follow a specific logic set by the historical development of the system. This network integration contains not only the concepts of interfirm adaptation and network mobilisation but also a dynamic aspect, as Hertz (1996) indicates:

> In the network approach, coordination or integration between organizations and their production system is the basis for the formation of and changes in relationships. Integration is a process of coordination with the specific purpose of creating a whole. Within these *exchange relationships* the organizations develop. Changes in integration are vital when studying dynamics from a network perspective. Over time, trust and resource commitments lead to an increased interdependence and long-term relations. (p. 180-181)

Integrating others and being integrated by others are two equally important issues concerning resource combination from the perspective of effectiveness and efficiency. As Möller *et al.* (2005) point out, to be an attractive partner, it is important for a firm to develop a flexible and efficient business domain that allows other firms to combine with their domains within an industrial system. Moreover, Möller and Rajala (2007) argue that an actor may play multi-roles for different groups of actors which are horizontally and vertically embedded in an industrial network. In this situation, network integration (which is closely related to resource mobilisation) becomes more complicated and challenging. One important issue is how an actor prioritizes its relationships and allocates resources accordingly; usually this requires the actor's ability to mobilise resources or other actors at the right timing. Another crucial issue is how to tackle the co-opetition between groups which requires different operation logics (Bengtsson and Kock, 2000). For example, company A may compete with company B on an existing product category using their respective clusters of resources while working together for the development of the next generation of product (or technology).

In summary, changes can be said to take place in the process of adaptation, mobilisation and integration within and between relationships. In other words, network dynamics are the results of business actors' efforts to meet their counterparts' needs through resource mobilisation and integration along the time dimension. These efforts are actors'

deliberate actions or reactions, based on their respective interaction histories and understandings of the networking environment, to adapt to changing conditions (Ford and Håkansson, 2006). Due to these efforts in relating one's resources and activities to others', network dynamics generated in the process of adaptation, mobilisation and integration can also be viewed as consequences of strategising between actors (Gadde *et al.*, 2003).

Network dynamics, which result from actors' efforts in mobilising and integrating aggregate resources in the evolution of the network, have strong strategic implications. The network evolution that concerns the activity pattern, the resource constellations and the web of actors can be seen as strategy development (Håkansson and Snehota, 1995; Harrison and Prenkert, 2009). Håkansson and Ford (2002, p. 137) view strategy process as "interactive, evolutionary and responsive, rather than independently developed and implemented". Therefore, network dynamics are closely associated with strategising between actors. In the next section, the IMP perspective on strategy will be discussed.

4. 4 Strategising in business networks

4.4.1 The IMP perspective on strategy

The rapidly changing environment, such as globalization and technological change, has blurred the organisational boundary, urging firms to gain complementary resources and knowledge through relational linkages. A number of studies have revealed that a firm's relationships embedded in networks are sources of competitive advantage (e.g. Gulati *et al.*, 2000; Håkansson and Snehota, 1989; Johanson and Mattsson, 1992). A business organisation may respond to the changing conditions by adjusting its network position; which in turn impacts upon relationship dynamics, e.g. strengthening an existing relationship, building a new relational bond or dissolving an old one (Möller and Halinen, 1999; Tikkanen and Halinen, 2003; Törnroos, 2004). From this angle, the network dynamics which are caused by interfirm adaptation and resource mobilisation between actors have strategic significance. In other words, network dynamics are the results of actors' strategising efforts on the dimensions of actor, resource and activity (Gadde *et al.*, 2003).

An increasing attention is being paid to the IMP tradition in the field of strategic research (Brennan *et al.*, 2008). A recent significant work in the area is by Baraldi *et al.* (2007). They conduct a theoretical comparison of the IMP perspective on strategy with five important schools of thought in strategy: Ansoff's (1965) rational planning, Porter's

(1980) positioning, Barney's (1991) resource-based view, Mintzberg's (1994) organic, incremental strategy and Whittington's (2003) strategy as a social practice. Their work sheds light on several distinctive features of the IMP perspective on strategic thinking. First, actors which are embedded in a complex network of organisations can act on their own with a certain degree of freedom given by the interdependence structure; however, this freedom is constrained by the actions of others in the network. Second, the IMP perspective accentuates a firm's network position whose uniqueness and competitiveness depend on how the firm relates to others in its networking environment where conflict and cooperation co-exist. Third, the IMP perspective considers the firm's relationship portfolios and its network as vital components in strategy formulation in which an organic view of the interplay between gaining knowledge, generating action and achieving commitment is emphasized. Fourth, strategising activities are performed by individual managers or practitioners within and across organisational boundaries in the process of relating their activities and resources to others', which is characterised by learning by doing.

More recently, Baraldi (2008) explicitly articulates "network strategy", which considers and uses the external network for a company's goal, based on the IMP approach and using IKEA and its industrial network as the empirical illustration. He argues that a network strategy can be understood in terms of structures and dynamics; in which the former is concerned with architecture of the network, the long-term features of each business relationship and the configuration of external resources, while the attention of the latter focuses on dynamics interactions that can be classified as interacting via inter-organisational routines for efficiency purposes and interacting via joint projects for development purposes. In addition, Harrison and Prenkert (2009) have identified three categories of strategising from an IMP perspective; they are *cognitive strategising* (e.g. acting based on a firm's network picture), *positioning strategising* (e.g. actions relating to maintain or change a firm's network position) and *adaptations strategising* (e.g. adaptations to a specific customer or supplier). Due to strategising between actors over time, they discern the dynamics of network strategising trajectories within a planned strategy process, based on the IMP's ARA framework.

4.4.2 Wielding positional power

The concept of network position is at the heart of the IMP approach to strategy. Unlike Porter's (1980) market position whose advantages are achieved by rivalry against others, network position mirrors a firm's relation to others in terms of actor bonds, resource ties and activities links in its network context (Johanson and Mattsson, 1992; Gadde *et al.*, 2003). This suggests that a business actor can influence others through its relational linkages to achieve its company goals (Baraldi, 2008; Håkansson and Snehota, 1989; Harrison and Prenkert, 2009). Each position embedded in such an interdependent network structure is thus equipped with a certain degree of power (Axelsson, 1992a; Thorelli, 1986). Moreover, all firms, supported by their respective memories, intend to preserve their positions by wielding their positional power, in other words, conducting strategising activities (Ford *et al.*, 1996). These activities may generate both positive and negative influences flowing between connected linkages, and consequently bring about changes in network dynamics. As a result, each company's network position has a dynamic and evolving characteristic.

From a network perspective, each firm is empowered either to initiate or countervail a change. Smith and Laage-Hellman (1992), from a triadic level analysis, put forth five strategic options of how a firm can restructure its business net while Easton and Lundgren (1992), viewing positions as nodes connecting flows of changes, identify several types of reaction for an actor to respond to a change initiated by others. Their work is summarized in Table 4.2. Their research implies that a firm's strategic action can be self-initiated or other-directed, depending on how actors interpret the best way of usage of knowledge and resources (Wilkinson, 2006; Henneberg *et al.*, 2006). On the other hand, when articulating rivalry strategies, Andersen (2008) places his focus on position and role and proposes four types of rivalry strategies that can be differentiated by the changes in role sets in relation to others. These strategies are role replacement, role enhancement, role redefinition and role alteration. He argues that a successful practice of these strategies hinges on a careful scanning of the network environment and a consideration of possible countervailing responses of others followed by the firm's strategic move.

The above work exhibits that each business organisation is exposed to an environment filled with strategising efforts between actors, attempting to exert control over the other using their positional power. In such an environment actors actually are dealing with a network paradox: an actor endeavors to control others, simultaneously; it is being influenced by its counterparts (Håkansson and Ford, 2002). Managers have to heed that control may incur destructive consequences especially when it becomes total (Ritter and

Ford, 2004). The studies by Andersen (2008) and Welch and Wilkinson (2005) reveal that the exercise of power may occasion interfirm conflicts in which one party attempts to improve its position at the expense of the other who perceives this as interfering with the attainment of its goals. These conflicts may then lead to a state of power imbalance, causing turmoil in the relationship. The turmoil may be mitigated if adaptive efforts of involved parties are made to eliminate the mismatches (Brennan *et al.*, 2003; Hallén *et al.*, 1991); otherwise the radical changes of relationship, such as relationship ending or new relationship building, cannot be avoidable.

Table 4.2 Initiating or countervailing change as means of wielding positional power

Initiating changes	By-pass	avoid an intermediary relationship
	Combination	co-work with the other for the third party
	Bridge	exert influence on the third party via an intermediary relationship
	Displacement	replace an existing partner with new one
	Separation	use another actor to interrupt a direct relationship
Countervailing changes	Reflection	refuse or nullify a change requested or initiated by its counterpart
	Adaptation	efforts made by the involved organisations to manage the change
	Absorption	acceptance of the change by absorbing the impact
	Transmission	change effects are transmitted to one or more other parties
	Transmutation	transform the activities to meet the requirements of that change

Source: Lundgren (1992) and Smith and Laage-Hellman (1992); prepared by the author

Network dynamics can be seen as the results of actors' strategising to maintain or change their network positions and adapting to particular counterparts, using their respective understandings of the environments and limited knowledge and power (Ford and Håkansson, 2006; Harrison and Prenkert, 2009). Thus, coping with network dynamics is a vital issue that is concerned with an actor's long-term sustainability. This issue is addressed in the following section.

4. 5 Coping with network dynamics

4.5.1 Organisational learning: Exploration and exploitation

The importance of the inter-organisational relationship is that it provides an actor with access to the complementary resources (including tacit knowledge) of the other actor and the third party with which the counterpart has the relationship. Sharing knowledge and developing new understandings are underlying reasons for actors to be engaged in a network of interfirm relationships (Johnston *et al.*, 2006). But the value of aggregate resources will be affected by the interaction process in which power-dependence structure, the mutuality with regard to goals, trust, commitment and investment, and the history are important factors (Ford *et al.*, 1997; Håkansson and Lundgren, 1997; Wilkinson, 2006; Wilson, 1995). That is, the knowledge created by a web of actors at a certain time period may become inappropriate or even obsolete at another time period. Following this thread, network dynamics can be explained by actors' attempts to improve their bundling of knowledge, the way of combining internal resources with external ones, so as to adapt to the changing environment. And thus, time plays a crucial role in the generation of network dynamics.

Coping with change in networks requires companies to develop adequate competence and knowledge; put briefly, it is about the ability of organisational learning. As Håkansson and his colleagues (1999) indicate, companies can learn through their own experiences or through the experiences of other organisations. They also point out that choosing from whom to learn and what form of learning are two crucial managerial considerations. This organisational learning can be viewed as a firm's adjustment of its relationship portfolios, attempting to balance the benefits and costs of exploitation versus exploration in the changing environment (Wilkinson and Young, 2002). According to March (1991, p. 85), the essence of exploitation is "the refinement and extension of existing competences, technologies, and paradigms" while the essence of exploration refers to "experimentation with new alternatives". For a firm to be able to maneuver exploitative strategy and explorative strategy is not an easy task, because the latter involves dealing with weak ties[7] and exposure to high level of uncertainties and risks. A possible way of maintaining a balance is to learn through the mix of relations (Wilkinson and Young, 2002); as emphasized by Håkansson *et al.* (1999), "[…] the more connections a relationship has, the greater are the possibilities to learn" (p. 445).

[7] Given that the strength of a relational tie is a "combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie" (Granovetter, 1973, p. 1361), a weak tie can be seen as an "undeveloped" relationship, while a strong tie can be viewed as a "well-established" relationship (Håkansson and Ford, 2002).

4.5.2 A dynamic view of network capability

Achieving an appropriate balance of exploitation versus exploration as a means of tackling changes in business networks requires a dynamic view of network capability. This view can be examined from three different perspectives: dynamic capabilities (Eisenhardt and Martin, 2000; Teece *et al.*, 1997), absorptive capacity (Cohen and Levinthal, 1990; Zahra and George, 2002) and network competence (Ritter and Gemünden, 2003). To begin with, the notion of *dynamic capabilities*, which is extended from the resource-based view (e.g. Barney, 1991), is elaborated in the studies by Eisenhardt and Martin (2000) and Teece *et al.* (1997). These researchers contend that rapidly changing environments can be tackled by manipulating resource configurations. Similar to Teece *et al.* (1997), the definition of dynamic capabilities is given by Eisenhardt and Martin (2000, p. 1107) as the following:

> The firm's processes that use resources – specifically the processes to integrate, reconfigure, gain and release resources – to match and even create market change. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die.

The dynamic capability view is developed to address the weaknesses of the resource-based view: the lack of precise definitions and rigorous arguments and its "static" theory which emphasizes on identifying resources at one point in time (Bowman and Ambrosini, 2003; Priem and Butler, 2001). From this dynamic view, competitive advantage is produced in unique organisational processes that comprise the roles of coordination (or integration), learning and reconfiguration. In other words, dynamic capabilities are embedded in organisational processes. This process of resource configuration evolves along a certain path or trajectory of competence development. Therefore, dynamic capabilities in this view are difficult for others to imitate.

Pertaining to knowledge creation and utilization, Cohen and Levinthal (1990) and Zahra and George (2002) advocate *absorptive capacity* as a dynamic capability. Following a similar thread of dynamic capabilities, absorptive capacity is "a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability" (Zahra and George, 2002, p. 186). Zahra and George further distinguish a firm's potential and realized absorptive capacity, in which the former refers to a firm's receptiveness of acquiring and assimilating external knowledge while the latter stresses the function of the transformation and exploitation capabilities. They argue that developing the potential

absorptive capacity hinges on the firm's ability to gain access to diverse and complementary external sources of knowledge.

Both dynamic capabilities and absorptive capacity emphasize the importance of organisational learning. The dynamic capability view considers learning as "a process by which repetition and experimentation enable tasks to be performed better and quicker" (Teece *et al.*, 1997, p. 520) within the firm boundary, while absorptive capacity stresses that learning is facilitated by inter-organisational interaction (Peters and Johnston, 2009), which is in agreement with the IMP's perspective on learning through interacting with others (Ford *et al.*, 1998; Ford and Håkansson, 2006; Håkansson *et al.*, 1999).

In the face of volatile environments, e.g. technology-intensive industries, the existing evidence drawing on the Interaction and Network approach has revealed that a firm can tackle the changing conditions using its competence of managing relationships and networks effectively and efficiently (Gemünden and Ritter, 1997; Möller and Halinen, 1999; Wilkinson, 2006). This competence, termed as "network competence", involves not only strengthening relationships by increasing investments but also, if necessary, dissolving dysfunctional relationships so as to release resources (Eisenhardt and Martin, 2000; Ford *et al.*, 1996). An elaboration of network competence is offered by Ritter and Gemünden (2003) in which this competence refers to a firm's specific ability to handle, use, and exploit inter-organisational relationships. They propose *relationship-specific tasks* and *cross-relational tasks* as the embodiment of the network competence, in which the former refers to activities, including initiation, exchange and coordination, to establish and maintain a single relationship while the latter comprises four different management tasks: planning, organising, staffing and controlling. In another study, Ritter and Gemünden (2004) point out that the development of network competence needs to be considered in corporate strategy formulation in order to generate competitiveness, such as innovation success.

What dynamic capabilities, absorptive capacity and network competence have in common is their focus on "resources" (both tangible and intangible), in which competitive advantage arises from the adequate acquisition, mobilisation and reconfiguration of resources in accordance with changing conditions. However, an important feature of network competence that distinguishes itself from the other two perspectives is its explicit treatment of business relationships as resources (Ritter and Gemünden, 2003), which is also emphasized in the work by Håkansson and Waluszewski (2002a). While complementary capabilities or part of required capabilities can be gained or accessed via relationships, a firm is argued to come into being without

distinctive and clear boundaries (Araujo *et al.*, 2003).

Technological development is found to have a close association with the evolution of business networks (Afuah, 2000; Håkansson and Waluszewski, 2002a; Harryson *et al.*, 2008). After the theoretical elaboration on the IMP's perspective on business relationships and networks (Chapter 3) and network dynamics (Chapter 4), the next chapter will examine the interrelationship between technological development and network evolution; in particular, the concept of value-creating business nets (or systems) will be discussed.

5 Technology and business network development

5.1 Introduction

[T]echnological development is an interactive process. (Lundgren, 1995, p. 89)

Business relationships are considered as a key component in technological development, including idea generation, product design, commercialization and launch (Easingwood and Harrington, 2002; Mohr *et al.*, 2004; Håkansson, 1997; Powell *et al.*, 1996). The importance of business relationships lies in their crucial role in connecting resources in the process of "resource interaction" (Håkansson *et al.*, 2009), allowing technological change to take place. It is also business relationships that bring scattered activities and heterogeneous resources together forming technology-based business nets which can be seen as "value-creating" and "technology-bundled" systems (Ford and Saren, 2001; Parolini, 1999). The value co-created by actors embedded in a technology-based net is determined by how productive activities (including resources used) are bundled or re-bundled. This bundling and re-bundling of activities is an important aspect of strategic thinking related to how a technology-based firm pursues competitive advantage, such as through bridging technological change.

5.2 Technology-intensive business environments

5.2.1 Characteristics of technology-intensive markets

In technology-intensive markets, such as high-tech industries, where the phenomena of technological uncertainty, market uncertainty, and competitive volatility prevail (Mohr *et al.*, 2004), technological prowess no longer guarantees success in the markets. A number of studies have shown that the acceptance of a technological solution in markets is the result of cooperation and collaboration between a variety of actors (e.g. suppliers, customers, complementors and even competitors) who own complementary resources (e.g. Hill, 1997; Moore, 1991; Håkansson and Lundgren, 1995). In order to better understand the interrelationship between technology and business networks, a fundamental issue for both practitioners and academics to consider is what characterises a technology-intensive market.

A working definition given by John *et al.* (1999) is that technology-intensive markets "are characterised by products that are based on significant amounts of scientific and technical know-how" (p. 79). They further identify "unit-one cost structure",

"intellectual tradability problems", "diversity of technologies", "network compatibility", "demand-side increasing returns" and "customers' expectations about the pace, size and uncertainty of improvements" as salient characteristics, summarized in Table 5.1. As these features are taken into account, firms are able to better understand the scope of their network boundary and study their positions in a web of interfirm relationships. For example, realizing the diversity of technologies that are applied to a particular product category facilitates development of managers' understanding about interdisciplinary work and integration of technologies between business organisations. The high-end mobile devices that are equipped with telephony, computing and digital imaging technologies are vivid examples. On the other hand, network compatibility stresses the importance of complementary technologies (e.g. hardware and software), which is a crucial criterion for a new product to migrate from the early market (a niche market) to the mainstream market (mass markets) (Moore, 1991).

Table 5.1 Characteristics of technology-intensive markets

Characteristics	Description
Unit-one cost structure	The cost of producing the first unit is very high in comparison with the costs of re-production.
Intellectual tradability problems	Buyer-seller exchanges often involve non-retrievable knowledge (when acquired knowledge cannot be returned or forgotten) which in turn influences a firm's positioning and compatibility decisions.
Diversity of technologies	The prevalence of diversity of technologies encourages the interdisciplinary work and integration of technologies between actors.
Network compatibility	Sets of complementary know-how are coalesced, enabling subsystems of products to work together without specific modifications.
Demand-side increasing returns	Demand-side increasing returns are created by externalities in know-how creation and dissemination, e.g. bandwagon effect in telephones.
Expectations about the pace, size and uncertainty of improvements	The pace of technological improvement, either evolutionary or revolutionary, leads to managerial challenges of firm competence, product life cycle and customer expectations. Uncertainties are related to the development of the complementary technologies.

Source: John *et al.* (1999); prepared by the author

5.2.2 Classification of technological change

Business organisations which are embedded in a technology-based network inevitably have to confront technological change initiated by themselves or other parties. Technological change may result in either a positive or negative effect on a firm's competence; which in turn affects the firm's relationships with others to which it is connected (Afuah, 2000). In the face of ever-changing technology-intensive markets, Slater and Mohr (2006) argue that different types of innovation require different managerial skills. However, classifying technological change is still confusing and contentious, particularly with respect to what constitutes significant change. Similarly, in a study reviewing disruptive technology, Danneels (2004, p. 247) notes:

> A question that remains is whether a technology is inherently disruptive or if "disruptiveness" is a function of the perspective of the companies subject to it.

There is a variety of terms used to describe significant technological change in the literature, such as disruptive technology, radical innovation, technological breakthrough, new technological paradigm or trajectory, and technological discontinuity (Christensen, 1997; Danneels, 2004; Dosi, 1982; Sood and Tellis, 2005; Tushman and Anderson, 1986). Based on the work by Mohr *et al.* (2004), innovative developments can be placed on a continuum of increment-radical development, as shown in Figure 5.1. On the right hand side of the continuum, radical innovations are mostly developed by R&D groups and are difficult to compare to existing practices while, on the other hand, incremental innovations are continuations of existing practices or methods and are evolutionary as opposed to revolutionary. In contrast to supply-side markets which are characterised by breakthrough innovation, incremental innovations take place in demand-side markets in which customer needs are articulated and product characteristics are well defined.

The definition of technological discontinuities given by Ehrnberg (1995) provides us with another way to distinguish radical change from incremental change. According to her, the appearance of technological discontinuities requires changes in competence and other resources necessary for designing and producing the product or physical changes in the product itself or price/performance changes. In this longitudinal research, both minor (incremental) and major (radical) technological changes in the evolution of a business network will be covered, but particular attention will be placed on the latter. To facilitate this research the term "the next generation of technology (or product)", which is often used by practitioners and academics in high-tech marketing (e.g. Tabrizi and Walleigh, 1997), will be adopted to identify a major turning point in technological change. The next generation of technology often creates a new technological trajectory

or S-shaped curve and results in price/performance changes.

Figure 5.1 Continuum of innovations

- Extension of existing product or process
- Product characteristics well defined
- Competitive advantage on low-cost production
- Often developed in response to specific market need
- Demand-side market
- Customer pull

- New technology creates new market
- R&D invention in the lab
- Superior functional performance over "old " technology
- Specific market opportunity or need of only secondary concern
- Supply-side market
- Technology push

Source: More *et al.* (2004)

5.2.3 The impact of technological change on interfirm relationships

Technological change has been regarded as a powerful engine of economic progress and corporate renewal, giving fresh impetus to firms' sustainable momentum (Danneels, 2002; Sood and Tellis, 2005; Suárez and Utterback, 1995). In addition to positive effects, technological change may bring about negative effects on a firm's and its counterparts' skills, knowledge, organisational routines and procedures, which are developed and used for a former technological application, rendering obsolescence of competences or investments (Afuah, 2000, 2001; Anderson and Tushman, 1990; Christensen, 1997; Danneels, 2004; Henderson, 2006; Henderson and Clark, 1990). As Afuah (20001) argues, technological change that has an impact on a firm's assets very often impacts directly on its supplier's assets as well, leaving the firm with a difficult choice between staying with existing partners or searching for new ones. This is similar to what Moriarty and Kosnik (1989, p. 14) observe:

> The rapid pace of technological change virtually guarantees that the best partner tomorrow may be different from the best partner today, leading to problems in maintaining alliances over a long time period.

A firm's failure to bridge technological change or its dissolution of a relationship with a

certain counterpart occasioned by technological change may result from strategic misfit instead of technical incompetence (Slater and Mohr, 2006). Ford and Redwood (2005) indicate that a firm's network picture (an interpretation of surroundings based on experience) may generate a limited view of networking and cause it to be trapped into an "innovator's dilemma" (Christensen, 1997), subsequently being outflanked by a new technology offering. To overcome the innovator's dilemma, Slater and Mohr (2006) put forth the concept of organisational ambidexterity to develop and market sustaining and disruptive innovations. In addition to strategic fit, Laage-Hellman (1997) argues that a firm's well-coordinated relationships for a certain technological application need to be built on some kind of "fit" with regard to functional fit, strategic fit, organisation fit and time fit. This implies that a firm's fit with other actors may be eroded by the appearance of technological change, jeopardising its interfirm relationships.

Technological change may also leave a firm's competences intact, allowing its interfirm relationships to be maintained or strengthened. Apart from competence-destroying effects, Henderson and Clark (1990) contend that the appearance of technological change may bring about competence-enhancing effects when the knowledge applied in most technology-based products is made up of component knowledge and architectural knowledge. The research by Afuah (2000) shows that some of a firm's partners (e.g. suppliers and customers) could survive technological change if the change is competence enhancing to these counterparts instead of competence obsolescing. These studies suggest that the appearance of technological change in a network usually begets relationship dynamics where relationships may be newly established, maintained, enhanced or dissolved.

5.3 Understanding Technology-based business nets

Being immersed in the process of business interaction, actors relate their resources and activities to others' in order to solve their individual and collective problems and permit value to be created for themselves and the counterparts. Ford (2009, p. 17) describes an important aspect of value in an interactive world as: "Value of an interactive business process for a particular actor is that actor's perception of the potential usefulness of the process in coping with its other current or future problems". Value-creation is also inseparable from an aggregate form (e.g. a business net) structured by layers of actors, resources and activities (Håkansson and Snehota, 1995). Similarly, Möller and Svahn (2006, p. 988) argue, "Essential to any business net is the underlying system through which it produces value". To understand technology-based business nets where value is created by collective actions among actors, an interactive view on resource interaction

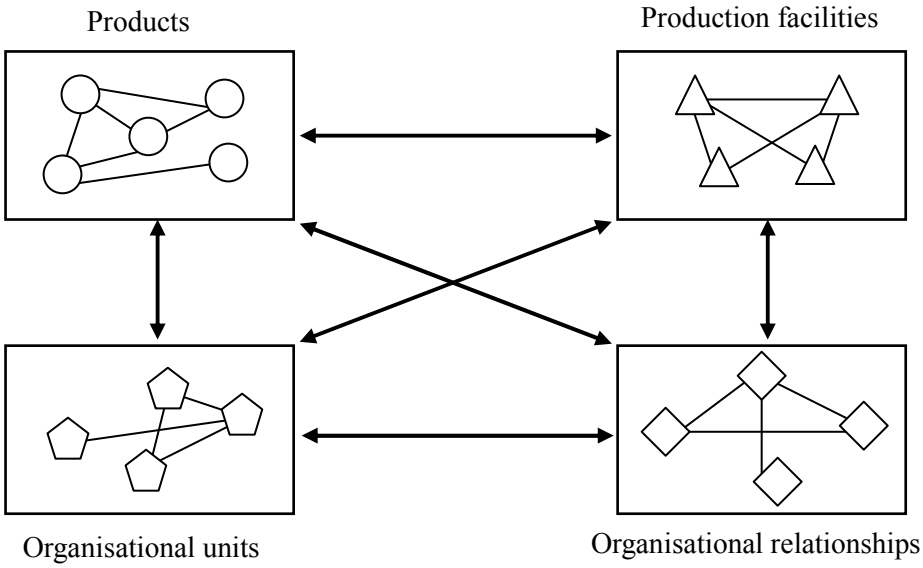
across firm boundaries (or 4R model) serves as a starting point, as Håkansson *et al.* (2009, p. 65) note:

> It is the ways that a resource *interacts* with other resources that define the nature of that resource and have the potential to generate economic value.

5.3.1 An interactive view on technological development: The 4R model

A heterogeneity perspective suggests that business environments are characterised by bundles of resources (Håkansson *et al.*, 2009; Håkansson *et al.*, 2004; Penrose, 1995). These resources exist in a flux through which they are used, combined, exploited and developed in a form of "resource interaction", allowing economic value to be produced and technology to be advanced. With the concept of resource interaction, an understanding of technological development in an aggregate structure (e.g. a business net or network) is permitted. Based on the work by Håkansson and Waluszewski (2002a) and Håkansson *et al.* (2009), resource interaction (or the 4R model) distinguishes and emphasizes the interplay between four types of resources, as shown in Figure 5.2:

Figure 5.2 The 4R model and the interplay between resources



Source: Håkansson *et al.* (2009, p. 68)

Products – They are tangible resources that are used, combined or moved around by different organisational units. Products can broadly include materials (e.g. inks for newspaper printing), components (e.g. chipsets in a PC) or end-products (e.g. a car).

Production facilities – They are also tangible resources but with more permanent and stable features than products. Production facilities are normally controlled and used by one organisation for productive activities, such as a PC assembly line.

Organisational units (or business units) – Organisational units can be seen as pools of intangible resources, including the knowledge and experience of individuals and groups and their skills in handling certain resource combinations.

Organisational relationships (or business relationships) – These relationships link both tangible (e.g. production facilities) and intangible (e.g. business units) resources and affect other resource combinations, resulting in business complexity where problems and opportunities co-exist.

Håkansson *et al.* (2009) provide several notions of how resources can be approached in an interactive business landscape. Firstly, the value of a resource derives from its connections with other resources. That is, an important mechanism of value-creation lies in interaction with other resources. Secondly, the characteristics of a resource evolve over time. This notion stresses the importance of using historical resource interactions to understand current resource interactions, e.g. using existing resources in a new way for a certain new product development. Thirdly, any single resource is embedded in a variety of combinations and contexts: in a resource collection within a company; in direct interactions with particular counterparts and in a larger resource constellation across firm boundaries. This notion permits the identification of certain usages and combinations of resources from a wide array of locations, which are built on an economic logic and centre around a mainstream technology. Fourthly, any change of a resource produces tensions in related resources, leading to a number of reactions with both positive and negative effects. The notion suggests that the process of innovation involves developing interfaces for new and related resources while trying to keep some of the existing resource interfaces stable. Fifthly, the effects of a change in a resource are influenced by interaction intensity. And lastly, the number of resources (e.g. number of counterparts involved) affected by a resource change is influenced by the broadness of interaction. The last two notions suggest that technological change is a matter of actors' actions and reactions embedded in an interactive, but lumpy process where tensions between resource interfaces and partly contradictory effects take place.

Time and space are vital dimensions of resource interaction. In line with the view of resource heterogeneity, "space" refers to a structure as the consequence of combinations between resources from an array of locations across firm boundaries, while "time" relates to a process of interaction between resources over time following a certain path or trajectory (Håkansson *et al.*, 2009; Håkansson and Lundgren, 1997). In the process of resource interaction, combination of resources is successively developed and adaptations between resource interfaces continue to exploit the value of resource constellations, such as for the emergence of a dominant design or for the penetration of markets with derivative products based on a mainstream technology. In this economic logic, the potential of a resource is constrained by its interaction with other resources. On the other hand, an innovation or technological change can be facilitated by moving certain resources to other locations; that is, to change the structure formed by previous resource interaction (Håkansson and Waluszewski, 2002b). However, doing so requires the handling of greater "friction" between resource interfaces. In brief, resource interaction in time and space provides both constraints and opportunities for technological development.

5.3.2 Value-creating and technology-bundled business nets

Technology-based business nets can be conceptualised as a "value-creating" and "technology-bundled" systems. Nets are seen as the subsets or subdivisions of networks or industrial systems (Mattsson, 1997; Hertz, 1992, 1996). This is analogous to Möller and Halinen's (1999) level two management: firm in a network. According to Easton (1992), nets can be classified along different dimensions: product, geography, process, technology, etc. He also contends that nets can be tightly or loosely structured, depending on the level of interdependence. A net can comprise different economic actors (e.g. supplier, customer, partner, and competitor) and different portfolios of relationships, depending on how a firm sets its boundary (Araujo *et al.*, 2003). Although the boundaries of all nets are artificial and not fixed, the concept of nets, at least, is able to capture the characteristics of connectedness and embeddedness of relationships and the importance of involved parties' roles performed in the division of labour (Anderson *et al.*, 1994; Johanson and Mattsson, 1992).

Viewing business nets as value-creating nets or systems is based on the notion that actors participate in business nets to co-produce value by embedding their respective resources and activities in these structures of larger aggregation (Campbell and Wilson, 1996; Holm *et al.*, 1999; Kothandaraman and Wilson, 2001; Möller and Rajala, 2007; Normann and Ramirez, 1993; Parolini, 1999; Stabell and Fjeldstad, 1998). Regarding

the definitions of a value-creating net, Parolini (1999) argues that such a value net consists of a set of activities carried out using sets of tangible and intangible resources. In a similar vein, Möller and Rajala (2007, p. 898) contend that a value-creating net is "a set of specific activities carried out by the actors constituting the net". Campbell and Wilson (1996, p. 127) regard a value-creating system as "a series of dyadic and triadic relationships that have been designed to generate customer value and build sustainable competitive advantage to the creator and manager". These definitions accord with the IMP's description of a business network consisting of interrelated layers of actors, resources and activities (Håkansson and Snehota, 1995). In addition, "the need to insert the activities of one company into a larger value-creating system" stressed by Parolini (1999, p. 61) can be seen as the role(s) that comes with the network position of that company in the system (Anderson *et al.*, 1998; Johanson and Mattsson, 1992).

In this doctoral research, however, the concept of value-creating net/system does not imply there will be a network leader, captain or hub firm directing the development of the net, as claimed by American schools (e.g. Campbell and Wilson, 1996). Moreover, it is possible for an actor to design its value-creating net in accordance with its network picture (Henneberg *et al.*, 2006; Mouzas and Naudé, 2007), but from an interactive perspective this ability of designing is enabled and constrained by the firm's relationships (Ritter and Ford, 2004). Since business organisations are adaptive and self-organising systems, they have a certain level of freedom to act and re-act to others based on their interpretations of surroundings (Ford and Håkansson, 2006; Ritter and Gemünden, 2003a; Wilkinson, 2006).

Apart from being described as a value-creating system, technology itself is also a key ingredient in forming a technology-based business net and has a strong influence on its evolution. Ford and Saren (2001) indicate that the value of a technology arises only when it becomes a mobilized resource that other actors are willing to purchase, use, or add some values to it. The extant evidence also shows that the success of a technology or products based on this technology hinges on a promoter's efforts to encourage external investments in complementary skills, relevant resources, and product or service availability (Easingwood *et al.*, 2006; Gawer and Cusumano, 2002; Moore, 1991; Schilling, 2003), suggesting that bringing an innovation to markets requires collective actions among different economic actors whose goals are aligned. Lundgren (2000) suggests that the concept of technological system can be used to set boundaries for a specific industrial network and to focus on particular exchange relationships.

The embeddedness and interdependence of a technology-based business net or system can be disassembled using the concept of technology bundles which consists of three

types of technology: product, process and marketing technologies (Ford and Saren, 2001; Thomas and Ford, 1995), see below for their definitions. When a firm considers its capabilities and specialised technology (or technologies) and sets its firm boundary for operation in particular markets, the firm will then prioritize its portfolios of supplier, customer, and even complementor relationships (Araujo *et al.*, 2003; Ritter *et al.*, 2004). Therefore, technology bundles not only reflect a firm's technological competence in the value-creating net but also reveal a firm's usage of shared knowledge in the net in the pursuit of economic goals.

- **Product technology**, which is the knowledge and ability to design a product or service valued by other actors. For instance, one important factor that contributes to the success of Apple's mobile phone and MP3 devices is its stylish industrial product design.
- **Process technology**, which is the knowledge and ability to manufacture or produce a product or service valued by other actors. For instance, many PC giants approach Taiwan-based OEMs due to these companies' excellence in manufacturing process management.
- **Marketing technology**, which is the knowledge and ability to market and deliver a product or service to those who require it. In the fierce competition of the consumer electronics industries, for instance, the success comes to the companies who are able to tailor their products to meet the different needs of their customers.

A company may possess two or even three types of technology simultaneously; however, the synthesis of these technologies within the company may not create superior competitiveness compared with undertaking cooperation or collaboration with other companies in terms of time or cost-efficiency or customer approachability. In this vein, the bundle of product, process, and marketing technologies is thus an important phenomenon that could offer the explanations as to how the relationships are formed and developed in technology-intensive industries.

In summary, a technology-based business net is characterised not only by value co-creation but also by bundles of technology. These two features of technology-based business nets show that activities which constitute the nets can be unbundled or re-bundled so as to maximise the value for customers as well as for parties involved in this value-creating process (Parolini, 1999). This also suggests that the structure of such a value net is ever-changing and never optimal. For any company embedded in a value-creating and technology-bundled business net, this unbundling and re-bundling of activities (including resources used) renders the traditional linear view of value-creating logic, e.g. Porter's (1985) value chain, inadequate when attempts are made to handle the

complexity and complicatedness in network environments. This is as what Normann and Ramirez (1993, p. 66) stress:

> […] key strategic task is the reconfiguration of roles and relationships among this constellation of actors in order to mobilize the creation of value in new forms and by new players. And their underlying strategic goal is to create an ever-improving fit between competencies and customers.

5.3.3 The path-dependent evolution of technology-based business nets

A crucial aspect of understanding a technology-based business net is its path-dependent evolution. The development of such a business net is driven by technological change which is the consequence of the evolution of a resource constellation around key products that apply specific technologies (Gadde and Håkansson, 2008; Lundgren, 1995). This development is the result of path dependence in which technological solutions are built into an industrial structure and are "locked in" by historical events. A classic example of path dependence is the QWERTY keyboard given by David (1985), in which he contends that "[a] path-dependent sequence of economic changes is one of which important influences upon the eventual outcome can be exerted by temporally remote events" (p. 332). Arthur (1994) points out that there are four generic sources of self-reinforcing mechanisms that bring about the lock-in and the consequent path dependence effect: large set-up or fixed costs (which lead to falling unit costs while output increases); learning effects (which lead to lower costs as prevalence of products increases); coordination effects (which arise as other actors take similar actions); and self-reinforcing expectations (where belief in product's success increases with increased prevalence).

In addition to self-reinforcing sequences, Araujo and Harrison (2002) emphasize the importance of reactive sequences in understanding path evolution. They argue that in reactive sequences, "initial events trigger a sequence of tightly linked reactions in which each event in the sequence is regarded as a reaction to temporally antecedent events […] initial disturbances do not generate positive feedback but instead trigger powerful responses that shift the path of a system into a new direction and not one that necessarily reinforces the first move" (p. 7). Reactive sequences focus our attention on the transformative processes that often carve new trajectories. The work by Araujo and Harrison (2002) suggests that path dependence does not imply either fatalism or determinism because the direction of the paths is influenced by strategically reflexive and temporally oriented actors who can make sense of their own positions, interests and

identities.

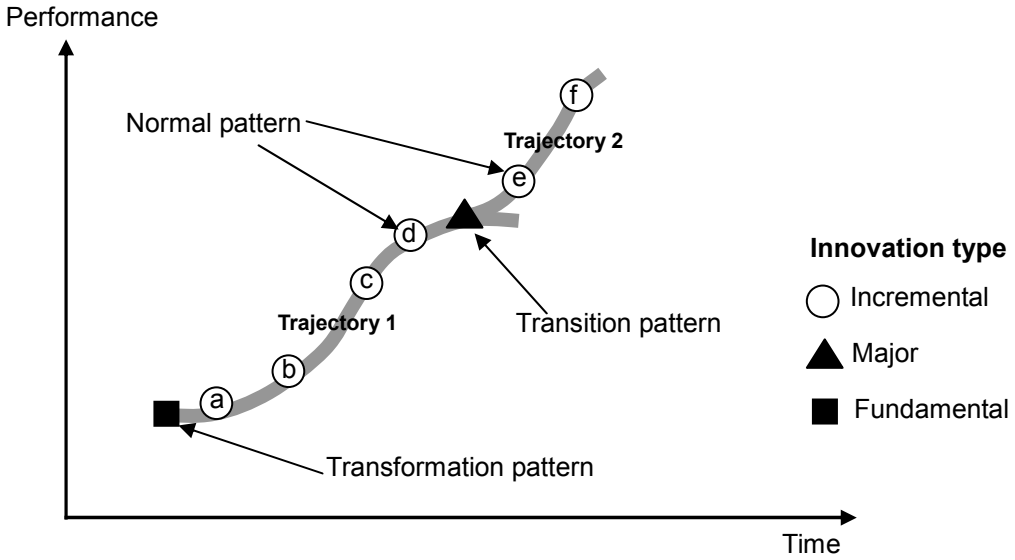
From an interaction perspective, the existence of path dependence in a business net arises from actors' pursuit of individual and collective goals based on interconnected relationships which are complementary, reciprocal and long-term orientated. Actors' behaviours are thus defined by their relationships; and the development of the net in which these relationships are embedded is filled with episodes and events, in attempts to achieve efficiency and effectiveness and to cover the investment costs (Håkansson and Lundgren, 1997). As Håkansson and Waluszewski (2002b) indicate, the interplay between four types of substantiated resources in an ongoing process of interaction creates the "heaviness" and "variety" of resources that make the paths more visible; these resources are products, facilities, business units and business relationships. The heaviness results from investments in physical and immaterial resources in business interaction while combinations of these resources produce a large variety. Due to the variety of combining resources, including unseen or unused features of resources, there are possibilities of creating new resources as well as new paths in the development of business nets (Håkansson and Lundgren, 1997; Håkansson and Waluszewski, 2002b).

"Place" and "time" are two crucial components in understanding path dependence in the development of technological-created business nets. The former views path dependence as "structure" while the latter considers path dependence as "process". Based on the work by Håkansson and Lundgren (1997), paths exist in an interdependent network structure by which actors' behaviours are controlled; and the broadness of a path is determined by investments in similar and complementary resources. They emphasize, "A path cannot exist in a vacuum, it must in some way be related to other paths, other structures" (p. 129). Owing to multi-facets of resources in multi-layered relationships (Håkansson and Snehota, 1995), a firm may hold several paths together. Seeing path dependence as process implies that an actor will encounter crossings of paths which represent possibilities of creating new resources (e.g. new technological solutions) to be exploited (Håkansson and Lundgren, 1997).

The understanding of the relationship between path dependence and technological development in a business net can be enhanced by three distinct innovation patterns proposed by Kash and Rycroft (2002), in which they take into account five intertwined factors in the process of development: core capabilities, complementary assets, organisational learning, path dependencies, and the selection environment. As Figure 5.3 shows, a transforming technology, which is fundamentally different from other technologies, launches a new trajectory that is related to a normal pattern characterised by incremental changes (e.g. from point a to point d). At some point in time the normal

pattern is replaced by a major (but not fundamental) technological change, the transition pattern at the intersection of two trajectories. Following the transition pattern is another normal pattern that aims to exploit the new technology (trajectory 2) with incremental changes. In the process of the normal pattern, path dependence is strong and actors within the net attempt to increase their returns by exploiting established competencies. The occurrence of the transition pattern often accompanies the rise of a new path, which breaks the existing structure by changing core capabilities and complementary assets.

Figure 5.3 Three innovation patterns



Source: Kash and Rycroft (2002), p. 587

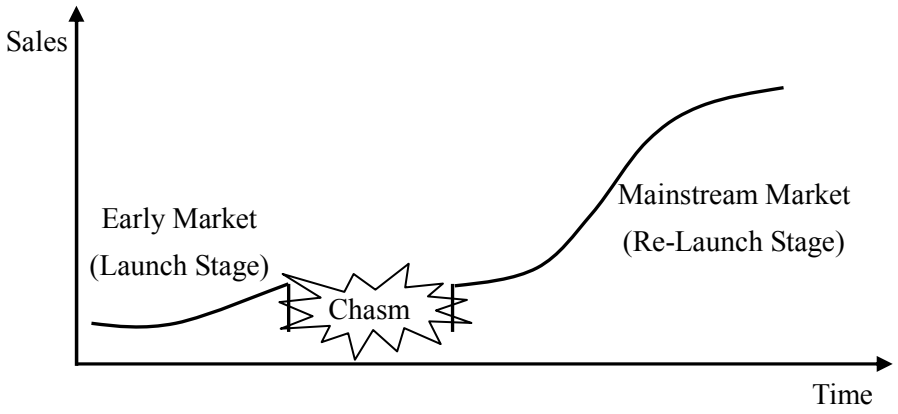
5.4 Managing technological change in a value-creating net

5.4.1 Crossing the chasm

Business actors invest and develop their respective technological resources in an aggregate structure (or technological system or industry) in order to pursue individual and collective economic goals by providing solutions (or products) that can meet end-users' needs and wants. To achieve these goals, a relatively clear path that directs the technological development has to be paved in the interaction process in which activities are aligned and mismatches are removed between interfaces. With the emergence of this path, actors who are embedded in the system are able to achieve the popularity of products and economies of scale and to generate increasing economic returns (Arthur, 1994; Håkansson and Lundgren, 1997).

An important reason for technological development along a path in a business net is to achieve efficiency and effectiveness and expand the market acceptance of products. The priority is to form a relatively stable system in which complementary technologies are bundled and integrated and actors' roles and positions are defined (Ford and Saren, 2001; Hertz, 1992; Johanson and Mattsson, 1992). The key lies in crossing a technological chasm. Based on his influential work *Crossing the Chasm*, Moore (1991) addresses three fundamental parts: the early market and the mainstream market separated by a chasm, the valley of death (see Figure 5.4). Moore argues that the initial success of a technological innovation in the early market does not guarantee the later prevalence in the mainstream market unless the chasm is surmounted.

Figure 5.4 Technology adoption curve



Source: Adapted from Moore (1991)

The existence of a chasm has been validated by Goldenberg *et al.*'s (2002) empirical

data from the consumer electronics industry, showing that between one-third and one-half of their cases encountered a saddle, a slump in sales after an initial peak. The chasm arises from critical differences of needs between early market customers and mainstream market customers. In order to cross the chasm, Moore (1991) suggests that a "whole product", which combines and integrates complementary resources, has to be constructed in the business system. A whole product is able to create a safer atmosphere of innovation adoption and appeal to mainstream customers who are looking for productivity enhancement and believe in evolutionary, not revolutionary, products and innovations. Built on Moore's work, Easingwood and Harrington (2002) put forth a four-step procedure for managers to launch (marketing to early market customers) and re-launch (marketing to mainstream customers) a technological innovation: marketing preparation, targeting, positioning, and execution (see Figure 5.4). This re-launch strategy is a prerequisite for the penetration of the mainstream market (Easingwood *et al.*, 2006).

Moore's (1991) work highlights three interlinked aspects in the development of a technology-based business net using the interaction and network perspective: network orienting, network building and network enhancing. *Network orienting* is about building the first momentum in the early market. It focuses on a firm's efforts in seeking for interorganisational commitments on the investment of the technology as well as in gaining access to new complementary resources, so as to reduce the risks, create core capabilities from a cosmopolitan learning (Kash and Rycroft, 2002), develop the best possible technology (Mohr *et al.*, 2004), and cultivate a winning image (Easingwood and Harrington, 2002). *Network building* stresses the importance of technology bundles after identifying key business partners following a cosmopolitan learning (Ford and Saren, 2001; Ritter *et al.*, 2004), so as to minimize the time in the chasm by transforming the product into a whole product that aims to be the best solution possible. *Network enhancing* concentrates on the cooperation and collaboration between established interfaces; that is, to broaden and strengthen the existing knowledge and to exploit complementary resources within the technological system (Möller and Rajala, 2007) in order to achieve the prevalence of products.

5.4.2 Creating sustainable momentum

In ever-changing, technology-intensive business environments, focusing on a single technological solution or technological generation no longer assures a firm's long-term success. Extant evidence (e.g. Christensen, 1997; Slater and Mohr, 2006) has revealed that a firm (or an incumbent) who rests on its laurels in the mainstream market with the

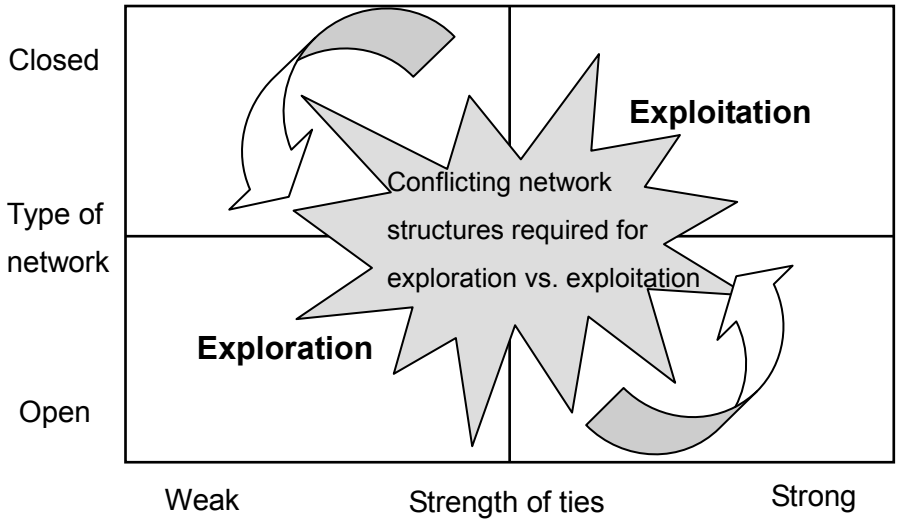
existing technological solution and ignores the emergence of new technology may easily lose its momentum and suffer from the invasion of a new entrant who introduces a new technological solution. As a result, gaining sustainable momentum by bridging new technology or the next generation of technology becomes a vital issue for technology-based firms.

A firm, who is embedded in a business net structured by actor bonds, resource ties and activities links, can be viewed as a nexus of paths (Håkansson and Lundgren, 1997). In other words, a firm may encounter a crossing which currently represents a weak path but has potential to become a strong and broader one based on a new technology. When a promising path is identified, a firm can migrate from the existing path to the new one by adjusting its resources or invest new resources into the new path, allowing its momentum to be sustained. This identification and migration requires the firm to be "ambidextrous" (Slater and Mohr, 2006). Such an ambidexterity comprises the skills of exploitation and exploration; in which the former is "the refinement and extension of existing competences, technologies, and paradigms" while the latter is "experimentation with new alternatives" (March, 1991, p. 85). A firm's ability to maneuver exploration and exploitation is closely related to its learning nature and interaction history. Just as March (1991, p. 73) argues:

> As organizations learn from experience how to divide resources between exploitation and exploration, this distribution of consequences across time and space affects the lessons learned.

A firm who is capable of utilizing exploration and exploitation within or between technologies can create sustainable momentum. The work by Dittrich and Duysters (2007) reveals that Nokia's exploitation strategy in the development of the first two generations of mobile telephony and an exploration strategy in the development of technologies for the third generation, including exploring a new market of mobile payment service, account for its success in mobile telephony markets. Using the Volvo case as an illustration, Harryson *et al.* (2008) propose that bringing an innovation from idea generation to commercialization requires transformation networks that link creativity networks (which rely on weak relational ties in open networks) and process networks (which rely on strong ties in closed networks), see Figure 5.5. Transformation networks aim to ensure a smooth shift from exploration to exploitation by transferring and integrating relevant knowledge that is created in creativity networks into process networks that aim to exploit established competences between interfaces to achieve a successful commercialization.

Figure 5.5 Transformation networks in innovation alliances



Source: Harryson *et al.* (2008), p. 749

Based on the above theoretical elaboration on business relationships and networks and their interrelationship with technological development, technological development acts as a compelling force that drives the development of relationships in networks. Just as Lundgren (1995, p. 92) observes:

> Technology is a significant part of industrial networks. Technological development is a compelling force driving the evolution of industrial networks, but this statement covers only half of the story. The evolution of the industrial network is also a compelling force driving technological change.

It is also fair to say that technological development can be seen as the outcome of relationship development. Managing network dynamics is not only strategically important but also concerned with a firm's ability to cope with technological change in order to gain long-term sustainability. However, when a value-creating net is under research, our understanding of the arrival of technological change, relationship dynamics derived from this arrival and how a firm embedded in such a net can cope with the arrival of technological change remains under-examined. In the next chapter, prior to bringing up research questions, this research gap will be discussed.

6 Revealing the research gap from existing understanding of technological changes and network dynamics

6.1 Introduction

This chapter deals with the existing understanding of technological change in business networks within which the research gap is revealed and research questions are developed. The research gap lies in an under-examined process, a transition period, which links two formations of a business net respectively based on an old and a new generation of technology or technological trajectories. This transition period is marked by mobilisation of resources and changes in connection of activities, which in turn beget relationship dynamics that render the reconfiguration of the business net and that affect competitive stances of actors embedded in this net. Towards this research gap, two research objectives and four research questions are developed. Prior to discussing the research gap, it is necessary to clarify some important definitions in order to facilitate the empirical investigation.

6.2 Some key definitions

This research aims to develop a longitudinal perspective on the evolution of a business net triggered by the arrival of technological change. To facilitate the empirical examination of this research in a processual network setting, it is crucial to clarify three important definitions: business net, relationship ending and technological change.

Business net – It is important to heed that all boundaries in network research are artificially decided on the basis of the industrial field (e.g. product technology) and are a result of the perspective and interpretations of the investigator or in the case of the actor's view of it (Axelsson, 1992b). This research adopts a focal net perspective to study technological change and network dynamics. This perspective centres on a focal actor's point of view about its important relationships that can be identified as a business net. More specifically, a business net in this research refers to a net that consists of an actor's supplier, customer and complementor relationships, representing a technology-bundled and value-creating net (Ford and Saren, 2001; Parolini, 1999). Such a business net, a subdivision of the network, also reflects the industry logic and captures the strength of complementarity among the members of the net (Easton, 1992; Johanson and Mattsson, 1992). Although the formation of a business net contains members'

deliberate actions, a business net in this study does not suggest that this net is managed by a hub firm or captain, as claimed by American schools (e.g. Campbell and Wilson, 1996; Kothandaraman and Wilson, 2001).

Relationship ending – Inter-organisational relationships have been considered as vital components in marketing in network economies (e.g. Anderson *et al.*, 1994; Sheth and Sharma, 1997). Regarding the definition of relationship, however, a consensus has not been reached. Zolkiewski (2004) points out that a conclusive definition of relationship is even more difficult to be found in a marketing context, despite the fact that some tentative definitions have been suggested. Consequently, the view of an ended relationship may differ among researchers. To facilitate this study, "ceasing to trade" is an important criterion to judge an ended relationship (Havila and Wilkinson, 2002).

Technological change – There is still a controversy over the classification of technological change in the literature of high-tech and innovation marketing (Danneels, 2004; Ehrnberg, 1995). In this research, the judgment of technological change is on the basis of a technological generation in which technological development follows a certain path (Kash and Rycroft, 2002). Within a business net based on a generation of technology, actors are engaged in the adaptive process in order to create increasing returns and the prevalence of products (Arthur, 1994; Christensen, 1997; Tabrizi and Walleigh, 1997). Thus, a major technological change is a shift from the existing generation of technology to another (or new or the next) generation of technology while minor technological change refers to incremental change within a generation (or path).

6.3 Revealing the research gap and developing research questions

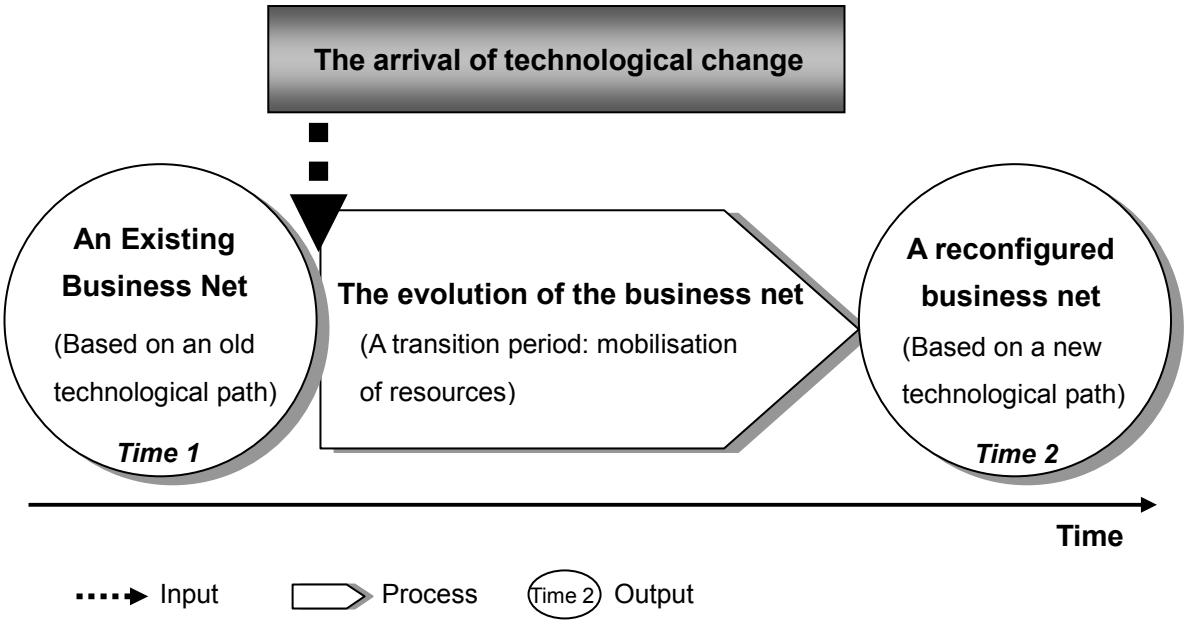
Network evolution driven by technological change is the central interest of this research, especially using a focal net perspective. This research interest arises from the diverse views on technological change. Bridging technological change has been treated as a critical event because it can generate fresh impetus to a firm's sustainability (Danneels, 2002; Suárez and Utterback, 1995). Another critical aspect of bridging technological change is that its appearance usually breaks a firm's cooperative relationships because of reasons such as competence-destroying or strategic misfit (e.g. Christensen, 1997; Slater and Mohr, 2006). To place this view in a network setting, the occurrence of technological change may result in relationship dynamics that render the reconfiguration of a business network, in which some relationships may be dissolved or established while some are strengthened or maintained (e.g. Afuah, 2000). In other words, viewing technological change as a critical event tends to regard technological change as an

independent variable (input) and regard relationship dynamics (that cause the restructure of a business network) as a dependent variable (outcome). However, this treatment of technological change runs the risk of deemphasizing the evolutionary and accumulative features of technological development.

The dawn of the network era suggests that interactions through developing exchange relationships have become an imperative for each individual actor to pursue its economic goals and enhance its competitiveness (e.g. Achrol and Kotler, 1999; Håkansson and Snehota, 1989; Möller and Halinen, 1999; Parolini, 1999). An interactive and network view of resource interaction suggests that the emergence of a technological paradigm or path is the result of the combination and interaction between heterogeneous resources embedded in an ongoing and adaptive process, in which actors hold their respective theories of how resources should be combined and engaged in interactions (Håkansson *et al.*, 2009; Håkansson and Waluszewski, 2002a). It is this ongoing and adaptive process that changes technological resources in terms of their features, usages and combinations. In other words, technological change arises from an interactive process characterised by collective and accumulative efforts of actors who are connected and embedded in networks. In this vein, technological change is seen as a process rather than viewing it as a critical event.

The process of the arrival of technological change at a business net is part of the evolution of this net and can be seen as a transition period which links two technological paths and during which resources (e.g. competences and relationships) may be eliminated or expanded, rendering the reconfiguration of the net (Afuah, 2000; Håkansson and Waluszewski, 2002b; Kash and Rycroft, 2002). Despite the interrelationship between the process of the technological arrival and network dynamics result from this arrival, this interrelationship remains under-examined. The existing literature indicates that the interrelationship can be decomposed into four elements: an existing net (at a certain point in time), the evolution of a business net triggered by the arrival of technological change and a reconfigured business net (at another point in time), as shown in Figure 6.1. While an existing net is based on an old technological path where net members occupy their network positions with clearer roles for the counterparts, a reconfigured net based on a new path can be seen as the consequence of the transition period triggered by the arrival of technological change where net members act or react to this arrival in light of their interpretations of surroundings. The above follows the logic of input-process-output proposed by Van de Ven and Huber (1990).

Figure 6.1 The arrival of technological change and business net evolution



Based on the existing understanding of the interrelationship between technological change and network dynamics, the first objective of this research is to investigate the process of the arrival of technological change and its impact on network configuration. With this objective, the following two research questions are developed:

- What is the nature of the process of the arrival of technological change at the focal net?
- How is the configuration of the focal net affected by this technological arrival?

The second research objective relates to relationship dynamics, especially the radical changes of relationships. As depicted in Figure 6.1, the reconfiguration of a business net is an important part that is closely related to the arrival of technological change. This reconfiguration results from relationship dynamics which are occasioned by the arrival of technological change and which usually contain radical changes of relationships (e.g. Afuah, 2000; Slater and Mohr, 2006). These radical changes of relationships can be identified by comparing the configurations (consisting of actors and relationships) of a business net before and after the arrival of technological change (e.g. Time 1 and Time 2 in Figure 6.1). Apart from building new relationships, other types of radical changes of relationships, such as ending or even reactivating relationships, have received increasing attention (e.g. Havila and Wilkinson, 2002; Tähtinen and Halinen, 2002). However, such radical changes of relationships are rarely examined in a technology-intensive

network setting where characteristics of embeddedness and connectedness need to be considered.

Relationship dynamics have strategic significance for actors embedded in a business net and they can be captured through studying those actors' changes in network positions. Given that a firm's network position is defined by the relationships to which it connects (Mattsson, 1987), radical changes of relationships not only bring about change in an actor's network position but also alter its competitive stance because a firm's network position signifies its accessibility to complementary resources, its power and freedom to influence others, and its combination of recourses and connection of activities (Johanson and Mattsson, 1992; Wilkinson and Young, 2002). When studying actors' network positions at different points in time (e.g. before and after the arrival of technological change), it is crucial to investigate their dynamic aspect: the roles that come with these positions (Anderson *et al.*, 1998), since a role signifies what resources are actually used in productive activities. In this way, more detailed relationship dynamics (including incremental and radical changes of relationships) through time can be revealed, which in turn, insights into network dynamics driven by technological change can be gained.

On the basis of the interest in relationship dynamics which arise from the arrival of technological change, the following two research questions are developed:

- How the arrival of technological change impacts on the relationship dynamics of the focal net, particularly the radical changes of relationships?
- How is a firm able to cope with relationship dynamics caused by the arrival of technological change at a business net?

In summary, the value of this research arises from the identification that technological change should be seen as the result of connected actors' collective actions and accumulated efforts embedded in an interactive process that links two network formations in which relationship dynamics take place, rather than viewing it as a critical event. The originality of this research lies in the combination of an input-process-output model with a focal net perspective to investigate the process of the arrival of technological change and relationship dynamics derived from this arrival. The insights developed from this research can enhance our knowledge of the emergence of technological change, bringing technological innovation to markets and coping with technological change by utilising interfirm relationships in networks.

Part III Empirical Research on the Optical Recording Media Industry

7 Methodology

7.1 Introduction

This chapter addresses methodological issues concerning how network dynamics triggered by technological change can be captured through the interplay between the theoretical foundation and the empirical world. In the first place, the chapter discusses the rationale of the adoption of a qualitative, longitudinal case study approach that facilitates investigating the process of the arrival of technological change at a value-creating and technology-bundled business net. Especially an input-process-output model was employed. Secondly, this chapter describes the research process in detail, including how the research topic and research questions were revealed in Chapter 6, and why an abductive logic emerged from this research. Then, the chapter deals with the interaction with the empirical reality; that is, how the case was selected, how depth interviews with managers were carried out, what other sources of evidence were consulted, and how these multiple sources of data were analysed. In the end, an evaluation of data quality in terms of credibility and generalisability is provided.

Quantitative research methods were excluded from methodological choices in this study for three reasons. First, the central interest of this research is to explore and understand the evolution of a technology-based business net which consists of meaningful individuals and organisations, rather than testing objective theories by examining the relationship among variables (Creswell, 2009). Second, since a particular emphasis is placed on the influences of time and temporality in the evolution of the net in which dyadic views from interconnected actors have to be captured (Halinen and Törnroos, 2005), it is difficult to gain richness and depth about this evolution using quantitative instruments, e.g. a questionnaire. Third, as Easton (1995) points out, the network phenomenon is constituted by the connections and the patterns of these connections create network processes; and therefore, "sampling theory is never likely to be applicable" (p. 468).

7.2 A qualitative, longitudinal case study approach

7.2.1 The adoption of methods

The strategies of inquiry of this research are on the basis of qualitative methods (Creswell, 2009). The word *qualitative* is about "the qualities of entities and on

processes and meanings that are not experimentally examined or measured" (Denzin and Lincoln, 2003, p. 13), while a *methodology* refers to "the choices we make about cases to study, methods of data gathering, forms of data, etc., in planning and executing a research study" (Silverman, 2005, p. 99). Easton (1995) argues that methodology has precedence over research methods, in which the former involves strategic-level options while the latter is concerned with research techniques (e.g. sampling, interviewing or observation) that best facilitate the study of the research phenomena. Silverman (2005, p. 99) emphasizes that "methodologies cannot be true or false, only more or less useful."

A crucial criterion in the choice of research methods (or approaches to inquiry) is the identification of research problem (Creswell, 2009). As Silverman (2005) points out, theoretical concepts (e.g. business interaction through relationships) define and explain some social phenomena, and provide ways of looking at the world which are essential in defining a research problem. This research takes an interaction perspective to study how business actors respond to changing conditions (such as technological change) in a technology-intensive environment, in which an actor depends on its own and others' resources to pursue economic goals (Ford *et al.*, 1998; Håkansson and Ford, 2002). In particular, the attention of the research is focused on developing a deep understanding of the arrival of technological change at a business net, in which an actor's efforts towards the change may be enabled and/or constrained by its interfirm relationships. In order to capture the dynamics in the network, the research considers the features of a value-creating and technology-bundled business net (Ford and Saren, 2001; Parolini, 1999) while retaining the characteristics of embeddedness and connectedness (Blankenburg and Johanson, 1992; Halinen and Törnroos, 1998), which make the statistical representativeness and inference inapplicable to this research and which highlight the importance of time and temporality (Easton, 1995). Thus, the selection of qualitative research methods is considered appropriate.

A qualitative method suits the purpose of this research mainly because it allows the researcher to interact with the informants from the natural research setting (namely, a technology-intensive business net), enabling the researcher to capture individual actor's points of view on the development of the business net, to examine the constraints of everyday life, and to secure rich descriptions of this interactive business net (Denzin and Lincoln, 2003). In addition to the close interaction between the investigator and participants, this qualitative method has merits of offering a holistic account of the process of the arrival of technological change and permitting an emergent design to collect the field data, such as adjusting research questions (Creswell, 2009). According to Denzin and Lincoln (2003), qualitative research is as a set of interconnected interpretive practices which involve a variety of empirical materials, in hopes of

achieving a better understanding of the subject matter at hand. As they (Denzin and Lincoln, p. 13) mention:

> Qualitative researchers stress the socially constructed nature of reality, the intimate relationship between the research and what is studied, and the situational constraints that shape inquiry. Such researchers emphasize the value-laden nature of inquiry. They seek answers to questions that stress how social experience is created and given meaning.

7.2.2 A longitudinal case study

Under the qualitative research strategy, a longitudinal case study is considered suitable to study the evolution of a business net (Dubois and Araujo, 2004; Easton, 1995; Halinen and Törnroos, 2005) and is chosen for empirical investigation for this research. Case studies have been a popular research strategy with the IMP research area, in which a particular emphasis is placed on the process of change over time (Alajoutsijärvi *et al.*, 1999; Dubois and Araujo, 2004; Easton, 1995; Halinen and Törnroos, 2005). As Stake (2003) indicates, case study is a choice of what is to be studied, where both case study researchers and readers can learn from the case. He stresses that a case study "is both a process of inquiry about the case and the product of that inquiry" (Stake, 2003, p. 136). Regarding what constitutes a case study, Yin (2003, p. 13) gives his definition as follows:

> A case study is an empirical enquiry that investigates a contemporary phenomenon within its real life context, especially when the boundaries between the phenomenon and context are not clearly evident.

With regard to longitudinal studies, Saldaña (2003) points out that time is at the heart of such studies because it allows researchers to analyse change of a social system and know how this system evolves through time, although no consensus on a required minimum length of fieldwork time is reached. He also argues that accumulative affects are the outcomes of an evolutionary process (e.g. the development of a business network) and this accumulative change can be discerned by researchers in a form of time triangulation which comprises three beats of time: before, during and after. The importance of time is as Halinen (1998, p. 112) argues, "Time, like space, is one the most significant dimensions through which human beings construct and interpret reality". Medlin (2004, p. 187) also points out that "time acts as an environment that constrains, shapes, and patterns business interaction and the deployment of resources and activities in space, for value is created by interaction according to a time/spatial

arrangement in which time encloses space". As a result, longitudinal research is often viewed as processual studies where dynamics are revealed through time (Easton, 1995; Halinen, 1998; Pettigrew, 1995, 1997; Van de Ven and Huber, 1990).

To use time to capture network dynamics, understanding its different perspectives is necessary. Halinen and Törnroos (1995) make a distinction between horizontal time and vertical time, in which the former is treated in a linear fashion, that is, the past and the future is bridged by the present; while the latter is related to the specific cultural and contextual setting. Similarly, Orlikowski and Yates (2002) argues that time can be understood in an objective-subjective dichotomy. An objective view conceives time as existing independently of human action; time is linear, mechanical, absolute, invariant and quantitative. A subjective view conceptualizes time as socially constructed through human action; time is relative, contextual, organic and qualitative. Orlikowski and Yates (2002) contend this objective-subjective dichotomy is often recognized as clock time and event time.

Such temporal-based processual studies stress "from-through" rather than "from-to" (discrete starting and ending points), in which the former outlines the process of change while the latter generates a product of change (Saldaña, 2003). A processual research design can be seen as an "input-process-output" model which focuses not only on the inputs and outcomes of change but also on process of change and which views each event in the process as a change in a variable (Van de Ven and Huber, 1990). Here, the process can be regarded as "a sequence of individual and collective events, actions, and activities unfolding over time in context" (Pettigrew, 1997, p. 338). In order to understand the evolutionary process, Pettigrew (1995) suggests that the research on change needs to explore the content, contexts and process of change, and study their interconnections through time. As a whole, the longitudinal study for this research can be seen in the manner described by Halinen (1998, p. 118) as:

> The processual perspective of development draws attention to the content of the process and its conceptual description. The process may, for instance, be described in dynamic concepts that are themselves defined in relation to temporal modes: to the past, present and future […] The development of relationships is viewed in relation to the processes evolving in relationships and the events occurring in their context, not in relation to the mere passage of time.

The concepts of time and process in this longitudinal case study are used in the following ways. Regarding time, the empirical examination of this research draws on both perspectives of time (e.g. clock and event time) to capture network dynamics

caused by the arrival of technological change, which marks the evolution of the focal net. This usage is in accordance with Halinen and Törnroos's (1995) relational time concept which combines horizontal and vertical time perspectives and which is argued to be a useful tool in conducting empirical research into interaction and networks in business markets. As for processual design, this research adopts an input-process-output model (Van de Ven and Huber, 1990) to facilitate the empirical investigation of network evolution driven by technological change. In such a model, "the arrival of technological change", "the evolution of the focal net" and "the reconfiguration of the focal net" respectively refer to "input", "process" and "output".

Once a processual research design is employed in a particular network context, a single case study which involves a number of interconnected actors is considered not only appropriate but also unavoidable due to the consideration of connectedness and interdependence between these actors and influences of time and temporality (Easton, 1995). This single-case study aims at providing holistic and rich descriptions of the process of the arrival of technologic change at a technology-based business net, including the impact of this arrival on relationship dynamics, rather than testing and generating theories via a multiple-case study based on replication logic (Yin, 2003). The rationale of adopting a single-case study accords with what Dubois and Gadde (2002, p. 558) argue:

> […] when the problem is directed towards analysis of a number of interdependent variables in complex structures, the natural choice would be to go deeper into one case instead of increasing the number of cases. It is difficult to comprehend how a little depth and a little width could contribute to the analysis of any problem.

In summary, the employment of a longitudinal single-case study has three advantages. In the first place, a case study enables the researcher to investigate the research phenomenon in detail so as to construct an in-depth understanding of the network complexity in a technology-intensive setting, in which why and how questions are of particular interest (Yin, 2003). Secondly, as Patton (2002, p. 159) indicates, such a qualitative inquiry strategy is highly suitable for processual research because "depicting process requires detailed descriptions of how people engage with each other", "the experience of process typically varies for different people so their experiences need to be captured in their own words", "process is fluid and dynamic so it can't be fairly summarized on a single rating scale at one point in time", and "participants' perceptions are a key process consideration." Thirdly, this longitudinal case study enables the researcher to learn from the case via an iterative process that allows the match between theoretical and empirical insights, and the acquisition of further knowledge related to

the subject under study (Dubois and Gadde, 2002; Eisenhardt, 1989; Stake, 2003; Yin, 2003). Just as Dubois and Gadde (2002, p. 554) argue, "Learning from a particular case (conditioned by the environmental context) should be considered a strength rather than a weakness. The interaction between a phenomenon and its context is best understood through in-depth case studies."

7.3 The research process

7.3.1 Searching for the research topic and questions

The journey of this doctoral research commenced in the autumn of 2006 and started by examining how a high-tech firm can create sustainable momentum by adopting new technology, in which the firm may have to confront ending cooperative relationships because of capability-obsoleting effects occasioned by the occurrence of technological change (e.g. Chandy and Tellis, 2000; Danneels, 2004; Moriarty and Kosnik, 1989; Sood and Tellis, 2005). It was thought that gaining new insights of how a firm tackled relationship ending could advance our knowledge of the successful migration to new technology. Apart from reviewing the literature of marketing and managing technological innovations, a great deal of attention was placed on the process of relationship ending (e.g. Halinen and Tähtinen, 2002; Stewart, 1998), its antecedents (e.g. Hibbard *et al.*, 2001; Ping, 1999), and the communication between parties in the ending process (e.g. Alajoutsijärvi *et al.*, 2000; Hirschman, 1970). At that time, the attention of the research was focused on the dyadic level, that is, the relationship between buyer and seller.

In the September and October of 2007, a pilot study was performed with a Taiwanese-based OEM (Original Equipment Manufacturer) and its Japanese-based customer (a technology vendor) from the optical recording media industry. The purpose of this pilot study was to investigate the content of destructive acts (Hibbard *et al.*, 2001) or ending (or critical) events (Tähtinen and Halinen, 2002) in the relationship on the basis of questions developed from the knowledge gained from the literature review. Based on the empirical data, a conference full paper (Chou and Zolkiewski, 2008a) was written and presented in the third Annual International Conference on Business Market Management. Drawing on the dyad-network perspective (Halinen and Törnroos, 1998) to delimit the boundary of the case study, an important finding in this paper is that an actor's bridging of new technology may act as a critical incident that triggers radical changes of dyadic relationships and consequently results in the reconfiguration of business network.

The network effects caused by the adoption of new technology then directed the attention of this research to the IMP Group's Interaction and Network Approach (Axelsson and Easton, 1992; Håkansson, 1982). Being immersed in the studies built on the IMP perspective, I kept reflecting upon the research framework and looking for a better interpretation of the pilot study. This area of "interaction" research soon fascinated me. Within the IMP domain, I found some powerful conceptual tools that offered the explanations of how a firm could enhance its competitiveness by managing interfirm relationships effectively, such as network position (Johanson and Mattsson, 1992) and interfirm adaptation (Brennan *et al.*, 2003). Then, the pilot study was re-analysed using a network perspective of strategy which considered the characteristics of connectedness and embeddedness. This reinterpretation of the case was later organised in a competitive paper (Chou and Zolkiewski, 2008b) for the 24th IMP Conference. The main argument of the paper is that a firm's bridging of technological change can be seen as a pivotal event as well as strategic change that may bring about relationship turbulence between the firm and its counterparts, in which relationship ending can be a strategic option that allows network resources to be reconfigured and the firm's momentum to be sustained.

Because of the input of new thoughts, I made it clear that the focus of this research was centred on the process of the arrival of technological change where this process would be marked by the mobilisation of heterogeneous resources based on actors' respective strategising. In the meantime, the research frameworks and questions were revised. Then, a five-month revisit of the field started from the April of 2008. The revisit mainly included extensive depth interviews with managers from the focal company and its suppliers and customers that formed a value-creating system. Due to new thoughts emerging from the data, several follow-up e-mails and phone-calls were carried out after the fieldwork. The research frameworks were also slightly changed.

7.3.2 An abductive process

The above (section 7.3.1) is the reflection on the process of my search for research problem and theoretical foundation. With retrospection, this process blends together induction and deduction, in which the former emphasizes generating theory from the data (e.g. Glaser and Strauss, 1967) while the latter focuses on testing theory via developing hypotheses. The reflection on this doctoral research process agrees with what Perry (1998, p. 788) contends that "it is unlikely that any researcher could genuinely separate the two processes of induction and deduction." As Bonoma (1985, p.

204) has pointed out, when case study research is carried out, a theory/data/theory revision cycle is beneficial. Particularly in the area of longitudinal (or processual) research, the mix of inductive and deductive components in the research process is advocated. Pettigrew (1997) agues that a processual study is an inseparable balancing act of deduction and induction. He also mentioned: "It is in this constantly iterating cycle of deduction and induction that the real creative process of the research takes place" (p. 344). Perry (1998) suggests the usage of a mix of induction and deduction for case study research, as he argues:

> Pure induction might prevent the researcher from benefiting from existing theory, just as pure deduction might prevent the development of new and useful theory (p. 789).

Similar to Bonoma's (1985) four-stage research process consisting of "drift", "design", "prediction" and "disconfirmation", Pettigrew (1997, p. 344) argues that an overall cycle of deduction and induction could comprise:

> the core question of the study → related themes and questions → preliminary data collection → early pattern recognition → early writing → disconfirmation and verification → elaborated themes and questions → further data collection → additional pattern recognition across more case examples → comparative analysis → a more refined study vocabulary and research questions

At the beginning of my doctoral research, I did not intend to adopt an "abductive" research design. An abductive logic just happened to emerge in my research process. I think I was lucky enough to meet my supervisor, Dr. Judy Zolkiewski, and with her guidance, I was able to enter into the IMP research field (before that I knew nothing about the IMP Group), and more importantly, to participate in IMP annual conferences from 2007 to 2009. These conferences acted as an excellent platform for me to get useful and constructive feedback on my work at different stages from leading experts in this field of B2B and network research, allowing me to review my research questions, theoretical framework, the results of my pilot study and the subsequent fieldwork and the presentation of my empirical data and its analysis. This iteration between theoretical framework and empirical data, facilitated by using feedback from IMP conferences, is the key that contributed to achieving abduction in my research.

Even though this occurred by coincidence, it is still worth mentioning this abductive logic because of its strengths in the development of theory. Within the domain of industrial network research, this abductive logic has received increasing attention.

Dubois and Gadde (2002) propose "systematic combining" as a proper case study approach. They contend that systematic combining "is a process where theoretical framework, empirical fieldwork, and case analysis evolve simultaneously, and it is particularly useful for development of new theories" (p. 554). Systematic combining aims to match theory and reality through a process of going back and forth between framework, data sources and analysis. In their work, Dubois and Gadde (2002) emphasize the evolving aspects of analytical framework whose interplay with the empirical fieldwork will lead to the identification of unanticipated but related issues which can be explored with expanded or revised framework and further empirical work. It is this iterative process that theory is developed.

7.4 Case selection, data collection and analysis

7.4.1 Delimiting a network boundary for this research

When carrying out a case study on the basis of a longitudinal (or processual) research design, two issues need to be noted. One of the issues is about research phenomena. According to Yin's (2003) definition of what constitutes a case study, it seems necessary to distinguish between contemporary and non-contemporary events in an attempt to facilitate case-based research. However, as Dubois and Araujo (2004, p. 209) contend, "There is no reason for establishing a tight distinction between contemporary and non-contemporary events if we take a processual approach to the phenomena of interest. History is always encoded in the structures that shape current choices." They highlight that the distinction between case research and case histories lie in the way narratives are organised.

The other crucial and interconnected issue is how the boundary of this network study is delimited, especially when time and temporal frames are considered. Concerning this issue, Halinen and Törnroos (2005) hold that the primary guideline is the content of the research problem. They suggest that the definition of network boundaries needs to take into account the concepts of "network horizon" and "network context", in which the former refers to an actor's view on how the network is extended while the latter is part of the network horizon that the actor considers relevant. Halinen and Törnroos (2005, p. 1289) stress that "Delimiting the case network is something that has to be done to trace the objectives of the study. Boundary setting is necessary for analytical purposes, for defining the case, and what belongs to it and to its context." The challenges of delimiting boundaries lie in that an actor's actions or reactions are influenced, enabled and constrained by relationships to which it connects (Ford and Håkansson, 2006; Ritter,

2000) and that the actor's resources have to be recombined and recombined with other resources in the development of the aggregate structure of which it is a part, especially in technology-intensive network contexts (Gadde and Håkansson, 2008).

A focal net perspective is employed to set an artificial and purposeful boundary for the investigation of the network evolution driven by technological change. This perspective, which centres on a focal actor's interaction with important and connected parties, is employed for theoretical and methodological considerations. Theoretically, the focal net here comprises the focal actor's important relationships (Alajoutsijärvi *et al.*, 1999), namely, its supplier, customer and complementor relationships, representing a technology-bundled and value-creating net (Ford and Saren, 2001; Parolini, 1999). Such a focal net is able to not only capture the characteristics of connectedness and embeddedness of business networks (e.g. Anderson *et al.*, 1994) but also facilitates an examination of the combination of resources and the connection of activities which are based on a major technological path and which are embedded in a technology-based network (Håkansson and Waluszewski, 2002a; Kash and Rycoft, 2000). This perspective also takes into account the "dyad-network embeddedness" which stresses the relationships' functions as transmitters and transformers of network change and which help investigate the spread of change from a certain relationship (Halinen and Törnroos, 1998).

Methodologically, adopting a focal net perspective suits the interests of this network research, one of which is about network dynamics caused by interconnected actors' actions upon or reactions to technological change. Regarding methodological choices for setting network boundaries, Brito (1999) advocates the use of issue-based nets as sampling units to capture the connectedness characteristic of network analyses. According to him, the constitution of an issue-based net is on the basis of "cooperative relationships amongst actors who aim to cope with a collectively recognised issue by influencing the structure and evolution of the system(s) to which they belong through an increased control over activities, resources and/or other actors" (p. 93). Brito (1999) points out that the richness of using an issued-based net can be obtained when the attention is focused on the development of a systematic view related to a particular collective issue, and the understanding of the dynamics of industrial systems driven by the mobilisation of collective interests.

7.4.2 Selecting the case

The empirical examination of this research aims to acquire the richness of network phenomena and help both researcher and readers to learn from the case, so as to advance the knowledge of network dynamics is a technology-intensive setting (Stake, 2003). For this purpose, selecting a suitable case becomes crucially important since it provides a platform for the researcher to iteratively interact between the theory and the empirical setting (Bonoma, 1985; Dubois and Gadde, 2002). A case (a focal net) from the optical recording media industry is purposefully and theoretically chosen under theoretical and methodological criteria. Firstly, based on the focal net perspective (discussed in section 7.4.1), the case that comprises a focal actor (an optical media maker which possesses process technology), its suppliers (which possesses product technology), customers (which possesses marketing technology) and a complementor (which possesses complementary resources) represents a technology-bundled and value-creating net (Ford and Saren, 2001; Parolini, 1999). Secondly, the focal net that consists of several relationships permits the study of the relationships' functions as transmitters and transformers of network change (Halinen and Törnroos, 1998). Thirdly, the industry as well as the focal actor has experienced several technological changes, in which network dynamics triggered by technological changes can be observed and sub-cases (the focal actor's net configuration based on each technological generation) can be identified along the time dimension. Lastly, the case enables the researcher to gain access to key organisations and interviewees, including the focal actor's competitors, allowing sufficient resources to be acquired while in the field (Yin, 2003).

This purposive sampling allows the researcher to study the process of business net evolution, which is the central interest of this research; and its selection of participants and sites permits the researcher to best understand the research problem and questions (Creswell, 2009; Silverman, 2005). This purposive sampling does not follow the logic of random sampling and a large number of informants, as typically found in quantitative research; it is theoretically driven (Eisenhardt, 1989; Miles and Huberman, 1994; Silverman, 2005; Yin, 2003). As Eisenhardt (1989, p. 537) contends, "The cases may be chosen to replicate previous cases or extend emergent theory, or they may be chosen to fill theoretical categories and provide examples of polar types. While the cases may be chosen randomly, random selection is neither necessary, nor even preferable." The theoretical sampling here can be seen as within-case sampling (Miles and Huberman, 1994) in which the focal actor and its focal net are all embedded in a broader environment, the network of the optical recording media industry. As Miles and Huberman (1994) indicate, such within-case sampling has an iterative or rolling quality, leading the researcher to new samples of informants and new documents. Thus,

"choosing cases in terms of your theory" and "changing the size of your sample during the research" are the characteristics of theoretical sampling (Silverman, 2005, p. 131).

7.4.3 Significant events as building blocks of process

Using "significant events" is considered in this research as a beneficial way to study the process of business interaction which is permeated with change influences initiated by interconnected, resource-dependent and profit-seeking actors. As Ford and Håkansson (2006, p. 8) indicate, "One way for researchers to deal with "lumpy" interaction is to identify "significant events" or "critical incidents"." The notion of significant events is similar to the concept of critical events used by network researchers, e.g. Halinen *et al.* (1999) and Schurr *et al.* (2008). Significant or critical events may have an "enabling" character that assists or stimulates a certain process or activity or an "inhibiting" character that hinders or creates difficulties for a certain process or activity (Törnroos and Elo, 2005). These events carry change forces which mark the evolution of a business network and may alter the structure of that network by begetting radical changes of relationships (Halinen *et al.*, 1999). Not all interaction episodes are critical or significant. But a critical event can be discerned from the process of business interaction pieced together by interaction episodes. As Schurr *et al.* (2008, p. 878) argue, "[…] critical events occur when actor bonds, resource ties, and activity links change in ways that produce company gains and losses."

In this research, "significant events", rather than critical events, are labeled as those events that alter the structure of actor bonds, resource ties and activity links because of the difficulties in measuring the criticality of events in business interaction. Törnroos and Elo (2005) point out that the criticality of an event hinges on its contextual circumstances. More importantly, an event's criticality in interactive environments is determined by actors' individual perceptions, which are affected by time and space (network structure) dimensions (Schurr *et al.*, 2008). For instance, a seller's price markup may be perceived as a critical event by its customers, but not by its suppliers or complementors. And the perception of this event among these actors may change, erode or even disappear over time. In this vein, "significant events" is a neutral usage.

Significant events in the process of business interaction are crucial to the development of a processual view of the focal net evolution, especially when the influences of time and temporality are taken into account. Saldaña (2003) emphasizes that time is data, enabling the researcher to investigate the "from-through" aspect of the processual study. To undertake such a processual study, Pettigrew (1997) suggests that researchers should

aim at producing a case study rather than a case history, in which events and chronologies are building blocks. This division of time into past, present and future permits researchers to relate significant events to technological development. In other words, the evolution of a business network driven by the arrival of technological change can be decomposed into a series of significant events, which can be described using an input-process-output model (Van de Ven and Huber, 1990). Therefore, using significant events helps the processual analyst not only to understand interacting parties' respective thoughts and attitudes towards the arrival of technological change but also the interrelationship between these events and its impact on the structure of the focal net.

7.4.4 Gathering empirical data

This longitudinal case study centres on the evolution of the focal actor's (company F's) business net in the optical recording media industry. Since the choice of the case is rationalised by the accessibility to the field and the occurrence of several major technological changes, an ambition of data collection is to reconstruct the development of the focal net based on these technological changes, in which periods of stable development and periods of transition may be identified. In other words, technological changes from CD-R to DVD-/+R, DVD double layer and high definition optical recording media technologies arriving at the focal net have to be covered in the empirical investigation. Thus, the data collection of this research mainly relies on a retrospective or historical methodological approach. Such an approach emphasizes gathering data at many points in time (Halinen and Törnroos, 1995; Pettigrew, 1997; Saldaña, 2003).

Based on a retrospective approach, empirical data was collected mainly through depth interviews with managers from the focal actor and its cooperative members, so as to reconstruct the history of the development of interconnected dyads that constitute the focal net. However, Halinen and Törnroos (1995) point out the time distance may prevent the researcher from producing an adequate description of history, especially when this description is built on a single source of data, e.g. interviews. When depth interviews for this historical study were carried out, a number of problematic issues took place in the field, such as managers' memory loss concerning the timing of particular events and contents of activities, and the data availability due to personnel turnover in organisations. As a result, documentary and archival materials were consulted, including industry statistics, market research reports, company annual reports, company newsletters and minutes of meetings. The importance of the triangulation of evidence is stressed by Halinen and Törnroos (1995) in order to reconstruct relationship

history.

The reconstruction of the evolution of the focal net which is embedded in the optical recording media industry mainly relies on qualitative interviews: face-to-face depth interviews with informants (Creswell, 2009; Halinen and Törnroos, 2005; Patton, 1987; Silverman, 2005; Yin, 2003). According to Patton (1987), "Depth interviewing probes beneath the surface, soliciting detail and providing a holistic understanding of the interviewee's point of view […] *The purpose of interviewing, then, is to allow us to enter the other person's perspective*" (pp. 108-109). Case study interviews have an open-ended nature, in which interviews appear to be guided conversations, pursuing a consistent line of inquiry about the interrelationship between technological development and the evolution of the focal business net, including resource usage and combination based on a mainstream technology (Yin, 2003).

72 interviews were carried out in three stages, covering a period from the end of 2007 to mid 2009 (see Appendix 1). The data was collected using three types of techniques: face-to-face, in-person interview, telephone interview and e-mail internet interview (Creswell, 2009). The first stage of interviews was based on a depth, face-to-face interview technique but towards a more informal conversational approach that allowed the researcher to be highly responsive to individual differences and situational changes, so as to increase the concreteness and immediacy of the interview questions and responses (Patton, 1987). There were two objectives at this first stage of data collection: 1) to identify significant events that resulted in radical changes of relationships between company F and its counterparts, and 2) to relate these radical changes to the arrival of technological changes at F's business net, and 3) to verify the appropriateness of the theoretical framework.

On the basis of the initial results, the attention of the research was shifted from the dyadic level to network level, and a focal net perspective was adopted for the second fieldwork which formed the main basis of the empirical data. Having gained access to key informants at the first stage, such as company F's General Manager, Marketing Director, QA Manager and Production Manager, permitted the identification of the focal net members and subsequent extensive depth interviews. These members included three of F's business customers (C1, C2 and C3, all based in Japan), three of F's suppliers (S1, S2 and S3), and one of F's complementors (D1, a drive maker based in Taiwan). In addition to the adoption of a focal net perspective, the theoretical framework were revised by taking into accounts characteristics of networks (e.g. interconnectedness) in order to develop a better fit between theory and the ongoing data collection. This reveals the learning and evolving characteristics of doing a case study (Dubois and

Gadde, 2002).

The second stage of data collection aimed at gathering managers' perspectives from the companies in the focal net using in-person depth interviews, in order to reconstruct the evolution of the focal net trigged by technological change, including the resource interaction based on different technological generations. What distinguished these two stages of data collection was the usage of an interview guide for the second fieldwork. This interview guide comprised two sections (see Appendix 2): a briefing of this doctoral research project and interview questions (Creswell, 2009; Yin, 2003). Using this interview guide was to keep focused on the subject which was confirmed after the first stage of data collection. As indicated by Patton (1987, p. 111), "The interview guide helps make interviewing different people more systematic and comprehensive by delimiting the issues to be discussed in the interview […] A guide keeps the interaction focused, but allows individual perspectives and experiences to emerge."

The third stage of data collection can be seen as a post-fieldwork or follow-up phase in which e-mail internet interview and computer-assisted telephone interview techniques were used (Creswell, 2009; Yin, 2003). This stage of data collection was in parallel with data analysis. It aimed at clarifying ambiguity or contradiction in the empirical data (e.g. the timing of using a new physical resource), acquiring more details about a significant event or the usage of a particular resource (e.g. how a key material was used in the production process), and confirming key findings with the informants. In spite of being a follow-up phase, this stage of data collection played an important role in assisting to achieve a more valid picture of the evolution of the focal net. This stage represented a close interaction between theoretical basis, collected data and the field, allowing new or complementary but crucial questions to be identified and asked. Such a post-fieldwork phase is beneficial to process research and maintaining accessibility to the field becomes crucially important.

The process of data collection employed a snowballing strategy which focused on locating information-rich key informants (e.g. company F's General Manager) who were able to identify significant events and involved parties, and more importantly, to help gain access to key informants from these parties (Patton, 2002). In this snowballing process, key parties and episodes were mentioned repeatedly; they marked the evolution of the business net. As depth interviewing continued, these parties and episodes were gradually linked together along a time dimension and based on a focal net perspective. In order to present a near-realistic picture of the evolution of the focal net, key informants from the companies outside the focal net were interviewed, including company F's competitors and other customers and a research institution (see Appendix

1). These interviews also facilitated the understanding of cooperative and competitive stance within and without the focal net boundary. It has to be noted that such a focal net boundary is artificially decided by the researcher so as to facilitate the empirical investigation (Easton, 1992).

7.4.5 Analysing empirical data

The major purpose of this research is to provide a reliable description of the evolution of the focal business net, which is marked by the arrival of technological changes. This description relies on a time-series analysis that is able to link the evolution of the focal net (process) to the arrival of technological change (input) and the reconfiguration of the focal net after technological arrival (outcome) (Patton, 2002; Van de Ven and Huber, 1990; Yin, 2003). This analysis of empirical data pays a great amount of attention to the episodic dimensions of events; however, the focus is not merely on temporal succession but also on the logical and theory-stamped association of events (Dubois and Araujo, 2004). As Yin (2003) points out:

> Whatever the stipulated nature of the time series, the important case study objective is to examine some relevant "how" and "why" questions about the relationship of events over time, not merely to observe the time trends alone. An interruption in a time series will be the occasion for postulating potential casual relationships; similarly, a chronological sequence should contain causal postulates. (pp. 126-127)

This research takes the business relationship as the unit of analysis. Via developing business relationships, tangible and intangible resources are combined and productive activities are connected across firm boundaries, forming a technology-bundled value net which is adaptive and self-organised (Ford and Saren, 2001; Håkansson and Snehota, 1995; Håkansson and Waluszewski, 2002a; Parolini, 1999). That is, a business relationship is a key component that determines not only the configuration of a business net but also an individual actor's ability to address changing conditions, e.g. technological change. Moreover, business relationships that are composed by interaction episodes bridge both stabilising and changing forces which are produced by interacting dyads and which subsequently beget network dynamics (Håkansson and Henders, 1995; Halinen *et al.*, 1999; Halinen and Törnroos, 1998). Thus, using the business relationship as the unit of analysis in this research has significance for network level (e.g. configuration of a business net), relationship level (e.g. relationship dynamics) and actor level (e.g. coping with the arrival of technological change).

The analysis of empirical data began with organising raw data (including recorded interviews, field notes and archival materials) and transcribing the recorded interviews[8]. These transcripts and field notes were then input into a computer using QSR software NVivo 7. Reading through these first-hand data, "codes" were built using the software, and these codes were further categorised into "themes" which were related to research phenomena (see Appendix 3 for example). Research notes were also kept using this software while consulting archival materials, such as industry statistics and market research reports. The notes were treated as corroborative information that assisted to build the linkages between notes and themes. Moreover, significant events related to the focal net members were identified and chronologically organised using these archival materials (see Appendix 4), forming a basis to trace the evolution of the focal net. However, the attention of the analysis was focused on explaining the relationship between significant episodes and describing the net evolution driven by the arrival of technological change by considering relational time (Halinen and Törnroos, 1995).

For illustrative purposes and analytical needs, three types of figure are developed from the empirical data. The first type of figure is concerned with significant events which are associated with the arrival of technological change at the focal net and which are organised chronologically. This type of figure is used not only to indicate the chronological sequence of events but also to illustrate the temporal and contextual influences of these events that lead to the arrival of technological within the focal net. The second type of figure relates to the configuration of the focal net at different points in time, especially after the arrival of technological change. With this type of figure, capturing network dynamics (which result from relationship dynamics) by comparing the previous configuration of the focal net is enabled. The third type of figure is developed to associate network dynamics with changes in roles played by the members in the technology-bundled value net. Actors' changes in their roles signify their usage or combination of certain resources and thus may help uncover how technological change is introduced in an interaction process.

The demarcation of an arrival of technological change at a business net is crucial to the empirical investigation of this research but challenging. This is because technological change takes place in somewhere that already exists and through an interactive process that has no easily identifiable beginning or end (Ford and Håkansson, 2006; Håkansson and Waluszewski, 2002b; Lundgren, 1995). Concerning the demarcation of the arrival of technological change, a focal net which consisted of the focal actor's supplier,

[8] Some interviews were not able to be voice recorded because some informants were unwilling to express their views while an audio recorder was used, and some places for interviewing (e.g. at a restaurant or Café) were not suitable for voice recording. In these situations, keeping field notes became a major way of gathering evidence while a face-to-face interview was carried out.

customer and complementor relationships and which was based on the first generation of optical recording technology (CD-R) was firstly constructed. Then, by identifying radical changes of relationship and changes in actors' roles which are caused by technological change, a basic reconfiguration of the focal net based on a new generation of technology (e.g. DVD recording technology) was built. With the establishment of a reconfigured net and its previous state, the attention was focused on the process of technological arrival linking these two net formations by studying significant events between the focal actor and its counterparts. Finally, the configuration of the focal net was amended in accordance with the consequences of these significant events. In this way, a longitudinal perspective on the evolution of the focal net driven by technological change was presented.

7.5 An assessment of data quality

In order to develop a near-realistic picture of the evolution of the focal net embedded in a technology-intensive environment, tackling the issues of trustworthiness of empirical data is crucial. The potential bias and inaccuracy of collected evidence have been noticed, which may hinder the analysis from achieving a valid picture, in particular, the research relies on a retrospective study: First, each informant's account towards research phenomenon is subjective, being influenced by his or her individual interaction with others and surroundings. Second, owing to their respective interaction histories, interviewees may have their own prioritisation of events; in turn, the views on relationship dynamics (e.g. an ending or reactivation of relationship) among interviewees may vary. Third, informants may provide an inadequate description of a particular event (e.g. people involved or chronological order of events), due to their loss memories.

Triangulating the evidence has been regarded as a methodological method to ensure qualitative validity that aims at achieving the accuracy of findings (Creswell, 2009; Miles and Huberman, 1994; Patton, 2002; Yin, 2003). In the pursuit of qualitative validity for the processual research, several steps were taken to obtain the accuracy of data. In the first place, the collection of empirical data employed a dyadic research design which did not favour a particular side of viewpoints (e.g. from the supplier side); instead, it attempted to mitigate the bias of opinions by interviewing interacting parties in the relationships under study. In addition to the members of the focal net, depth interviews included the focal actor's business customers, suppliers and competitors, whose actions and reactions may alter the co-opetitive stance and power-balance within the focal net due to the connectedness of relationships. These additional interviews

provided corroborative evidence in terms of the combination and mobilisation of technological resources within the focal net. Then, the usage of multiple sources of data was found pivotal and beneficial because it allowed the researcher to mitigate the risks of informants' memory loss and subjective interpretations of interaction episodes. In addition to depth interviews, archival materials (e.g. industry statistics and market research reports) were consulted in the reconstruction of the evolution of the focal net.

Apart from the triangulation of evidence, spending prolonged time in the field and utilising respondent validation are viewed as beneficial ways of increasing qualitative validity (Creswell, 2009; Miles and Huberman, 1994). With the consideration of time and costs required to stay in the field, a mediated way was the employment of a follow-up stage of data collection. Using computer-assisted interviews and e-mail internet interviews, this follow-up stage enabled the researcher to confirm findings with the informants, to acquire supportive information about research phenomenon and to obtain new data about new subjects that emerged from the data analysis. Moreover, the process of data collection and analysis attempted to shorten the distance between the research setting and readers by providing detailed descriptions of research phenomenon based on an abductive logic. That is, the accuracy of data needs to be continuously evaluated during the research process. In this way, qualitative validity can be enhanced.

An additional issue regarding the trustworthiness of empirical data is qualitative reliability. According to Silverman (2005, p. 224), reliability is about "the degree of consistency with which instances are assigned to the same category by different observers or by the same observer on different occasions." In order to increase reliability, an interview guide which listed interview questions was used in the research process. This interview guide was developed from the initial fieldwork which could be seen as a pilot study. Similar to what Yin (2003, p. 67) has pointed out, "The protocol is a major way of increasing the *reliability* of case study research and is intended to guide the investigator in carrying out the data collection from a single-case study." Besides, recorded interviews and field note were transcribed and digitally stored, allowing the same case to be repeated. This computer-assisted data analysis and data backup is another important way of increasing reliability.

Another issue concerning the trustworthiness of data is generalisability. Yin (2003) argues that the results of case study research can be generalised to some broader theory. Instead of generalisability, Creswell (2009) considers "particularity" as the hallmark of qualitative research by arguing that "the value of qualitative research lies in the particular description and themes developed *in context* of a specific site" (p. 193). Although the purpose of this research is to develop a deeper understanding of the

evolution of a business net triggered by technological changes rather than transferring findings to other settings, generalisability can be achieved since the focus of the research design is placed on analytical generalisation or analytical inference (Dubois and Gadde, 2002; Easton, 1995; Yin, 2003). Therefore, the detailed and trustworthy description of this longitudinal single-case allows the readers to develop their own interpretations of the story. Furthermore, the iterative interplay between theoretical framework, data sources and analysis enable the researcher to develop models or frameworks that can be applied to other contexts.

Last but not least, the trustworthiness of this research report takes into account two ethical issues: Firstly, prior to conducting each in-depth interview, the purpose of the research and the research problem were explained to the interviewee(s). Besides, promises of assuring confidentiality of information were made to the interviewees. In this way, interviewees could understand the research background and better give their opinions regarding each research question at their ease. Thus, the richness and depth of information can be enhanced. Secondly, the languages used in in-depth interviews included Chinese (which is the official language of my country), English (which was used with informants from Japanese-based companies) and Taiwanese (which is my mother language). The usage of these languages was to facilitate the communication with the interviewees. Then, the data was analysed and reported in English. To achieve an accurate account of information, the triangulation between a variety of data and with informants, as previously described, were adopted.

It has to be noted that this research has two limitations. First, although this single-case is built on extensive interviews with managers from the focal company and its supplier and customer and complementor companies and archival materials, the picture presented is still subjective and industry-specific. Generalising the findings of this research would be difficult. Second, network research suggests that a network can extend boundless and the influences of change forces initiated by actors may flow among interconnected relationships. Although a focal net perspective is used in this research, the capturing of network dynamics and our understanding of them remains limited.

8 The case study

8.1 Introduction

This chapter aims to provide a description of the evolution of a business net embedded in the optical recording media industry, which is based on different technological generations using a focal net perspective. The description covers a time-span of 10 years from 1997 to 2007, in which major technological change has taken place three times, from CD-R to DVD-/+R, DVD Double Layer and HD/Blu-ray technologies. Driven by the appearance of newer technology and the co-existence of old and new technologies, the evolution of company F's business net (focal net) is lumpy and complicated. In its evolution, four net reconfigurations have been identified. These reconfigurations are a result of radical changes of relationships triggered by the arrival of technological change. These radical changes of relationships include the dissolution of existing relationships, the entry of new relationships and the reactivation of previously ended relationships, accompanying the mobilisation of resources between net members.

8.2 The appearance of a CD-R-based value-creating net towards the end of 2001

8.2.1 F's establishment of interfirm relationships

Following the first release of CD-R specifications created by Sony and Philips in 1990, a network of optical recording media producers gradually evolved. In the early stage the major players were the manufacturers of electronic devices or components, mostly based in Japan, who produced CD-Rs themselves and sold them under their brand names. As CD-R technology was applied in a wider area of the market and its complementary products (recording drives) increased in availability, established companies set up operation sites overseas and new entrants joined the industry as CD-R producers, including those based in Taiwan. At that period of time, those pioneers attempted to penetrate the US and EU markets by setting up logistic centres, production factories and sales offices (or subsidiaries). Costs later became a crucial issue when new entrants got more competitive. At this time the network stretched across Asia to Europe and United States.

A turning point in the development of the industry occurred in 1997 that urged some of the industry pioneers to develop their outsourcing strategies for CD-R products. Firstly,

a significant fall in CD-R prices and the increasing availability of recording drives or burners (complementing CD-R discs) intensified the industry competition. Secondly, the DVD Forum was established in August, prompting these technology vendors to devote more resources to the research and development of DVD-R, the next generation of CD-R. These industry pioneers started looking for CD-R outsourcing partners. Thirdly, perceiving the promising future of CD-R, the Taiwan-based media makers engaged in production capacity expansion; and at the same time, actively approached potential business customers (technology vendors) to minimize the uncertainty of the expansion.

Positioning as an OEM, company F (the focal actor) aimed to be a leader in this area. The priority for them was to acquire OEM contracts from industry pioneers, who were experienced in media manufacturing and possessed technical know-how and media brands. From this, company F was able to further expand its production capacity and pursue economies of scale. While establishing its customer relationships, company F also developed its supplier and complementor (drive maker) relationships with attempts to be more competitive. The following explains company F's relationship establishment with these actors.

Company F's relationship with company C1

In late 1998, after more than one year's contact, company F gained business agreements from company C1. Before that, company F's Sales Manager and R&D Manager flew to Japan a number of times to seek the opportunity of cooperating in the optical recording media business. Although F's CD-R samples failed to satisfy company C1 several times, a new sample, which was based on Cyanine dye (a type of organic and synthetic dye) and which was developed in early 1998, amazed company C1. As a Sales Manager at company F recalled, "*In a business trip while we were in a meeting in their factory, they just came out with their test report of our Cyanine-type sample. We passed! They were astonished at our R&D capability. Due to this satisfactory result, we extended our stay in Japan for a more detailed discussion with them. Our top management was cheered by this achievement.*" Company F's R&D Manager reflected "*In addition to our technological capability, Cyanine dye was another key factor since they used Cyanine-based solution in their CD-Rs. Our newly developed CD-Rs matched their product strategy.*"

Prior to signing business agreements and product specification agreements, company C1 sent a team consisting of R&D, engineering, quality assurance and procurement personnel, to survey company F's operation in order to make sure that company F was able to stably produce CD-Rs which met their quality requirements and market demands.

Company C1's Procurement Manager noted "*Our outsourcing strategy aims to be more competitive in markets with regard to product quality, cost and operational efficiency by cooperating with our business partners.*" Their QA Manager stressed "*Our brand is equal to the best quality in the optical recording media markets.*" In the face of booming CD-R markets, this relational tie allowed company C1 to acquire a stable, qualified and cost-competitive source of CD-Rs and facilitated more concentration on its marketing deployments. This relationship also enabled company F to pursue economies of scale in CD-R production and strengthen its technological competence by taking advantage of company C1's experience in product development and manufacturing management.

Company F's relationship with company C2

Company F began its OEM-customer relationship with company C2 by signing business agreements in August 1999. Facing the pressure of production costs in the optical recording media business, company C2 started to search for an outsourcing partner in late 1998. The company asked its Taiwan-based agent, who had been selling company C2's electronic components for a couple of years, to carry out an initial survey of optical recording media makers in Taiwan. Then, three makers were on the candidate list; company F was one of them. In mid 1999 several managers from company C2, accompanied by their Taiwanese agent, visited these three makers. Company F made a good impression on company C2 during their visit and in the end company F was selected as company C2's outsourcing partner. Just as a Sales Manager from company C2's agent noted, "*We were impressed by their (company F's) tidy production floors especially when compared with the other two companies. Moreover, their production was well managed. They left an impression of a professional media maker.*"

Production capacity was a key factor that contributed to company F's establishment of a cooperative relationship with company C2. A senior manager at company C2 pointed out that their weakness of "poor production capacity" hindered them from pursuing economies of scale, although they possessed strong R&D and standardisation capabilities. This manager argued that the criteria of selecting an outsourcing partner were "*its cost competitiveness based on its large production capacity. Another criterion was its well-organised QC (quality control) system.*" On the other hand, company F thought that its cooperation with company C2 allowed it to enhance its technological capability since company C2 was not only a major player in the CD-R market but also a technology leader in the CD-RW domain. In addition to the optical recording media, company C2 had built its optical recording drive (or burner or recorder) business. This relationship also enabled company F to maintain good communication on technical issues in order to assure the compatibility between its media and company C2's drives.

A characteristic that distinguished company F's relationships with companies C1 and C2 lay in solutions used for the CD-R production; particularly dye materials which were used to coat the discs in the clean-room process, and which were burned by the laser beam in a drive to backup data. The dye material was crucial not only to the production yield rate but also to the CD-R compatibility with drives and the longevity of data storage. Company F used its in-house developed dye solution to volume produce CD-Rs for company C1 while using company C2's key materials to manufacture exclusively for C2-branded products. The adoption of dye material was viewed as an important characteristic of product differentiation in the markets with regard to product performance (e.g. compatibility) and disc colour (different chemical formula of dye materials usually resulted in different colours which could be distinguished from recording sides of discs).

Company F's relationship with company C3

As an OEM, company F was endeavoring to be a leader in the industry. The company thought that with the establishment of a leading position, it would be able to participate in industry standardisation activities, which were mainly controlled by Japanese companies. This was one of company F's corporate visions. This ambition was embodied in its expansion of production capacity, continuous R&D investments and aggressive actions of acquiring OEM orders. In early 2000, company F dramatically enlarged its production capacity by acquiring two small and medium-sized media makers. Later in the same year, it obtained OEM business agreements from company C3, a Japanese technology vendor that owned an influential brand in the photographic industry. In addition to its sales team's efforts, company F's relationship formation with company C3 was also a result of its well-known manufacturing technology and production management. Unlike companies C1 and C2, company C3 did not solely outsource CD-Rs from company F. Prior to this relational tie, company C3 had established a partnership with company R1, which was another media maker based in Taiwan and one of company F's main rivals.

Company F's relationship with company D1

Company F developed its complementor relationship with company D1 (a drive maker) in early 1999 when company D1 had just been spun-off from its mother company based in Taiwan. The most important function of the relationship was to work on the compatibility between their products (the blank recordable disc and recording drive). Since both companies F and D1 concentrated on their OEM businesses which were highly complementary, this relational tie allowed the dyad to exchange market intelligence (such as market demands and trends), technological development and

information about the counterpart's customers. A close cooperation with drive makers was a crucial factor that determined a media maker's competitiveness in terms of developing and launching new products (e.g. CD-R with enhanced recording speed). As a Senior Engineer from company D1 noted, "*The attention of industry competition is placed on "technology" and "cost" […] In terms of technology, the key hinges on how you can create or maintain a lead, ahead of your competitors, in releasing higher recording-speed products or new products that apply a newer technology.*"

Company F's relationship with company S1

Not long after company S1, which was a Swiss-based dye material supplier, entered the optical recording media industry in 1999, company F's relationship with company S1 began. Holding a similar view to the informant from company D1, company S1's Senior Sales Manager argued that "*Those who could get ahead of others in releasing new CD-R products with higher recording speed would have a good chance to win out. Our strategy was to provide a technologically advantageous dye material that enabled our customers to quickly develop new CD-R products, without great efforts in adjusting other raw materials in production.*" By this relationship, company S1 aimed to be company F's major supplier of dye material due to its huge production capacity. Perceiving the importance of dye material in product performance, this relationship allowed company F to enhance its knowledge of dye materials; and at the same time, to increase product assortments for its customers. Company S1's solution was not only adopted by company F but also many other CD-R makers, including company F's competitors, such as company R1.

Company F's relationship with company S2

Before the Millennium, company F had cooperated with company S2, which was a Taiwan-based supplier of sputtering targets, for several years. Sputtering targets were important materials that were used after the dye-coating process in a clean-room production. This material was also closely related to the longevity of data storage on a disc after recording. Although company F had several sources of sputtering targets (including suppliers based in Japan), its relationship with company S2 was close. The main reasons were, as indicated by a senior production manager at company F, that company S2's sputtering targets were cost competitive and with good quality. Moreover, it was good at responding to company F's technical requirements by quickly revising their materials. With regard to company S2's strength, one of its sales representatives gave his opinion, "*At the moment maybe we are poor at innovation, but I believe we are good at following in the industry, due to our strong material analytical capability. We can provide targets whose qualities are not noticeably inferior to those made by Japanese companies.*"

Company F's relationship with company S3

After the clean-room process in the media volume production, each output of discs has to be label-printed and packaged, two additional processes before shipment. In the beginning, company F relied on several small-sized companies to do the disc packaging. As its volume kept growing, company F found some problems in outsourcing the disc packaging. First, it was difficult for these companies to stably offer good packaging quality that met company F's high standards, as requested by its Japanese customers. Second, the transportation between company F and these packaging factories increased the risk of getting semi-finished discs damaged, such as scratches or contamination on disc surfaces. Third, these limited and scattered packaging capacities made it difficult for company F to drive costs down. For these reasons in August 2001, company F set up company S3, an independent company which specialized in the manufacturing of disc-packing cases and which also offered packaging services. Another advantage of this relationship was their relationship's ability to customize the needs of label-printing and disc packaging styles for company F's OEM customers.

8.2.2 Adaptations between focal net members

Interfirm adaptations aim to meet the specific needs of the counterparts and remove mismatches between parties through behavioural and organisational modifications (Brennan *et al.*, 2003; Halinen, 1997). Such adaptive behaviours were observed in company F's relationships with its focal net members. Following the establishment of customer, supplier and complementor relationships (focal net relationships), a fundamental issue company F had to face was how to utilize these relationships effectively and efficiently. This issue comprised two managerial challenges: capacity utilization and new product development. Capacity utilization referred to the efforts to maximise the usage of installed production capacity by satisfying customers' needs, while new product development was about how to gain a lead by releasing higher recording-speed CD-R products ahead of competitors. In order to conquer these challenges, company F was engaged in a series of interfirm adaptations.

Interfirm adaptations for capacity utilization

Maintaining good relationships with customers, such as company C1, was a prerequisite for company F to stably utilize its production capacity. However, maintaining good relationships with these Japanese customers was not an easy task. This was mainly because these companies had experience of media manufacturing and their standards for product quality were very high. The product specifications among these customers also

differed. Take companies C1 and C2 for example, the dye material used for company C2 was not permitted for use in production for company C1. Different dye materials required different production parameters. In other words, company F's production processes for companies C1 and C2 were incompatible.

In order to manage diverse requirements and needs from companies C1, C2 and C3, company F took two measures. Firstly, company F had to operate separate production lines. The delimitation of production areas allowed company F to customize the production process for each of its customers, including usage of materials, equipment parameters and quality controls. Secondly, company F allocated a Sales Manager and an Account Manager to each customer, in which the former was mainly in charge of market development and sales contact while the latter's responsibilities were related to the operation in the factory; coordinating between functional departments, e.g. R&D and Production. An Account Manager from company F gave his job description, "*Except for getting orders, my job is to make sure that the mass production for my client will meet the schedule. If the production is delayed for some reason, say, product quality issue, I have to make a judgment in deciding how to continue the process or, if necessary, call a meeting to settle the problem. If we cannot solve the problem right away, I need to contact the client. Furthermore, it's my duty to coordinate our R&D and QA engineers to prepare new product samples for customer verification.*"

The allocated production areas and business contacts functioned as a suitable platform to increase mutual understanding and facilitated aligning the activities between company F and its focal net members, especially with its business customers. This arrangement allowed company F to deal with the requests or problems from companies C1, C2 and C3 separately and in a timely manner. On the other hand, the resources allocated to these customers could be integrated by weekly internal meetings between departmental heads, sales and account managers. For these customers, they were able to gain access to necessary information (e.g. mass production status or new product development) and documents (e.g. quality or shipping reports) from the allocated contacts. Furthermore, this interaction created a certain degree of transparency that allowed each dyad to cultivate mutual understanding. One example was company C1's willingness to offer some technical information based on their experiences to help company F improve the production yield rate.

Company F's adaptations between its focal net members are illustrated by Figure 8.1. Using company F's relationship with C2 as an example of interfirm adaptation, a series of coordinative activities between the dyad were carried out after their relationship establishment. After acquiring OEM orders from company C2 (see (a) in Figure 8.1),

company F allocated production floors in accordance with company C2's demands. In their strategic partnership, company F used materials developed by company C2 to exclusively produce CD-Rs under company C2's brand. In order to ensure a smooth running of production (a match between company C2's materials and company F's production equipment), company C2 sent a team consisting of R&D, production and QA engineers to provide technical support (see (b), (c), (d) in Figure 8.1) and fine-tune the production parameters and set quality control standards. Meanwhile, company F set up a team accordingly to receive company C2's technology transfer. After the technology transfer and production pilot run, the dyad brought out a standard operating procedure (SOP) document, which specified the production process for company C2's media, for example the frequency of quality inspection.

Among companies C1, C2, and C3, company F thought its relationship with company C1 was the most strenuous to maintain. As company F's QA Manager, Account Manager and R&D Manager pointed out, the difficulties arose from company C1's strict requirements for CD-R quality. While the production area was allocated, company C1 sent a team to company F's factory, which comprised a technical manager, a R&D manager and a QA manager who were experienced in production processes, optical media design and production quality control respectively. Their purpose in company F was not to transfer technical know-how but to investigate the characteristics of production lines (especially injection machines and dye-coating machines) and stability of the production (fluctuation within and between each production line), so as to make "reasonable" regulations for production, including quality control procedures and quality specifications.

With regard to quality control, company C1 demanded that company F increased the frequency of on-line inspections and that they should use five types of testing devices (three of which were used exclusively for company C1) to inspect each production lot. Since company C1 had the same types of testing devices, it demanded company F to make correlations between both sides' devices, in order to precisely control the quality. Before each shipment, company F had to submit an outgoing report (the inspection results based on their specification) to company C1 who also sample-inspected each shipment using the correlated specifications (they called it "incoming inspection"). Moreover, company F was required to collect and reserve four pieces of CD-R from each production lot as samples for quality traceability (if there was a claim). In order to meet company C1's requirements, company F tried its best to use the same production shifts and QA engineers for company C1's mass production, whose experiences accrued through the daily operation. Its QA department also allocated two employees to prepare outgoing reports and manage the reserved CD-R mass production samples.

Figure 8.1 Business interactions between focal net members in 2001

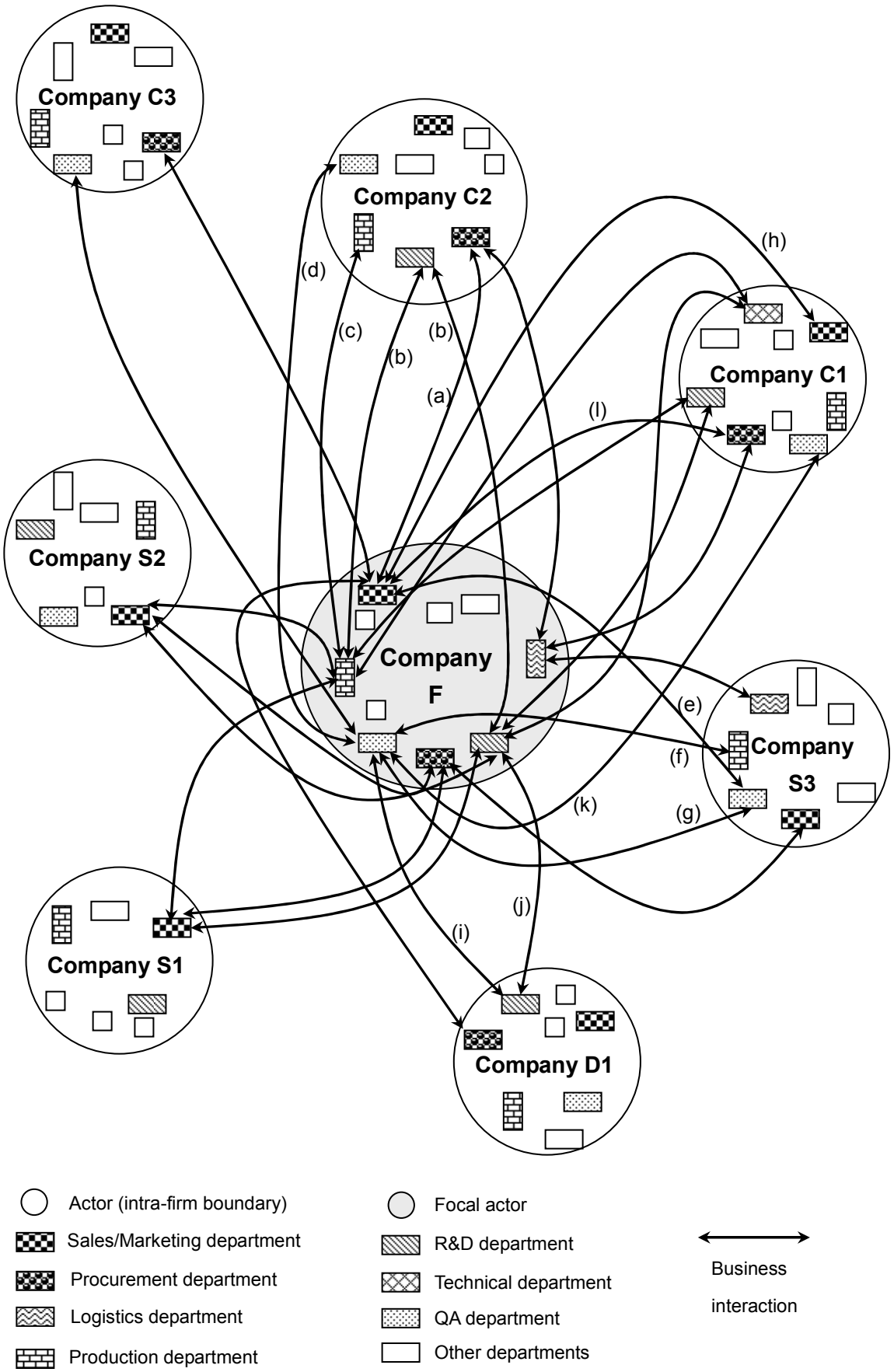


Figure 8.1 Business interactions between focal net members in 2001 (Continued)

Explanation

(a) C2's procurement dept discussed with F's sales dept about business plans

(b) C2's R&D dept provided F's production and R&D departments with technical support

(c) C2's prod dept provided F's prod dept with technical and engineering support

(d) Both C2's and F's QA departments worked together to define quality control procedures

(e) F's sales discussed and exchanged new ideas about packaging styles with S3's QA dept

(f), (g) F's QA interacted with S3's QA and production departments in terms of new packaging styles, production capacity and production quality control

(h) F's sales actively suggested new ideas (e.g. new packaging styles) to C1's marketing dept

(i) F's QA and D1's R&D tested and evaluated each other's new products and discussed the results

(j) Based on the results from (i), F's and D1's R&D found solutions to fine-tune technical parameters for their products and to ensure product compatibility

(k) F's QA sent new product samples to C1's QA for quality verification and discussed quality issues

(l) When good results were achieved from (k), F's sales and C1's purchaser would work on C1's programme of new product launch, e.g. printing and packaging designs and delivery schedule

Despite the low production yield rate resulting from company C1's strict requirements in the beginning, company F was able to improve the production rate by adjusting its chemical formulation of dye material and other relevant production parameters without breaking company C1's terms. According to company C1's Procurement Manager, one of company F's merits was "*high technical skill to produce discs*". The ability to produce high quality and cost competitive CD-Rs allowed company F to acquire more orders from its OEM customers. In order to meet company C1's market demands, the focal actor further expanded its CD-R production capacity in 2001. Although it had to go through a rigorous procedure to get new production lines approved by company C1, company F overcame this task using superior manufacturing technology. By the end of 2001, company F's monthly CD-R shipment to company C1 worldwide reached a record-high number of more than 25 million pieces, approximately six times the quantity that was shipped in the beginning of 2000, containing more than 80 items of packaging styles.

Another important reason that explained company C1's increase of CD-R orders was company F's investment in company S3, a provider of packaging materials and packaging service. Company F's relationship building with company S3 created two advantages. Just as an Account Manager at company F explained, "*Our investment in*

company S3[9] *allows us not only to drive down the material cost, e.g. packing cases, but also provide our customers with customization for disc packaging styles. Besides, we were able to better control the quality in the packaging process"*. Company C1's Procurement Manager also mentioned, "*They (company F) studied many packaging styles, including those developed by other customers, and suggested new ideas to us. This enabled us to quickly release new packaging styles to market. The "Lunchbox" (company C1 promoted this packaging style in US markets) was an example […]."*

The cooperation with company S3 enabled company F to streamline the whole production process, from clean-room production, disc label-printing and final product packaging to the logistics of shipments. Moreover, the interaction, particularly between company F's Sales and QA, and company S3's QA and Production Departments (see (e), (f) and (g) in Figure 8.1) allowed the dyad to study the application of each type of packaging machine and to develop packaging capacity and possible styles which took into account the production cost and customers' requirements. An obvious benefit generated from this interaction was company F's ability to offer its customers new packaging ideas; for example, company F's sales representative suggested new ideas to company C1's designers in their Marketing Department, see (h) in Figure 8.1.

Interfirm adaptations for accelerating new product development

Releasing new products by boosting CD-R recording speed (e.g. from 16X to 24X) had been considered as an important means to stay competitive in the optical recording media industry. "*Gaining competitiveness in this industry lies in two aspects: One is your speed of launching new products and the other is the possession of patents*", said a Sales Manager at company C1. A senior engineer from a provider of polycarbonate material mentioned, "*From our point of view, "cost" (production cost) and "speed" (launching new products) determine how competitive you are in this volatile industry.*" Furthermore, company F's R&D Division Manager emphasized, "*Upgrading media recording speed has become a must in order to survive the competition. It is no longer optional.*"

Optical recording media and recorders cannot exist in isolation from each other. A good compatibility guarantees the digital data can be precisely recorded onto a disc and be retrieved without a loss. In other words, when a new media product with higher recording speed (e.g. CD-R24X) is launched, its compatibility with new recorders (e.g. CD-R 24X recorder) needs to be assured, especially with major drive brands; and vice versa. As company S1's Senior Sales Manager noted, "*You (as a drive maker) cannot claim that your product is only compatible with media brands A, B and C, but not with*

[9] The company information in the quote, and hereafter, will not be revealed for confidentiality.

D and E. Customers always assume that it is your responsibility (to guarantee the compatibility)." Informants from companies F and D1 indicate that factors which affect the compatibility include dye material used in a disc, the chipset of a recorder and the setting of laser power in a recorder. Thus, achieving a good compatibility relies on good communication between media manufacturers and drive makers.

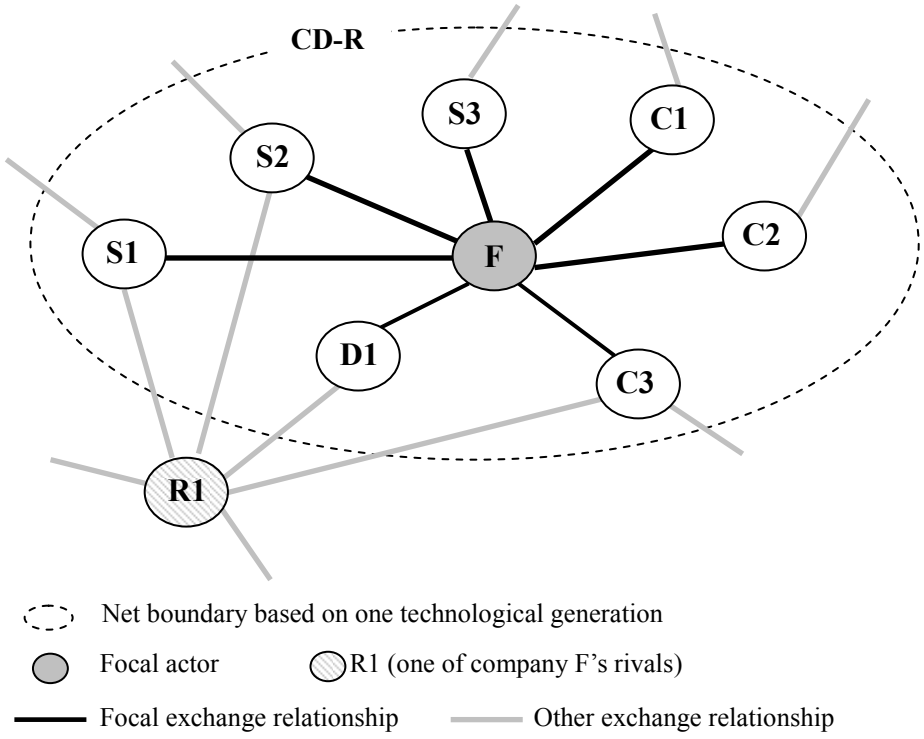
Perceiving the importance of the compatibility between the optical recording media and recorder, company F set up a quality lab under its QA Department to control and evaluate its own, as well as its competitors' media compatibility and reliability. One of the lab's responsibilities was to communicate with major drive makers based in Taiwan, Japan and Germany, including company D1. Take company F's interaction with D1 for instance. While company F's R&D had developed a new CD-R product, new samples were sent to its QA's quality lab for reliability and compatibility testing, in which the latter test referred to the backward compatibility (the compatibility between new samples and old types of drives). Once the new samples passed the internal evaluation, these samples were sent to company D1 for evaluation. On the other hand, company D1 would sometimes provide its new product (prototype) to company F for testing (see (i) in Figure 8.1). Then, they would exchange technical information.

Based on the performance of new CD-R samples, company D1 would adjust the technical parameters (e.g. firmware) in its new type of recorder to ensure the compatibility. But sometimes, company D1's adjustment for company F's media would decrease its drive compatibility with other makers' media, and in turn, it would ask company F to amend its product design, such as dye formulation. Consequently, company F's R&D needed to get involved in the technical discussion to find solutions (see (j) in Figure 8.1). When company F achieved a satisfactory result in compatibility tests, it would then provide its OEM customers with new samples (e.g. company C1) for verification (see (k) in Figure 8.1). When company C1 verified these samples, it would issue an official report to company F's QA. Then, company F's Sales and company C1's Procurement would decide the schedule of mass production for the new product (see (l) in Figure 8.1). Regarding the timing for launching a new product, a Sales Manager from company F said, "*A sweet point in time is when you launch a new product with few competing products in the markets.*"

8.2.3 A relatively stable focal net

Following the establishment of customer, supplier and complementor relationships, a value-creating net centred around company F gradually took shape and evolved towards a relatively stable state, as shown in Figure 8.2, which is a snapshot of the focal net based on CD-R technology towards the end of 2001. A stable focal net did not suggest that the net was static; instead, it was the consequence of continuous coordination between focal net parties. An example was company F's allocation of resources and adjustment of activities to receive company C2's CD-R technology. Another example was the communication between companies F and D1 to ensure a good compatibility between the media and recorder, especially when launching a new product. The continuous interaction between these actors also created routines and procedures, e.g. quality control procedures in the mass production.

Figure 8.2 A snapshot of the focal net towards the end of 2001

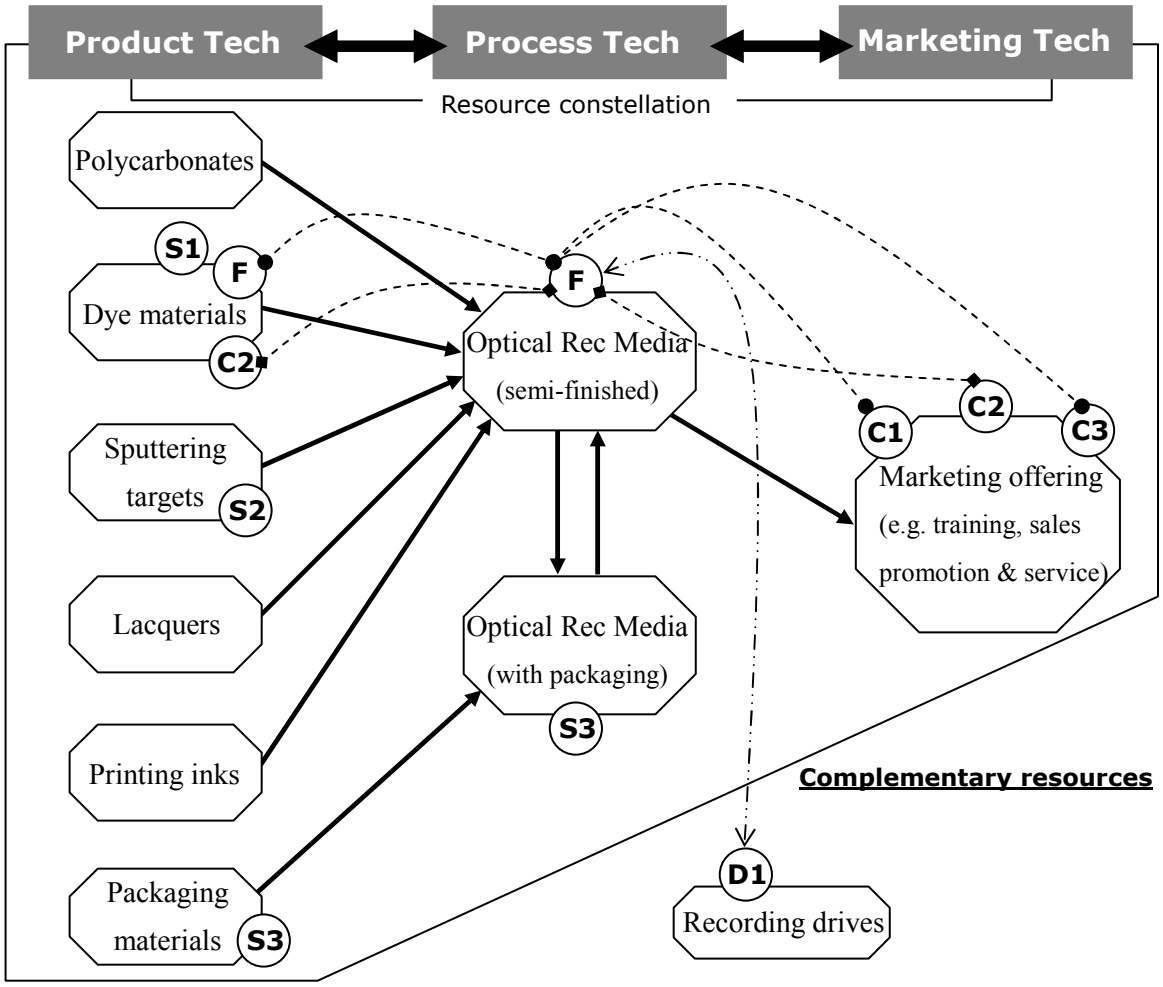


Moreover, this relatively stable net did not imply that the development of the business net only contained positive influences since the net was embedded in a broader and open environment (the network), where cooperation and competition co-existed. As exhibited in Figure 8.2, the focal net was not isolated from its competitors' boundaries

(or competing nets); they were connected via companies C3's or S1's relational linkages with the focal actor's competitors, such as company R1. As company S1's Senior Manager pointed out, "*Because of the characteristics of easy-to-use and high productivity, our dye material was adopted by almost all Taiwan-based media makers, including many small-sized ones.*" This signified that negative influences (e.g. a competitor's price reduction or expansion of its production capacity) resulting from a competing net, may travel through these linkages into the focal net.

The adaptations within the focal net allowed the net members' positions and roles to be more clearly defined. As shown in Figure 8.3, company F positioned as an OEM which used its in-house dye material in its own manufacturing process to produce CD-Rs for companies C1 and C3, who positioned themselves as technology vendors. Company F also used company S1's dye material to provide CD-Rs for other customers. At that period of time, company F occupied one position but performed two roles in using product and process technologies. Positioning as a technology vendor, company C2's in-house dye material was exclusively used by company F to produce CD-Rs under company C2's brand. Company C2 also performed multi-roles in the focal net characterised by technology-bundles based on CD-R technology. Based on the adoption of dye materials, three sub-systems could be identified within the focal net. These were sub-systems based on companies F, C2 and S1's dye materials respectively. Each sub-system had its proponents (customers). These customers' CD-R products could be differentiated by the dye materials used, due to the differences in disc colour (the recording side) and performance (e.g. disc longevity). In addition, S2 and S3 are important suppliers to company F in the value net, respectively providing sputtering targets and packaging materials and services. As for D1, the evaluation of product compatibility and information exchange between F and D1 enabled the dyad to enhance their competitiveness in the market in terms of product performance.

Figure 8.3 Roles performed by the focal net members towards the end of 2001



Materials or products that are produced using a certain type of technology (e.g. process tech)

Technology-bundling

Focal net member (actor)

Combination of resources and connection of activities

These lines indicate unique resource combinations between focal net members. For example, C2-braded CD-Rs were produced by F using C2's dye materials, while F used its in-house dye solutions to produce CD-Rs for C1 and C3. Besides, F adopted S1's dye materials to produce CD-Rs for other customers.

Compatibility evaluation and exchange of product information and market intelligence

8.3 The first reconfiguration of the focal net in early 2004

8.3.1 Interfirm conflicts

The appearance of a relatively stable business net based on CD-R technology (see Figure 8.2) did not signify that company F encountered less conflicts with its focal net members. Although company F's interaction with its partners was getting closer and became intense (e.g. company F's cooperation with company C1 on a variety of CD-R packaging items), their interaction was marked by interfirm conflicts. Company F's switch to the same dye material as company C1 for company C3's production was an example.

Initially company F used a dye solution for company C3's production that was modified from the one used for company C1 in order to differentiate from the other's CD-Rs. To company F, the modified material had an advantage of lower cost. But soon, the failure to meet company C3's quality requirements forced company F to switch to the same solution as company C1's. This event caused dissatisfaction in the triad because company F viewed company C3's specification as too strict to follow, while company C1 was displeased by company F's introduction of its designated dye solution, causing it trouble in marketing activities. This event was finally settled by company F's separation of production areas with appropriate process control, so as to meet these two customers' requirements. Company F's R&D Manager gave his opinion on this event, *"I reckoned company C3 had an intention towards our in-house developed dye material because they requested our QA to provide them with the information about the formula of our dye material for the reason of better quality control […] They could easily analyse our dye material because of their strong chemical background. Of course, I refused to follow it. It was our know-how!"*

After the Millennium the optical recording media market was boosted by the popularity of the Internet and its applications, such as the sharing and backup of digital data, music and video, which in turn tempted a number of new media makers, drive makers and media brands into the industry, driving a further price reduction and intensifying the competition. Among these players, some even partnered to provide "turnkey solutions", allowing the newcomers with little technical background to volume produce CD-Rs easily. Consequently, company F and other media makers' profits were squeezed, although the market demand had been rocketing and company F's CD-R shipments had been growing (especially for company C1).

In the face of intensifying competition it was difficult for company F to maintain its

value-creating net, particularly to balance the product cost and quality. The decreasing profit margin caused company F's top management team to put pressure on its production department to increase the production output and lower the cost. What the production department tried was to source some cheaper substitute raw materials (e.g. homemade label-printing inks) and shorten the cycle time in volume production. However, the result was not satisfactory. They accused the QA department, which held that their responsibility was to assure product quality on behalf of their customers, of controlling the quality too strictly. In some important cases, company F's logistics department ignored the quality judgment by their QA engineers and shipped products to customers, running the risk of merchandise being returned in order to meet the shipping schedule. Thus, inter-department conflicts as well as interfirm conflicts often occurred in the ongoing process of interaction. As a Senior Manager at company C2 mentioned, "*We often requested company F to improve the production process to dramatically increase the importance of judgment because the quality requirement of our customers was severe. Company F's policy of balancing cost and quality was different from ours and conflict occurred. They sometimes accepted our request and sometimes refused, depending on the case.*"

8.3.2 The arrival of DVD Recordable technologies at the focal net

In order to improve the profitability in the CD-R business (for both media and drive makers), the attention of most companies in the industry was placed on releasing new products or reducing production and operation costs. The fast movers were able to open windows of opportunity and enjoy higher profit margins before the followers caught up. Consequently, the CD-R new product life cycle (e.g. from CD-R 40X to 48X) was shortened from six months to three months, leading to more intense competition. While a new product (e.g. CD-R 48X) was launched, the price of the existing product (e.g. CD-R 48X) dropped further.

As the development of CD-R technology was near its technological limit (the ultimate recording speed), company F encountered a hurdle to upgrade its in-house developed dye material for the production of high-speed CD-Rs. Company C1 was very concerned about this matter since they had devised a plan to launch a new product and informed company F about their increase in the CD-R demand through forecast meetings. This was resolved when a compromise was decided upon: switching to a new dye solution which was developed by company S1 but fine-tuned by company F. An Account Manager at company F recalled, "*Our customer (company C1) was not happy with this change. Firstly, they didn't like Phthalocyanine-based dye (company S1's dye solution)*

because it gave their CD-Rs no unique features. They preferred what we developed (Cyanine-based dye solution). Secondly, it took time for them to verify a major change in the design of the product. They were afraid their market momentum would be suspended. However, it was the only choice. If they didn't use it, then they really gained nothing." With this new solution company C1 was still able to maintain their position as one of the leading brands to release new CD-R products with the highest recording speed.

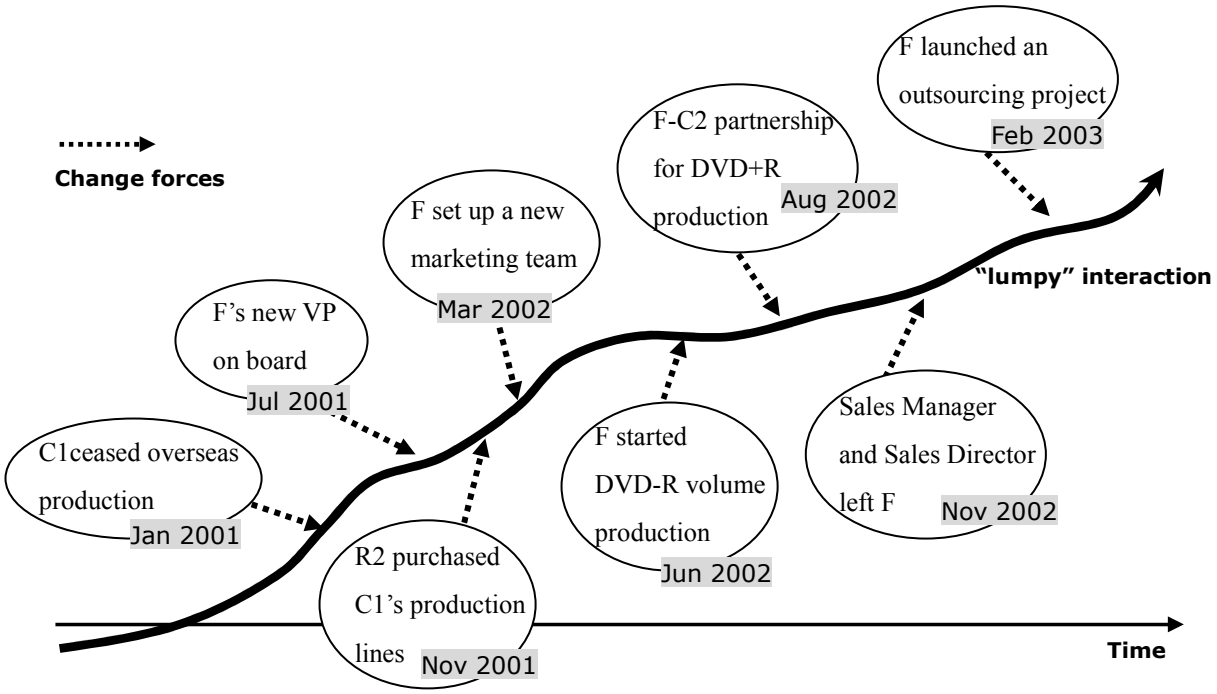
However, this new dye solution, which was achieved by the F-S1 cooperation, was propagated by S1 which allied with a UK-based technical consultancy and a Germany-based equipment maker as the provider of turnkey solutions. Company C1's leading advantage was soon caught up to by its competitors whose CD-R products also adopted company S1's solution. This resulted from company S1's simultaneous cooperation with company F and its competitors, such as company R1 (see Figure 8.2). Company S1's Senior Sales Manager noted "*Our dye material had almost become a standard. […] If you wanted to produce Phthalocyanine-based CD-Rs with good quality, our solution was the best choice. But we have to say company F did give us a boost. Because they were a leading manufacturer, other CD-R makers would follow whichever solution they used in their CD-Rs.*"

While company S1's dye material became the dominant solution for CD-R production, company C2 still kept its in-house developed solution, arguing that it was the best way to retain the feature of its branded CD-R although it suffered from further intensified competition initiated by the prevalence of company S1's solution. Two senior managers from company F's Japan-based customers thought that company F's cooperation with company S1 left it with a negative reputation of a "price killer" in the industry. One of the respondents even thought that company S1's success was simply from good luck, just because everyone used its material. An R&D manager at company F thought that its top management should have patented their research achievement, or at least, used legal contracts to restrict company S1 from spreading this material.

To get rid of the disadvantageous situation caused by the fierce competition in the CD-R business, major companies in the industry, including company F and its business customers, developed their countermeasures respectively. A common view among these actors was that embracing the next generation of technology could give fresh impetus to the industry as well as company growth. Since each member in the focal net possessed different resources and capabilities and experienced different interactions, they had different interpretations of their surroundings, which were reflected in subsequent events; particularly the significant events, as illustrated in Figure 8.4. These significant

events not only affected the evolution of the focal net but were also closed related to the arrival of DVD recordable technologies (both DVD-R and DVD+R) at this value-creating net.

Figure 8.4 Significant events associated with the arrival of DVD technologies



A crucial decision made by company F was the recruitment of its vice president in July 2001, who was invited from a well-known IT company to devise new operational strategies. These strategies included improving the CD-R profit margin by a price markup on OEM quotations, speeding up the preparation of the next generation media (DVD recordable products), developing company F's consumer media brands (including sub-brands) by setting up a marketing team, and reviewing its OEM customer portfolio using new criteria. These strategies were decisive for the future development of the focal net because some of them interfered with its customer's expectations while some fitted with its counterpart's plans.

Decreasing profitability in the CD-R business directed company C1's focus on restructuring its organisational activities. The remarkable actions it carried out were the shutdown of manufacturing operations at its US-based plant in January 2001 and the subsequent sale of production lines at the end of the same year. This plant mainly manufactured VHS and CD-R products in which the production of CD-Rs had operated for less than four years. Company C1 thought that this decision resulted from changing

marketplace conditions, industrial shifts and the competitive outlook for the optical recording media. It had to face the "marketplace reality" according to company C1's Plant Manager. A Sales Manager at company C1 also mentioned, "*The reason why we closed our plant in the US was that our production was not profitable especially in the face of challenges from Taiwanese media makers. CD-R production had become a burden. For example, my performance was better than other sales based in the US. The key lay in the fact that we didn't have production in the South-East Asia (the respondent was previously based in Singapore and he did not have to worry about production costs).*" In the meantime, company F's shipments for company C1 kept growing, including a variety of disc label-printing designs and packaging styles. To satisfy company C1's increasing demands for CD-R products, company F also expanded its production capacity.

Company C1 tried to persuade company F to purchase its used production lines, but failed. Company C1 expected, by this trading, that its relationship with company F could be strengthened. If company F had taken over their production equipment, company C1 would have placed more orders to company F and been able to further restructure its production factories based in Japan and Europe. However, this request was refused by company F's new vice president, who was recruited to help improve the firm's operational performance. The vice president believed that the used CD-R equipment would bring nothing but burdens. Company F was concerned about whether or not the used equipment could fit its facilities and the production system, which in turn would affect the yield rate of mass production. Moreover, company F had shifted its focus onto DVD technology. Although it had the capability to alter the CD-R equipment to fit the DVD production process, company F thought doing this was not cost-efficient.

Despite the close cooperation on the CD-R business, company F's reluctance to take the deal frustrated company C1. This close relational tie was built on mutual benefits, as company C1's Procurement Manager pointed out, "*Both companies got reasonable profit in the market.*" In November 2001, company C1's used CD-R production lines was taken over by company R2, a Taiwan-based OEM and company F's main competitor. According to a Sales Manager at company C1, company C1 had a relationship with company R2 in the floppy disk business before its relationship establishment with company F. He indicated that a major difference between companies F and R2 was the management style, in which company F was "executive-manager-led" while the latter was "CEO-led". This was one of the reasons company C1 selected company F as its partner on the optical recording media business. But this time, company C1 deeply appreciated company R2's timely assistance without asking for any

conditions (e.g. CD-R orders). Company C1 viewed this as a "great favour".

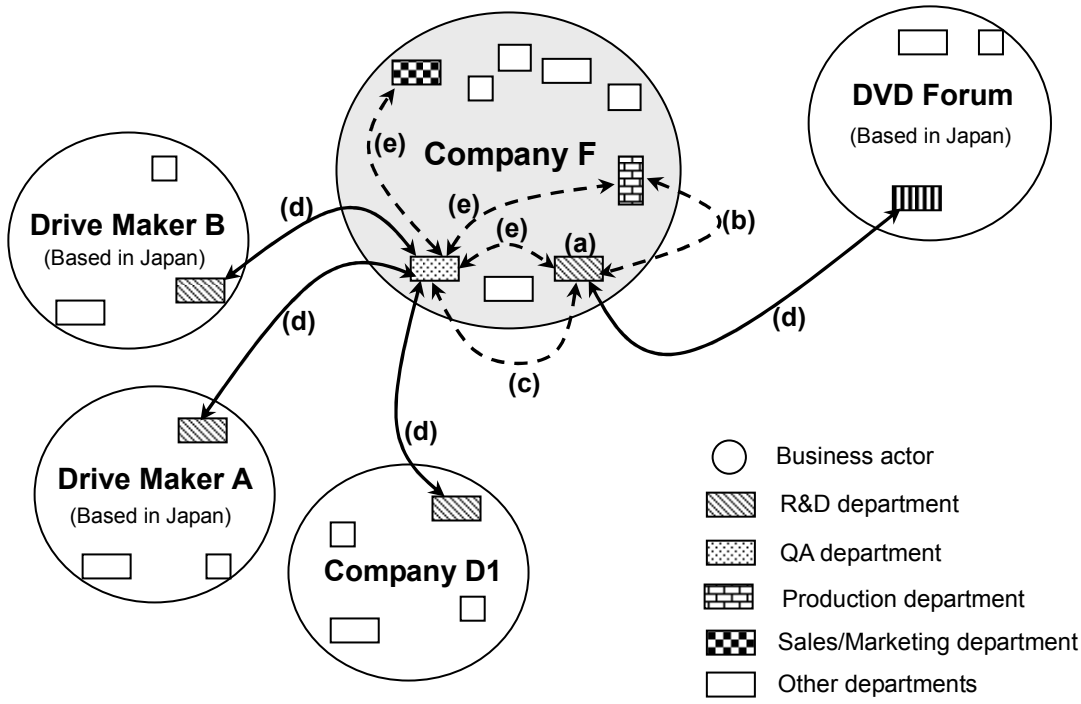
Another major strategic change made by company F was its set-up of a marketing team in March 2002. This marketing team, which was led by a new Deputy General Manager, aimed to change company F's OEM-oriented sales strategy. This team placed its focus on three aspects: developing its own brand business, increasing CD-R price and selecting OEM customers. Company F thought it was able to do so because it occupied an important position to exert influence in the industry. Company F's marketing head made such a description, "*From the point of view of product marketing, we played a decisive role in the industry due to our quantity (production capacity). We had an approximate 15% to 20% market share of the total manufacturing output in the world after all. We were in the leading position in media manufacturing. Because of this 15% to 20% market share, the volume and its allocation of customers (customer portfolios) were enough to influence the media price and supply-and-demand in the industry. We believed we had such an influence.*"

While developing its own brand business, company F was actively preparing the phasing-in of DVD-R production in June 2002 and DVD+R production in August of the same year. The chief considerations for the introduction of the next generation of technology were to improve the profitability and widen product lines for its own brand business. After about two years' research and development, company F was able to volume produce DVD-R discs in early 2002 (see Figure 8.5 for this process). Unlike its competitors who installed new production lines for DVD production, company F mainly relied on altering existing CD-R production lines to fit the requirements of DVD-R volume production, in order to reduce the capital expenditure. Even so, company F still had to invest in new machines (e.g. bonding machines), testing apparatus and develop new materials. In particular, investment was needed in the DVD-R stampers (used on the injection machine to produce disc substrates) and dye materials which were keys to company F' leading position. Although using an altered production line had a drawback of longer cycle time (than a new production line), it created an advantage: the flexibility in switching between CD-R and DVD-R production, especially when the markets fluctuated. Company F named its unique capability of altering production lines as "FMS" (Flexible Manufacturing System).

Company F's development of its own brand business created a good platform to promote its DVD-Rs. This was mainly due to the fact that company C2 placed their focus solely on DVD+R technology (in which its was a technology leader) and that company C1 retained the supply of DVD-R products in its factory based in Japan and was unwilling to release DVD-R production orders. While company F decided to

introduce DVD-R mass production, the CD-R demands from retail markets were still strong (although the price war had been initiated) and company C1 expected that company F could develop more capacity for its global demands, especially for its US markets. However, company F hesitated to meet company C1's request. It believed that introducing DVD technologies, including company C2's technology, was much more important than maintaining the CD-R business. With the support of its own brand business, company F was able to migrate from CD-R technology to DVD-R technology.

Figure 8.5 F's development of DVD-R technology from mid 2000 to early 2002



A verification laboratory in the DVD Forum, which is an international organisation to define, disseminate and verify DVD format (e.g. DVD-R and DVD-RW)

Inter-organisational interaction Intra-organisational interaction

Explanation

The project of developing new optical recording media (DVD-R) was kicked off by R&D (see (a)). When the product design was completed, R&D engineers co-worked with the Production Department to make samples for QA's evaluation (see (b) and (c)). As the evaluation result was satisfactory, then company F's QA and R&D sent samples to key drive makers and the DVD Forum respectively, in which the former tested the sample's compatibility with their new drive models while the latter verified the DVD format (see (d)). Finally, QA informed relevant departments of the final evaluation result (see (e)). Then, the Sales/Marketing department could decide how and when to launch the new product.

In addition to its reluctance to purchase the used CD-R equipment and maintain and develop more CD-R production capacity, company F's CD-R markup intensified company C1's dissatisfaction. After studying their company's operation through a series of internal meetings with relevant departments (such as R&D, Sales, Production and Finance and Accounting), company F's newly established marketing team released a media price book for its sales team, including a markup in price for CD-R OEM (partly because of the limited production capacity). Company F's Sales Manager; who had worked closely with company C1 since the beginning of relationship and who had developed a mechanism to respond to changes from different sales regions with regard to product items, price, quantity and logistics; failed to follow the new policy. He argued that "*Their (the marketing team's) strategy of price markup was totally wrong. A good maneuver should build on conditions where you were able to tempt your competitors to firstly markup rather than simply increasing your price by saying that you had controlled over a 30% of worldwide output. In the short run, your customers had no choice but accepted it. However, it forced them to turn to the second source […] Those who had the last laugh were your competitors."* Then in November 2002 the Sales Manager and his department head, who always tried to meet company C1's needs in the CD-R business, resigned from company F. Company F also transferred the company C1 Account Manager to another department to handle the CD-R outsourcing project. This situation deepened company C1's dissatisfaction with company F and, in early 2003, caused the top management of both parties to return to the negotiation table.

On the other hand, a crucial consideration in company F's decision not to expand the CD-R production capacity was its preparation for company C2's transfer of DVD+R technology that was created by the DVD+RW Alliance in which company C2 was a leading member. Although company C2's CD-R orders were much smaller than company C1's, company F believed strengthening its relationship with company C2 could allow the firm to gain a more competitive position in their DVD media business. By taking advantage of company F's production capacity and technological competences, company C2 could focus its attention more on technical development of DVD+R and its own brand management. Most important of all, company C2 was able to develop its OEM business which was a major strategic change. Company F's Deputy General Manager viewed its relationship with company C2 (partnering as an OEM entity) in this way, "*I regard our cooperation with company C2 as a "partnership". From the point of view of the smiling curve, firstly, they control the left end; namely, the patent or key technology. The middle, we call it process or manufacturing; focuses on time to market and cost. This is the area in which we specialize. Regarding the right end, it is about managing brands which is also controlled by company C2. They are in*

charge of approaching key customers […] In addition to acquiring their technology, we get another advantage from this relationship: we are permitted to develop our own brand business and approach second tier customers."

According to a Senior Manager at company C2, "leader of DVD+R technology", "participation in standardisation" and "actual business development" were important factors to attract company F to co-work with them as an OEM entity. He argued that this relationship could be characterised by "give-and-take"; company C2 provided company F with DVD+R technology and in return received cost and quantity from the counterpart. It was the mutual understanding and trust that sustained the relationship from CD-R business to DVD+R business. Just as company F's General Manager indicated, "*Our partnership with company C2 in the DVD area was built on the mutual trust we had developed from doing CD-R business. Without having a good interaction and mutual trust, it was quite difficult for a company to transfer their in-house developed technology to another firm and depend on the counterpart's manufacturing technology to supply products that met their requirements. Regarding our relationship, since we had developed a high level of trust among engineers and from the management team to the working team, it was natural for us to head towards this (partnership).*"

8.3.3 Relationship dynamics within the focal net from mid 2001 to early 2004

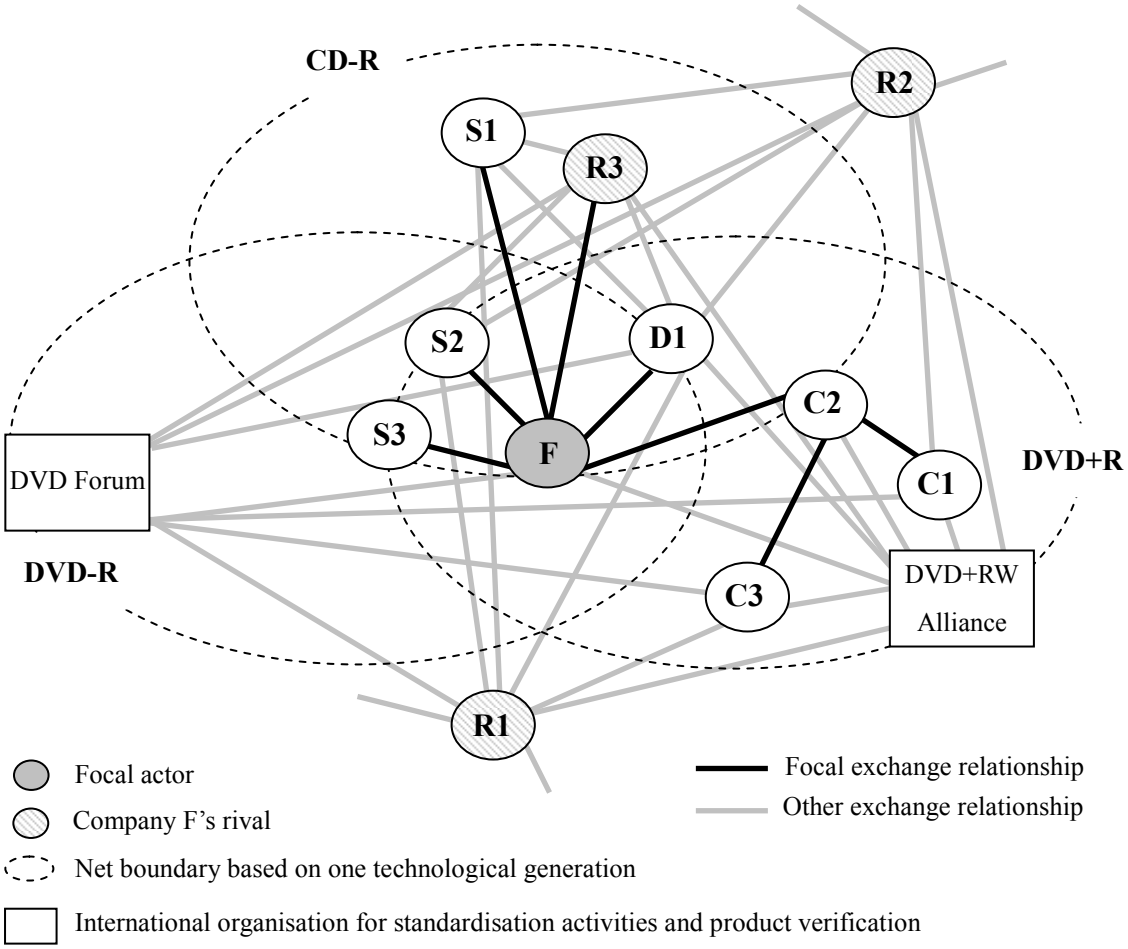
The significant events above, which were associated with the arrival of DVD recordable technologies, brought about changes in the relationship dynamics within the focal net. Following this technological arrival, some of company F's relationships faded away and other relationships continued and a new relationship was established, as illustrated in Figure 8.6, a snapshot of the focal net in early 2004. Furthermore, this arrival allowed the focal net boundary to extend from the application of CD recordable technology to DVDs, in which some actors' adjustment in their role sets that came with their positions could be identified, see Figure 8.7.

Radical changes of relationships

From mid 2001 to the end of 2002, a series of events between companies F and C1 (e.g. F's reluctance to purchase used production lines and its CD-R markup), which were initiated by company F's strategic change directed by their new vice president, made the dyad gradually distant. Although both parties' top management teams met several times from early 2003 to try to protect mutual interests and resume the cooperative atmosphere that existed before company F's phase-in of DVD technology, they failed to reach common ground, mainly because of strategic misfit. Perceiving little possibility of

restoring the relationship, company C1 actively developed its optical recording media business with company R2 who purchased its used CD-R equipment at the end of 2001. Company C1 gradually transferred its orders to company R2, attempting not to disturb its marketing activities. While company C1 established operational routines and procedures with company R2 (e.g. being able to stably supply CD-Rs), its relationship with company F faded away in early 2004.

Figure 8.6 A snapshot the focal net in early 2004



Note: This figure aims to illustrate the focal net evolution from its previous state (see Figure 8.2). This purpose explains why the left side (DVD-R) of the figure remains blank. Moreover, the blank area does not suggest that company F had no exchange relationships based on the DVD-R business.

Regarding the fading relationship with company F, company C1's Sales Manager and Procurement Manager thought this event could be ascribed to several reasons. Firstly, company R2 purchased its used production lines, which company F was reluctant to take. Secondly, company F's CD-R price did not meet its expectation, but company

R2's did. Thirdly, company F hesitated to install more production lines in accordance with its demands. Company C1's Procurement Manager emphasized that "*Quick action is the best policy in doing business*". He thought that company R2 was an "owner company" in which the CEO judged all issues himself quickly, such as purchasing its used equipment. Although company R2's technical knowledge was not as good as the focal actor, the Procurement Manager thought that company R2 always tried to get skills from other companies. However, company F thought that profit sharing was an important criterion for a relationship to continue. As company F's General Manager contended, "*Profitability determines a firm's viability in the optical recording media industry.*"

When communication between companies F and C1 reached deadlock, company F approached several second- and third-tier CD-R makers in Taiwan, Hong Kong and China and finally developed a new relationship in July 2003 with company R3, a Taiwan-based second tier OEM, to outsource CD-Rs to tide over its capacity shortage (see Figure 8.6). However, seeking a partner among competitors was not an easy task for company F. A senior manager who was previously in charge of the outsourcing project at company F said, "*Our original plan was to find a media maker who could produce CD-Rs that met our requirements. But the candidates found our standard was too severe to follow, because they were short of technological competences and experiences of dealing with major media brands. We tried to offer some technical support. However, our R&D and Production Departments were afraid that their know-how would be leaked out. Consequently the support was quite limited. These makers also viewed that they had to increase the expenditure, e.g. using high quality materials, so as to produce qualified CD-Rs for us. Moreover, they didn't want to be controlled by us.*" Company F's cooperation with company R3 was built on a trading relationship. Company F did not require the counterpart to follow its standard in producing CD-Rs. Instead, it adopted a sampling inspection procedure (e.g. MIL-STD 105E inspection) to control the quality of each shipment.

As shown in Figure 8.6, company F's relational tie with company C3 was broken after the arrival of DVD recordable technologies at the focal net. Company C3 became one of the victims of company F's new criteria for selecting OEM customers. The new criteria included the volume of monthly purchase orders, track records of account receivable, and strategic advantages (e.g. owning patents). This broken tie was mainly due to the fact that company C3's monthly CD-R orders were too small and unstable. Compared with companies C1 and C2, company C3's media brand was not as popular. Although company C3's top management considered company F an important partner and wanted to talk with their counterpart, F's vice president who possessed the power to make the

final decision was unwilling to start the discussion. The vice president's reaction frustrated Company C3. Company C3 expressed its disappointment and dissatisfaction to a senior sales manager at company F. Finally, their exchange relationship was discontinued from June 2003.

Incremental changes of relationships

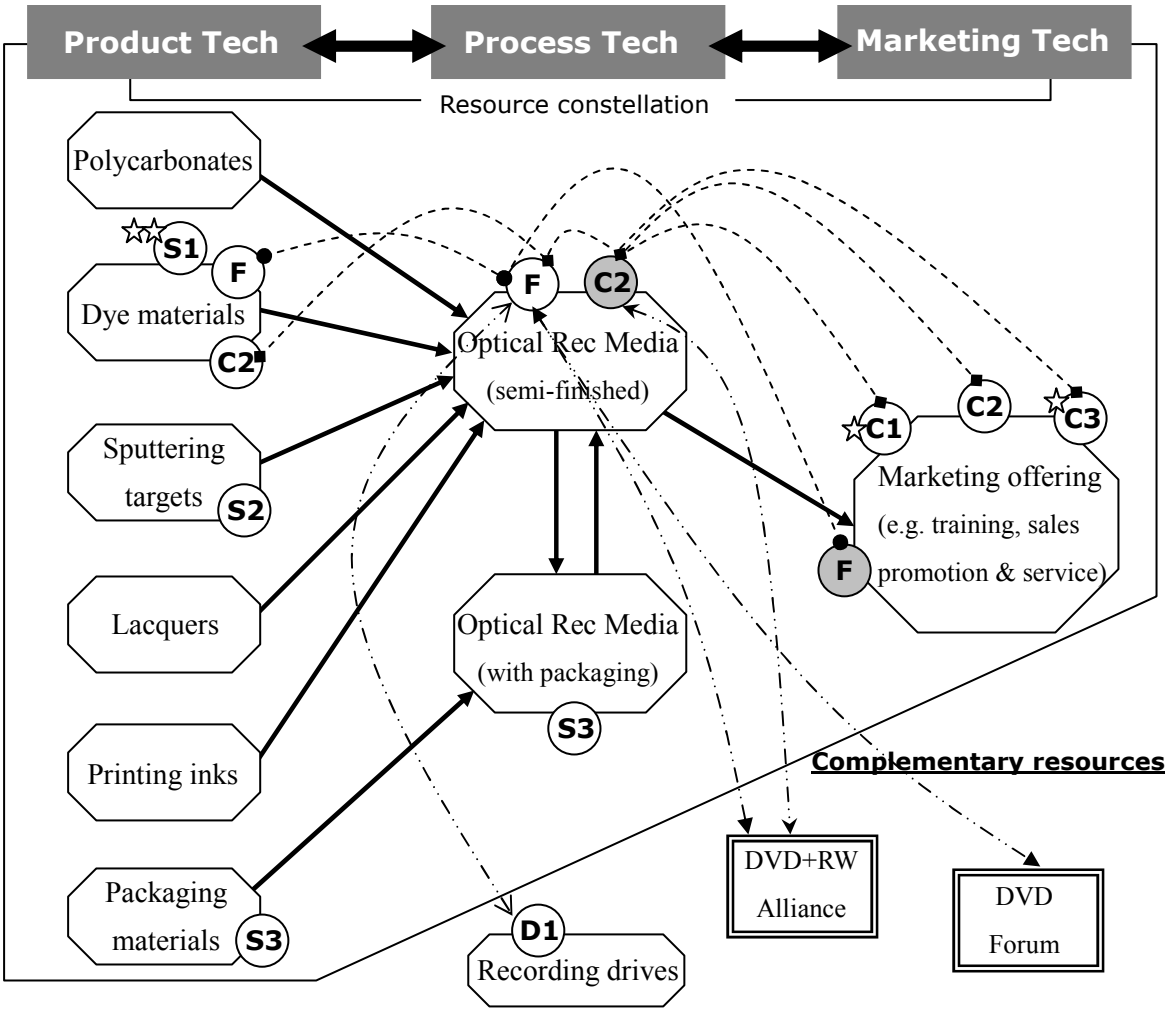
Except with companies C1 and C3, company F's relationships with its net members were sustained after the arrival of DVD recordable technologies. Despite the continuation of these relationships, there were some changes that could be observed when compared with the previous state of the focal net. In the first place, companies S2 and S3 (the suppliers of sputtering targets and packaging materials) were able to serve company F's business markets based on CD-R, DVD-R and DVD+R technologies (as illustrated in Figure 8.6), because the technological change from CD to DVD did not have a great impact on their technological competences. As a sales representative from company S2 noted, "*Both CD and DVD recordable technologies uses silver targets in production to sputter a reflective layer on each disc. The materials are the same. Although there are a number of different types of sputtering machines among our customers, the only difference to us is the target dimension […] For us, the most important task was "management", managing how to meet customers' requirements.*" As for company D1, in addition to its own technological competence, its close relationships with design houses (chipset providers) based in Taiwan and Japan enabled it to acquire key components and thus was able to migrate quickly to the next generation of technology.

Unlike companies S2, S3 and D1, company F's relationship with company S1 remained in the CD-R business. Although company S1 had achieved a very successful CD-R dye business, it failed to migrate to the next generation of technologies. Company S1 attributed its failure to two reasons. One was that the company, in which the dye material of optical recording media was just one of its product portfolios, missed the best timing to release its new solution for the DVD recordable media because of the changes in its top management team. The other reason was that the verification of its DVD samples using its newly developed dye material was put off by the DVD Forum which was mainly controlled by Japanese-based companies. Without getting the approval from the DVD Forum, no media makers would adopt company S1's solution. As company S1's Senior Manager mentioned, "*I believed those Japanese vendors had learned a lesson from the CD-R business […] Although we delayed the release of our DVD solution, from the user's (media maker) point of view, we provided an alternative. Why would the customers not give it a try? May be would it be a better solution after trying it out? Who could make the decision to try it? As a media maker, it was up to*

your customers. Your customers would request you to pass the verification […] This verification was controlled by those Japanese companies."

Following the arrival of DVD technologies, an obvious change within the focal net was companies F's and C2's change in their role sets (see Figure 8.7). Under its vice president's strategic maneuvering, company F started to develop its own brand business. This additional and new role allowed company F to release its DVD-R products (based on its in-house developed dye material) as well as company C2's DVD+R products more quickly that the competitors. Also, besides its own brand business, company C2 played another role as an OEM through partnering with company F. Both companies developed a mechanism to co-promote their DVD+R business: company C2 defined, approached and managed major media brands (e.g. companies C1 and C3) while other brands (e.g. second-tier and company F's own brands) were handled by company F. Based on this mechanism and company C2's leading technology, companies C1 and C3 became company C2's OEM customers (see Figure 8.6 and 8.7). Despite broken relational ties, company F's relationships with companies C1 and C3 were indirectly connected via company C2 within the focal net boundary. While companies F and C2 were playing multi-roles in the technology-bundled value net, S1, S2, S3 and D1 remained being F's important suppliers and complementor.

Figure 8.7 Roles performed by the focal net members in early 2004



Materials or products that are produced using a certain type of technology (e.g. process tech)

Focal net member

New role of the focal net member

Combination of resources and connection of activities

F used its in-housed dye materials to produce both DVD-Rs and DVD+Rs for its newly established brand business

C2 provided DVD+R products that was manufactured by F using C2-patented dye materials for C1 and C3 as well as its brand business.

F only provided their DVD+Rs via C2 for C1 and C3

S1 only supplied CD-R dye materials for F

Compatibility evaluation and exchange of product information and market intelligence

Product verification

C2 joined standardisation activities at the DVD+RW Alliance

International organisation for standardisation

8.4 The second reconfiguration of the focal net towards the end of 2004

8.4.1 A bottleneck in upgrading DVD-R technology

The deteriorating situation in the CD-R business made company C3 aware of the importance of embracing the next generation of the optical recording technology. It realized that having its own brand business was not enough to stay competitive in this volatile industry. With its chemical background in the photographic area, company C3 invested R&D resources in developing dye materials for DVD recordable media, attempting to improve its position in the industry. This move gave company C3 the ability to leverage its influencing marketing technology and product technology. Company S1's Senior Sales Manager made his comments on company C3's role change, "*Let me explain in this way. We simply act as a supplier of dye materials. As for them (company C3), they have another means of manipulating their position. In other words, they can give you business orders for their brand on condition that you use their dye material in production […] In reality, selling dye material is much more profitable than selling discs. In order to penetrate the dye material market, they use their brand influence.*"

In the so-called "relationship aftermath" phase, company F's sales people still kept in touch with their contacts in companies C1 and C3, hoping there would be chances to do business with each other again. Through this channel company C3 was seeking the possibility to cooperate with company F on the DVD-R media business that could promote its in-house developed dye material. Company C3 thought it would be a boost to its profitability if its dye solution was adopted by company F, which possessed a considerable production capacity. Initially, company C3's dye material was rejected by company F several times because of quality problems. Company F's General Manager noted, "*In the beginning, the performance of their dye material was not good. They had difficulty promoting their DVD solution. For a while, they were involved in a process of trial and error. Finally their dye material was fine-tuned to a satisfactory level.*"

In addition to quality issues, one more important factor was company F's R&D director's insistence on using the in-house developed dye material for DVD-R volume production. He argued that sourcing an external dye solution would impair the firm's technical capabilities as well as its competitiveness. Moreover, developing an in-house dye material could achieve a cost advantage. The Deputy General Manager at company F's Research Centre (the ex-R&D director) mentioned, "*We didn't count on external dye solutions since they were very expensive.*" He added, "*The reason why we developed our own dye material was that we expected our research and development*

would bring us additional advantages. Developing our own dye material, which other makers were incapable of doing, allowed us to achieve lower production cost. Indeed, our DVD-R gained a good reputation because of good value for money. It boosted our own brand sales, particularly in European regions […] However, this cost advantage had little effect upon our OEM business. This was because the production cost was not a main focus in the early stage of the DVD market." But the sales and production departments did not appreciate R&D's efforts. They believed using a qualified external dye solution could allow the firm to get more OEM orders. This intra-organisational conflict was suppressed by the R&D department's timely release of the latest version of dye solution for DVD-R production that met the needs of the markets, such as new products with higher recording speeds.

Since its first launch of DVD-R (1X recording speed) in the second quarter of 2002, company F was able to opportunely upgrade its DVD-R to higher recording speed by adjusting the chemical formulation of its dye material and by getting its new version of DVD-R verified and approved by the DVD Forum. In the DVD recordable media business, each manufacturer's new version of DVD-R and DVD+R media must be tested and certified by the DVD Forum and the DVD+RW Alliance respectively, so as to use the format organisations' logos. However, the delay in releasing the latest version of DVD-R (from 8X to 16X recording speed) in mid 2004 changed company F's postures. This delay arose from company F's version of DVD-R failing to be certified by the DVD Forum. This failure caused the momentum of company F's brand and OEM businesses to be suspended. This event later led to significant changes in company F's value-creating net.

The pressure from the sales department and business customers forced company F to approach company C4, another Japanese-based technology vendor which also possessed commercial dye solutions for CD and DVD recordable media production. Since starting their CD-R OEM businesses, company C4 partnered with company R2 (company F's main competitor). In fact, company C4 had once approached company F to promote its dye material for DVD production in early 2002. But this approach was in vain because of company F's reluctance to adopt external dye solutions. This dissatisfaction made company C4 hesitate to deal with company F. An R&D Manager at company F recalled, "*We didn't cooperate with them (company C4) on CD-R business because they selected company R2 as their exclusive partner. Even so, we didn't clash with their business in the CD-R period. But from the beginning of the DVD business, we decided to do it our own way and declined to use their solution. We believed we could work it out […] In the end the situation was that we sought to source their dye material, but this time, they were reluctant to sell.*" Furthermore, company C4 considered that selling its dye

material to company F at this timing would impair its partnership with company R2. It was also afraid that its know-how would leak out, particularly to company C2, company F's strategic partner. Company F's approach resulted in nothing. Without other choices, company F then turned to company C3. Meanwhile, company F's R&D director was transferred to another business group for internal political reasons.

8.4.2 Relationship dynamics within the focal net from mid 2004 to the end of 2004

Company F's need to release the latest version of DVD-R reactivated its relationship with company C3. As a Production Manager at company F pointed out, "*At that time we had to approach a technology vendor who owned patents or dye materials in order to win back the market share. Then, we sought their (company C3) assistance […] That is to say, due to rapid change in the market situation, there were several measures you could take in order to maintain your leading position. One was to have customers who agreed to your ways of doing things. Another was to develop dye materials yourself and get them quickly certified [….] We were not fast enough, so we were forced to approach them (C3). That was the fastest way to solve our problem. I thought the key lay in how quickly you could shorten the gap.*" With company C3's dye solution and its intervention in the communication with the DVD Forum, company F's higher speed DVD-R was soon certified by the format organisation. Then company C3's solution was introduced to company F's mass production in July 2004 while company F's R&D continued to improve its own dye material.

The restoration of the relationship between companies F and C3 was built on mutual interests. For company C3, "profit" was a crucial consideration. As its Operations Manager indicated, "*Companies F and C3 helped each other. We had to make money. Company F was the number one manufacturer. They had mass production technology and some advantages. As for company C3, this time, we had the dye and the raw material. So our position was a bit…um…special in the industry. I proposed to Winston (company F's General Manager) and his people that we supplied dye and they used our dye technology to produce good quality and low cost discs. Then we cooperated and we could survive in the industry. This was one way we cooperated with each other.*"

Company C3's cooperation with company F was vital to sustain its dye and media brand business. Although its relationship with company R1 continued, company C3 thought that company R1's production capacity was insufficient to grow its new role as a dye supplier. It had to find additional media makers, but there was little chance for company C3 to develop an exchange relationship with company R2 whose relationship

was very close to company C4. Companies C3 and C4 were rivals in the industry in terms of dye material and media brand. Thus, company F became its main target. In order to make company F keep using its dye material, company C3 gave them DVD-R orders. To strengthen this relational tie, company C3 exclusively outsourced to company F, the production of a new type of printable DVD media which was the result of its R&D efforts with a famous Japanese-based drive maker. This unique technology allowed consumers to burn pictures and/or write titles on the label side of DVD discs using the laser of the drive. Company C3's Operations Manager thought that by developing such a value-added product, they could increase their chance of surviving in the industry.

However, in the beginning the cooperation between companies F and C3 on the DVD business was not smooth. Company C3 originally requested company F not only to use its dye material but also follow the process it prescribed to produce DVD-Rs for its brand. But company F just wanted to use the dye material while maintaining its independent operation in terms of R&D, process engineering and production. Company C3 eventually compromised after negotiation and company F proving its ability to use company C3's dye material to produce good quality discs. Company F's General Manager expressed his thoughts on this matter by using company C3's cooperation with company R1 as an example, "*You (company C3) request the counterpart to follow your ways to produce discs. Since the maker uses your material and follows your instruction, here comes a problem: how can the maker deal with the inferior (out of spec) discs? The choice is either to buy them back or to compensate in some ways. Otherwise, the maker is forced to markup. They have to absorb the cost. This is to demonstrate that you restrict your counterpart's action, but simultaneously, your business freedom is constrained […] In such a business model, your procurement cost is relatively higher. When your profit margin gets lower, your business model comes under question.*"

Company F's re-cooperation with company C3 brought about another reconfiguration of the focal net towards the end of 2004, as illustrated in Figure 8.8. Through the relationship reactivation with company F, company C3 hoped that it could stay competitive and would be able to countervail company C4's position in the industry. On the other hand, company F's adoption of company C3's solution tempted company C1 to source products from company F again. In the face of fierce competition in which a variety of products based on different recording technologies co-existed, company C1 thought that the relationship reactivation with company F could allow it to be more flexible in marketing strategies. According to company F's Sales Director, this was partly because of their continuous contact with company C1 to update their own company's operation. As shown in Figure 8.9, company C3 exercised its influences

using its roles in product technology as well as in marketing technology. As for company S1 (another supplier of dye material), it still remained in the CD-R business despite its launch of new DVD dye material in December 2004. Company S1's release of new material was not able to sway the established ties, such as company F's relationship with company C3 or the relationship between companies R2 and C4, in which interfirm adaptations had been made.

Figure 8.8 A snapshot of the focal net towards the end of 2004

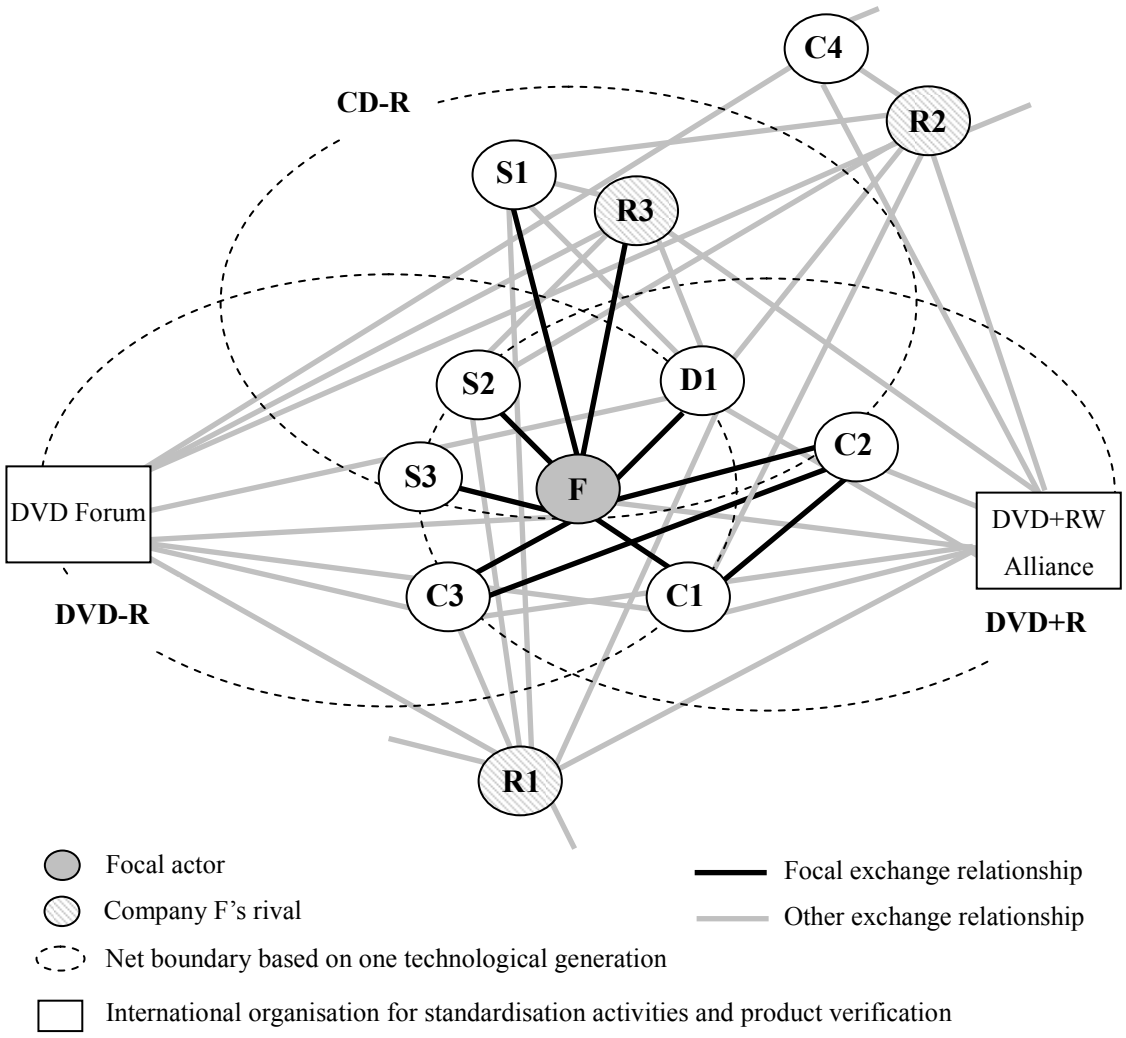
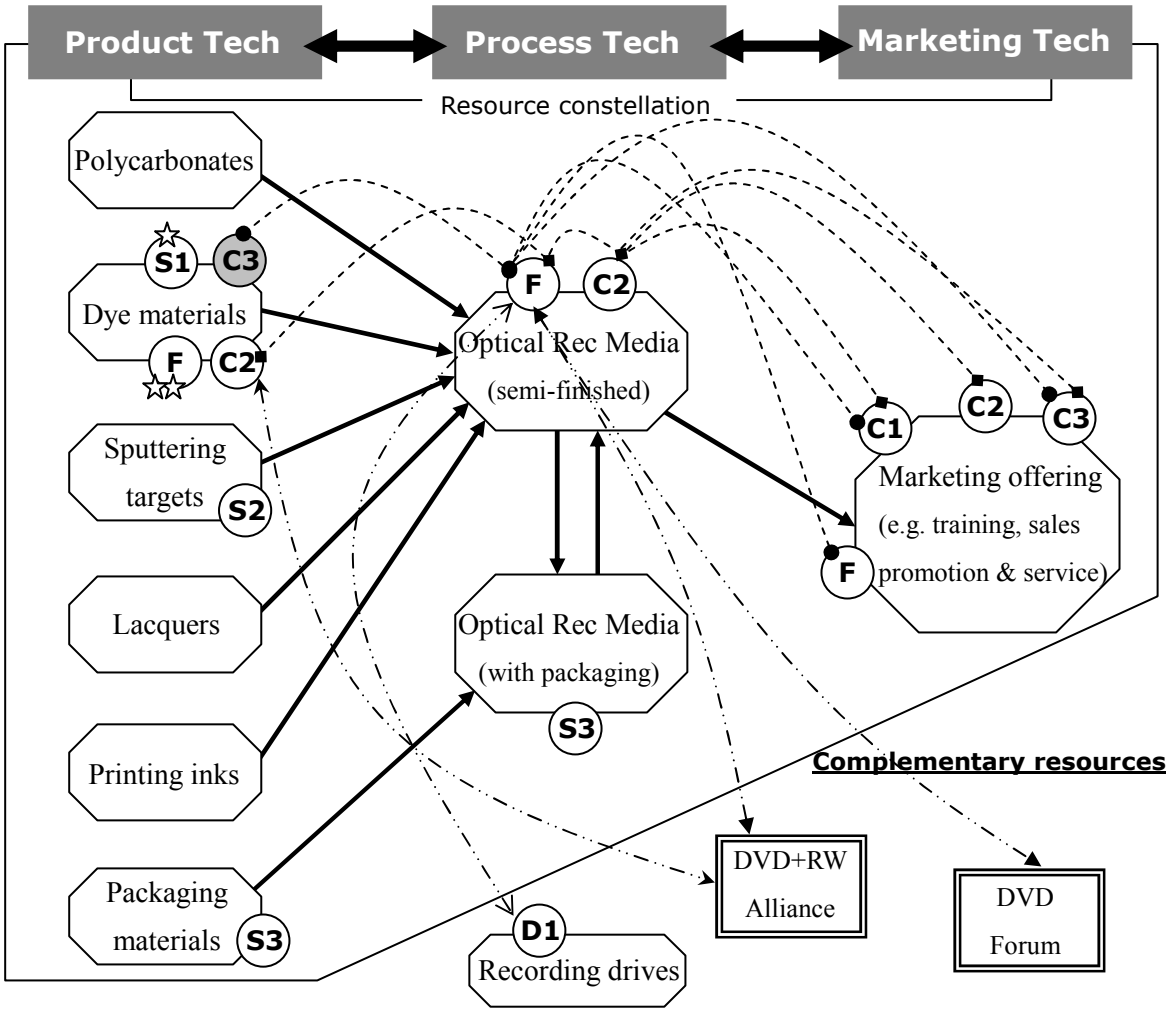


Figure 8.9 Roles performed by the focal net members towards the end of 2004



Materials or products that are produced using a certain type of technology (e.g. process tech)

Focal net member

New role of the focal net member

Combination of resources and connection of activities

F used C3's dye materials to produce DVD-Rs for C1, C3 and its brand business

C2 maintained its partnership with F, providing DVD+R products for C1, C3 and themselves

S1 only supplied CD-R dye materials for F

F used its in-house dye solutions for CD-R and DVD+R manufacturing

Compatibility evaluation and exchange of product information and market intelligence

Product verification

C2 joined standardisation activities at the DVD+RW Alliance

International organisation for standardisation

8.5 The third reconfiguration of the focal net towards the end of 2005

8.5.1 The arrival of DVD DL recordable technologies

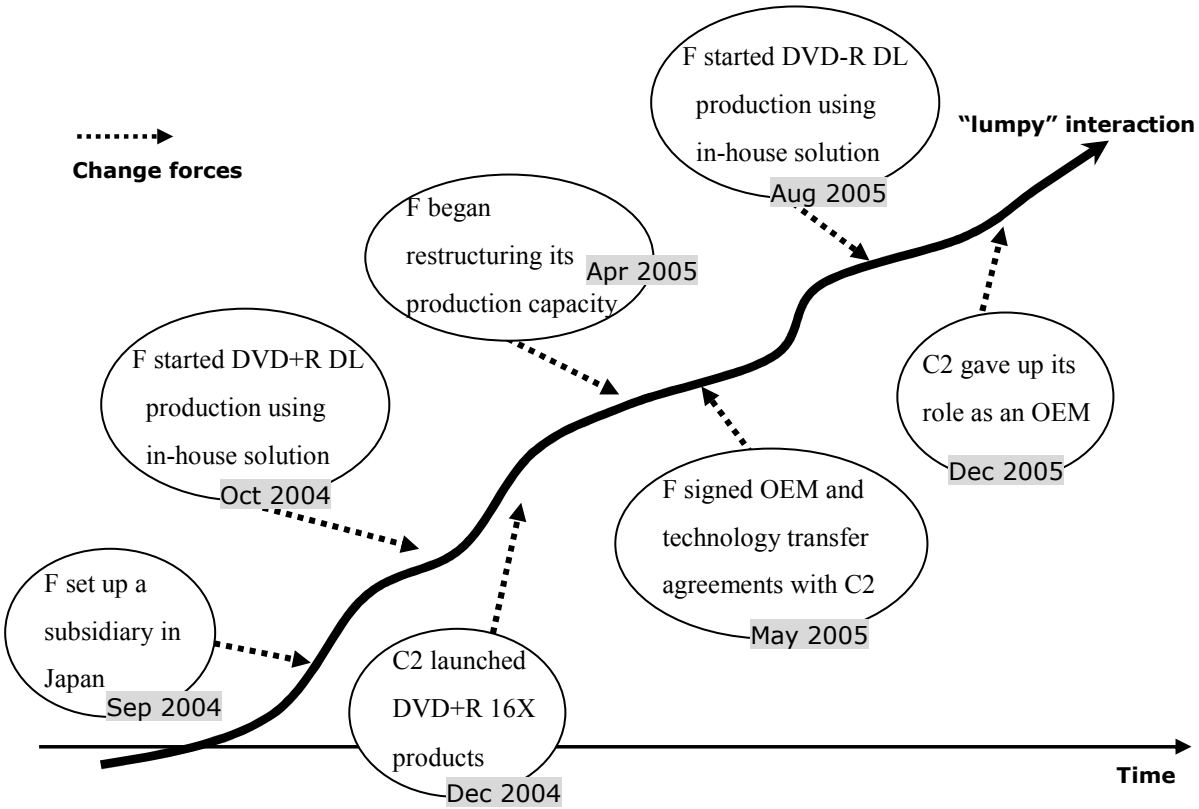
The constant need for investment in new technology and new production equipment did not deter CD-R makers (especially those medium and small sized ones) and newcomers from entering the DVD battle field. The availability of key materials, equipment and even turn-key solutions meant DVD manufacturing technology was not a serious issue. A Sales Manager from a second-tier OEM mentioned, "*Basically, as long as you have enough capital to invest in new production lines, you are able to produce DVD discs; since you just purchase raw materials, use them in your machines and go through the whole process. The key hinges on how you adjust or control production parameters so as to stabilize your production to produce good quality discs. Therefore, I think the barrier for entering into this industry is not technology but the capital that allows you to purchase new production equipment.*" A process engineering manager at company F described this phenomenon as "the spread of technology" and he further added, "*The spread of technology resulted in drastic increases of supply in the markets which in turn occasioned a collapse of media prices.*"

The leading players in the industry, e.g. companies F and C2, expected that their migration to DVD technologies would improve their operational performance. However, severe competition and terribly low margins that these players suffered in their CD-R businesses were not expelled by the emergence of new technologies due to the spread of commercialized materials, equipment and even the production process. The spread of technology also resulted in the expansion of production capacity among producers. In the face of such a tough environment, these leading players were forced to introduce new products with higher and higher recording speeds, so as to gain slightly higher margins and a degree of exclusivity that allowed them to distinguish themselves from their competitors. Another way for them to enhance their performance was to drive down costs to the best of their abilities. Moreover, a Senior Sales Manager from a second-tier OEM pointed out a crucial factor that might determine an OEM's competitiveness, "*In reality the optical recording media industry is highly standardized. That is, all media makers follow the same standard to produce discs. The rule of the game is clear: who can produce cheaper discs […] Moreover, all brands in the world have their own vendors (or suppliers). But due to the excess of supply over demand, the numbers of vendors will be limited. So it is very important how you can manage to become regarded as a first tier vendor by international brands*."

The informants from companies F, C1 and C2 all indicated that it took more than 13

years for the development of CD-R technology to reach its technological limit. However, it took less than eight years for the full development of DVD-R technology (even shorter for DVD+R). In such a rapidly changing DVD market, company F placed their attention on differentiating its products. According to a manager from company F's Global Logistics Division, "*Our top management team always pushes us to develop differentiated products to stimulate the market demand and gain higher profitability. How can we differentiate our products from others? This can be achieved by driving down your cost or developing higher-recording-speed products or the next generation of technology.*" As a result, company F regarded the bridging of DVD DL[10] (double layer) technologies as a crucial means to enhance the firm's operational performance. The arrival of DVD DL technologies at the focal net was affected by several significant events, as shown in Figure 8.10.

Figure 8.10 Significant events associated with the arrival of DVD DL technologies



[10] DVD DL is short for DVD Double Layer recording technology. A DVD-R DL or DVD+R DL disc, developed by the DVD Forum or the DVD+RW Alliance respectively, has a double recording capacity of a DVD-R or DVD+R disc.

The C2-F partnership allowed company C2 to become a market leader in DVD+R technology in terms of market share, product quality and new product launch. Such a business model also permitted company F to advance its knowledge in developing own solutions (including dye materials and process) for DVD+R manufacturing, even for DVD DL. However, the lead created by their cooperation was short-lived, a few months at best. As an R&D manager from a second-tier OEM said, "*For medium and small sized makers, the main problem of releasing a new product was 'timing'. They were eventually able to catch up because they could acquire relevant technical resources from material or equipment suppliers.*" A Senior Sales Manager from this OEM indicated, "*Basically, each maker was able to upgrade their media. It was always the companies like company R2 or F who firstly brought out new products. But they only could keep their lead for one to two quarters at most […] The technical issues could be covered by external solutions.*" Facing such a competitive environment, company F actively prepared the phase-in of DVD+R DL technology before company C2's release of DVD+R 16X (which was the limit in speed-increase) in December 2004.

Although company F's cooperation with company C2 did achieve some advantages, it perceived that its advantages had been gradually neutralized by its main competitors' (e.g. company R2's partnership with company C4) improvement of their effectiveness and efficiency. Company F's General Manager pointed out, "*Our business model that was built on the complementarity between R&D and manufacturing made company C2 the market leader. But meanwhile, others were improving their business processes. Eventually there was not a big difference between our model and other's. The gap in terms of timing and performance was narrowed.*" In order to satisfy its own needs, company F not only kept cooperating with company C3 on DVD-R technology while partnering with C2 but also actively continued its research and development of dye materials and production processes, especially for DVD DL technologies. An encouraging result of its R&D efforts was the success in developing its advanced dye materials and process for DVD+R DL manufacturing in October 2004. Prior to the mass production of DVD+R DL discs, company F set up a subsidiary in Japan in September 2004, which was led by a Japanese senior manger transferred from F's headquarter in Taiwan. This decision was made for two considerations. One was that the bottleneck in upgrading its DVD-R technology made company F aware of the importance of strengthening its communication with standard organisations, such as the DVD Forum and DVD+RW Alliance based in Japan. The other reason was that the Japanese market was an important beachhead of the optical recording media and had strategic influence for company F's own brand as well as OEM businesses.

However, company C2 felt threatened by company F's aggressiveness in bridging

DVD+R DL technology. Since the mainstream technology was still DVD single layer rather than DVD double layer, company C2 worried that company F's move would impair its business customer relationships based on the existing business model (its partnering with company F as an OEM entity), especially that DVD single layer 16X (the maximum recording speed of this type of technology) was expected to be released to the market in the end of the year. Company C2 did not worry for nothing because some customer(s) had previously tried to directly approach company F for "cheaper" products. On the other hand, company F thought that company C2 had gradually lost its speediness in responding to change conditions, such as price fall caused by competitors' counteractions. As company F's General Manager mentioned, "*Because the gap in terms of performance, quality and even the cost had been narrowed, their advantage of this layer (between their customers and the focal actor) in the business structure was reduced. Then, you could see their market was beginning to shrink.*" Initially, company F's DVD+R DL discs were produced for its own brand business without breaking the commitments with company C2.

In the first quarter of 2005, most second-tier media makers had their DVD+R 16X products certified by the DVD+RW Alliance and started their volume production. But this left media makers nothing other than price to attract buyers, including CD and DVD products. From April 2005, company F began restructuring its production capacity, including upgrading DVD single layer products to 16X and transferring more production lines to DL manufacturing. These restructuring activities resulted in a dramatic change: company F ended its CD-R manufacturing in Europe and moved the facilities to Vietnam. The European manufacturing based in Germany and Northern Ireland, which was established around the Millennium, enabled company F to better serve its European market and to be exempted from the levy of anti-dumping duty. However, the heavy pressure of production costs forced company F to search for a new production site that allowed them to drive down the cost. At the same time, it also moved some CD-R lines from China and Taiwan to Vietnam so as to concentrate its Taiwanese manufacturing more on DVD and higher-end technologies. In this way company F was able to receive company C2's DL technology and subsequently introduce DVD-R DL manufacturing in August 2005, based on in-house solutions.

Company F's cooperation with company C2 was sustained by signing an OEM and technology transfer deal for DVD+R DL business in May 2005. This continuation of partnership was built on company F's ability to handle company C2's DL technology and company C2's lack of production capacity. Moreover, in a press interview the chairman of company R2 (the focal actor's main rival) mentioned that there had been a trend of concentration of players for some time in the industry and the optical recording

media market would be dominated by a few makers, especially when the technological development came to multi-layer formats. He also pointed out that only three companies were able to volume produce DVD DL discs: companies F, R2 and C4 (of which the latter two firms had developed a close relationship since doing the CD-R business).

In their sustained relationship, companies F and C2 maintained the same business model developed from their DVD+R (single layer) business in which company F followed company C2's process (including the usage of key materials and product quality control procedure) to produce DVD+R DL discs for C2's brand and OEM customers. Company F were also allowed to use company C2's process to produce discs for its own brands and other customers. Simultaneously, company F maintained another process of DVD+R DL manufacturing based on its in-house developed solutions. According to company F's R&D Manager and company C2 Account Manager, its own process had an advantage of superior quality despite lower yield rate while company C2's process was cost-efficient. Maintaining different production processes, including DVD-R DL manufacturing, permitted company F to increase their flexibility in marketing strategies. As F's marketing head noted, being as a leading manufacturer their aim is to satisfy customers' needs by "one-stop shopping".

8.5.2 Relationship dynamics within the focal net from late 2004 to the end of 2005

The accessibility to technical resources, such as materials and processes, permitted a plethora of producers to join the DVD recording media industry. However, the fierce competition made many producers unprofitable and they subsequently withdrew from the battlefield. A Sales Department Manager at company R3 (which developed a trading relationship with the focal actor) observed that "*Indeed a lot of things can be sourced, such as a turn-key solution. But it is futile if the cost of your sourcing and production does not allow you to vie with major companies. For example, if you adopt company C3's dye material but produce more expensive DVDs, you get low competitiveness. Having money allows you to buy raw materials, equipment and process, but more important issues are: how you can drive down your cost and how you can produce good quality discs with competitive prices.*" In tough circumstances, most players who survived from the fierce competition in the DVD business hesitated to invest in DVD DL technologies. This manager also mentioned "*I think the first barrier is the capital expenditure. It is very expensive to install a new DVD DL production line. Because most of us do not make profits from DVD businesses, few companies will invest in DL or even Blu-ray*". In addition, according to a senior R&D manager from company F, the requirements of product precision raised technical difficulties in the mass production,

such as yield rate. As a result, business buyers (e.g. company C1) faced a more limited selection in terms of suppliers of DVD DL media.

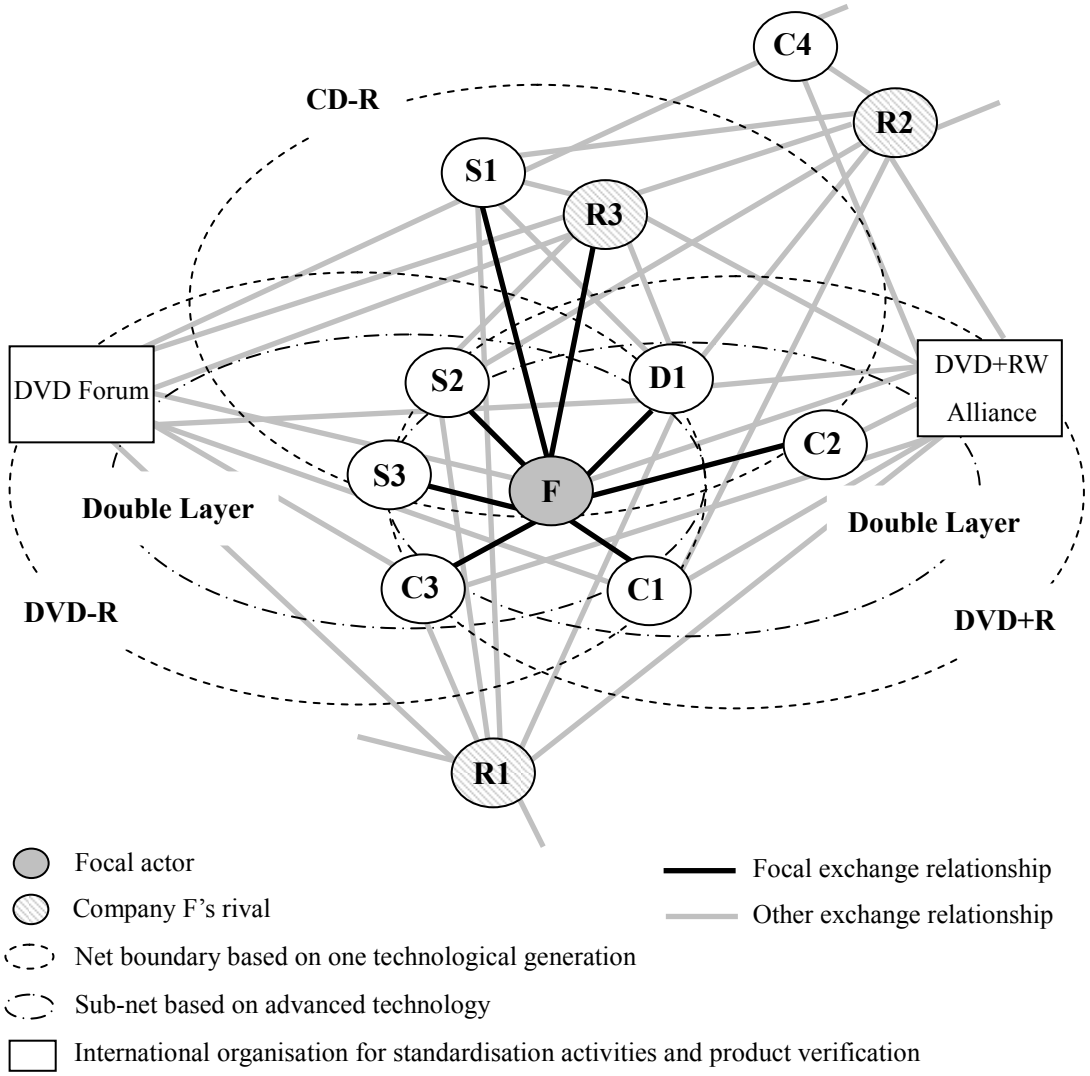
Unlike the appearance of DVD technologies, the arrival of DVD DL technologies did not bring about turbulence of relationships in the industry. As company F's R&D Division Manager argued, "*Fewer options decreased the degree of rivalry for resources, because only a few makers could provide high-end products.*" However, not long after this technological arrival, the conflict of customer allocation between companies F and C2 had been enlarged by squeezed profit margins. A Senior Manager at company C2 pointed out, "*Because both parties had their own products, both parties' sales often tried to approach the same customers and conflict occurred. It was almost impossible to resolve.*" When DL products started to penetrate the markets, the prices of existing products further dropped. For those makers who were unable to migrate to DL technologies, the only method to attract customers was price since the technological development of single layer DVD had reached its limit.

The decreased margin made company C2's business model difficult to sustain, forcing its business customers as well as company F to seek a more efficient and effective way of doing business. Consequently, company C2 gave up its role as an OEM in December 2005. Its retreat from the OEM business resulted in the third reconfiguration of the focal net (see Figure 8.11), in which company C2 returned to the roles as material supplier and branding company (see Figure 8.12). According to company F's marketing head, "*This is what I said; that this model later became less effective, since this structure (working as an OEM entity) could not afford the decrease in margin. From another point of view, if one layer can be removed from your business structure, you will have better margin and increase your market acceptance. In terms of high market acceptance, there are two types: B2B and B2C. When a layer is removed from your B2B structure, you are able to offer a more attractive or competitive price; in turn, the price for the B2C end becomes cheaper.*"

A Senior Manager at company C2 thought that its business model encountered a great difficulty in maintaining the roles of material supplier and OEM simultaneously after the arrival of DVD+R DL technology. He argued that its sales capabilities were not strong enough to maintain their share in the markets in which DVD+R and DVD+R DL technologies co-existed. Moreover, in comparison with its main competitor (company C4, who partnered with company R2, see Figure 8.11), its sales capabilities were weaker. Towards this, company F's General Manager offered his views, "*When the gap was narrowed, their (company C2) market strategies remained unchanged. While they were trying to enlarge their market, say, if their sales capabilities were not enhanced,*

their market would easily decrease or shrink. In that situation, it became more difficult for them to handle their business customers."

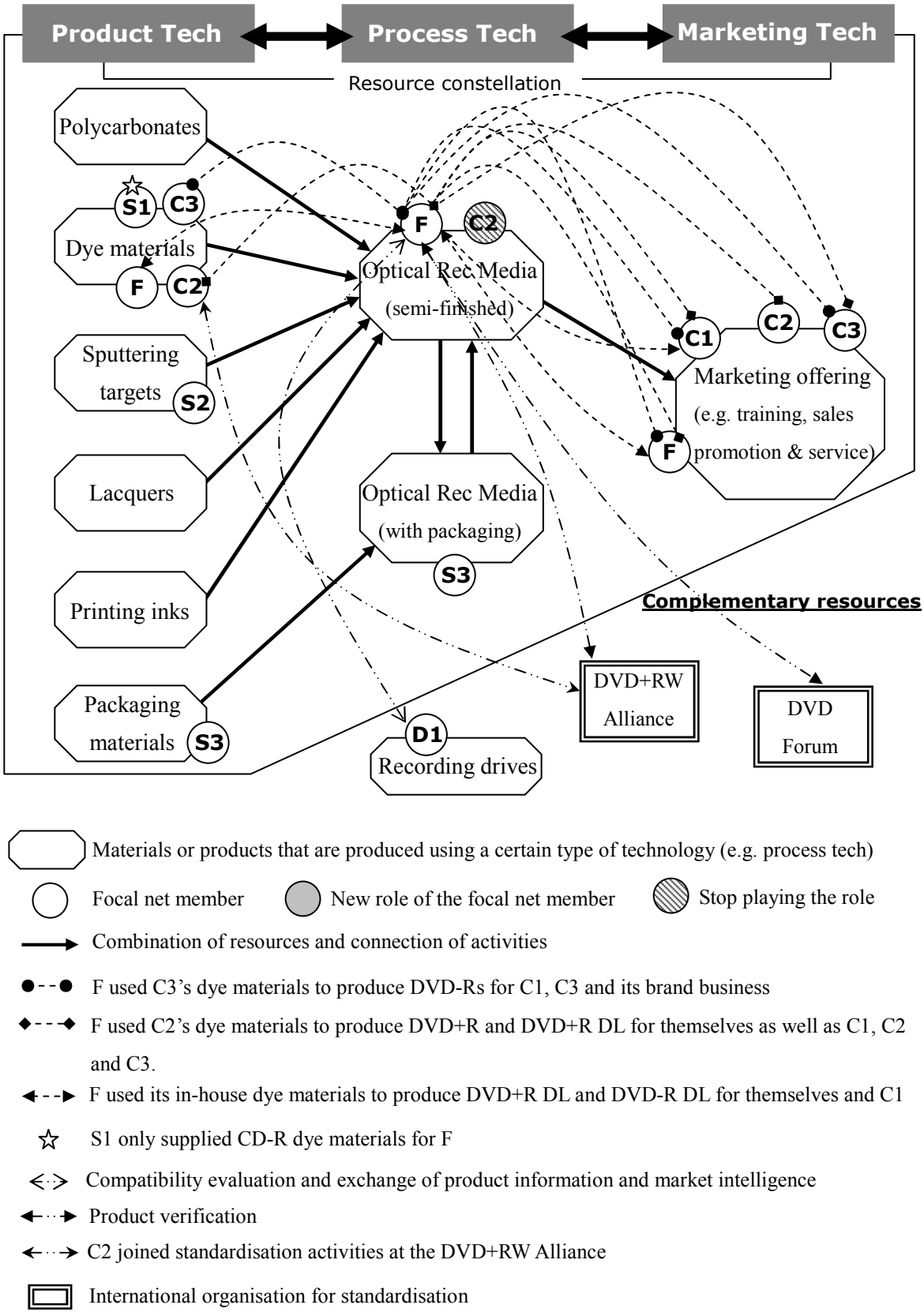
Figure 8.11 A snapshot of the focal net towards the end of 2005



The arrival of DVD DL technologies did not occasion radical changes of relationships within company F's value-creating net; an exception was C2's breakup of its relational ties with C1 and C3 due to its change in its role sets (see Figure 8.11). These net members' relationships with company F persisted mainly because their competences were not made obsolete by the arrival of technological change. Even so, an obvious change could be captured: some actors had been trying to reduce their dependences on media business by developing new businesses that were not associated with optical recording technologies. Take company S3 (packaging material supplier) for example, as

its QA Manager said, "*We place our attention on two things: driving down cost and developing new products (new business). One of our targets is to decrease the ratio of our shipments for company F. This is because every time they face the pressure of keeping costs down, they in turn ask us to cut prices.*" Regarding company S3's new business, the manager continued, "*We have developed a new product called 'backlight module frame' which is a component for LCD TVs or monitors. After altering our injection machines successfully, we have started a small volume production for a customer […] We once tried to develop some products that could be applied in the medical area, but failed.*"

Figure 8.12 Roles performed by the focal net members towards the end of 2005



8.6 The fourth reconfiguration of the focal net in mid 2008

8.6.1 The arrival of HD DVD and Blu-ray technologies

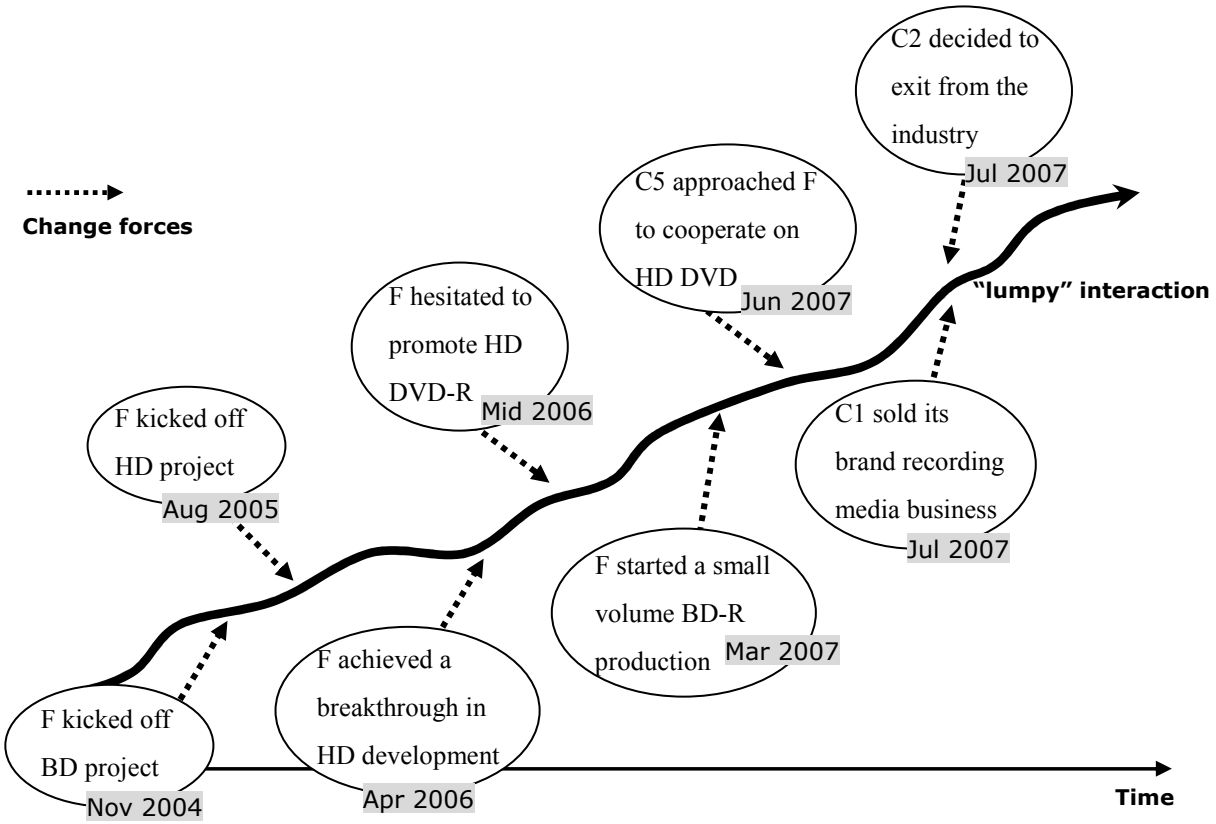
After entering the DVD era, the development of the optical recording media industry had been characterised by format rivalry, such as DVD-R vs. DVD+R. A similar format war also occurred on the stage of the high definition optical recording media. It was the rivalry between HD DVD (short for High Definition/Density DVD) and BD (short for Blu-ray Disc), in which the former was developed by the DVD Forum chaired by Toshiba while the latter was invented by Blu-ray Disc Association led by Sony. Although each format organisation had finalized its respective specifications before mid 2004, the market remained embryonic until 2006 when Toshiba launched its industry-leading HD DVD player and Sony made its debut of PlayStation 3 (PS3, the game console). This was mainly because the relevant industries, such as high definition display, media and content, were not mature enough to popularise the application of technology.

Positioning as a leading optical recording media manufacturer, company F believed that the high definition optical recording media would gain its popularity in coming years and its migration to HD DVD and Blu-ray technologies would strengthen its position because of high technical and capital barrier. With regard to the impact of technological change, the Deputy General Manager from company F's Media Manufacturing Business Unit pointed out that materials and equipment were crucial to CD and DVD production while the manufacturing of BD or HD DVD would be determined by one more factor: the process management. As he noted, "*The production equipment in this industry is very professional and the equipment can only be used for optical recording media manufacturing. The equipment as well as production materials are available in the market. As long as you can afford to buy them, optical recording media manufacturing is not a big problem. In this sense, at most you just need to maintain your production at most. However, BD production will be different. The framework of manufacturing processes, including resources, experiences, education and stability, will determine your competitiveness.*" Company F thought that the emergence of new technology would eliminate more makers from the industry.

As shown in Figure 8.13, there were several significant events affecting the arrival of HD DVD and BD technologies and subsequent changes within the focal net. Following a successful pilot-run of DVD+R DL production using in-house dye solution, company F kicked off its BD project in November 2004. At that time, the Blu-ray Disc Association had finalized and disseminated its BD-R (short for Blu-ray Disc Recordable)

specification. Not long after signing OEM and technology transfer agreements with company C2, company F kicked off its HD DVD project in August 2005. An advantage of the cooperation with company C2 was F's ability to allocate more R&D resources for the development of the next generation of technology. Another reason for this decision was that company F viewed DVD DL media as an interim product, despite that it was among few manufacturers who were able to produce DVD DL discs. As its marketing head said, "*Analogous to telecommunication hardware standards, if you regard CD as the first generation (1G) and DVD as the second generation (2G), then I would say DVD DL is 2.5G. It is an interim product.*" Moreover, according to a R&D Manager from a second tier OEM who had a close relationship with Sony (the format leader of BD camp), "*The barrier to manufacturing DVD double layer is high. In addition to altering some production machines, there are other technical issues to be overcome. But this is not the main reason we opt not to do it. We did a survey. We think it won't become a mainstream product, unless HD DVD or BD doesn't go any further.*"

Figure 8.13 Significant events associated with the arrival of HD DVD and Blu-ray technologies



After approximately a nine-month development, company F achieved a breakthrough in its HD DVD-R development in April 2006. They were able to volume produce HD DVD-R discs at an amazingly low cost, using the newly developed dye materials and based on the existing DVD production machines. Moreover, company F's HD DVD-R achieved a very good compatibility with key drive makers' prototype recorders. The Deputy General Manager at company F's Research Centre thought that an important factor which contributed to this achievement was "the accumulation of experiences". He indicated, "*In the HD DVD or BD battlefield, it will be harder for new entrants to compete because they have no experience. From the point of view of manufacturing technology, the accumulation of experiences from CD and DVD is absolutely one of our advantages. Regarding the future competitive stance, there is little room for new makers.*" With a similar view, company F's marketing head thought that their unique FMS (flexible manufacturing system) allowed them to transfer to HD DVD-R production without a great effort.

With this achievement, the HD DVD project team leader, an R&D manager, considered this was a great opportunity to enhance company F's position in terms of its media brand as well as technical competence. In addition, this achievement could allow company F to participate standardisation activities in the DVD Forum. Thus, the project leader urged his sales and marketing teams to promote this newly developed and industry-leading media. However, his efforts in intrafirm communication failed to get positive responses. On the one hand, the sales team was not interested in HD DVD-R because of few market demands. The mainstream products at that moment were still DVD+R 16X and DVD DL products. Meanwhile, on the other hand, the HD DVD and BD camps were neck and neck, having their respective supporters, including media studios and retailers. The unclear situation made company F sit on the fence. The marketing team hesitated to promote HD DVD-R at that time. Towards this, the project leader even proposed to the top management asking for permission for them to promote this achievement themselves; but no decision was made on this proposal. Being disappointed and frustrated by the reaction from his sales and marketing teams, the project leader gave their achievement to the production department, leaving the management work of HD DVD-R for other departments.

After early 2007 several significant events turned company F towards actively responding to changing conditions. Firstly, after more than two years' efforts, company F was capable of volume producing BD-R discs from March 2007. The longer development time compared to HD DVD-R was the result of BD-R's higher technical barrier. Just as a senior R&D manager from company F pointed out, "*The physical specification of BD-R is totally different from HD DVD-R. The different specification*

requires producers to purchase new equipment, such as mastering, injection and cover layer machines. In addition, BD-R testers are incompatible with DVDs' […] The most difficult part in production is how to control the evenness of the cover layer of each disc, since its thickness is only 0.1 mm." Although the market demand for high definition optical recording media was still very low in 2007, the ability to produce both HD DVD-R and BD-R permitted company F to better react to the changing environment.

In June 2007, company F acquired a great chance to demonstrate its competence of HD DVD-R manufacturing: one of the format leaders based in Japan (company C5) actively approached company F to co-promote HD DVD recording technology. Company F thought company C5's approach exhibited its approval of company F's manufacturing technology and product quality. Both parties developed a technology vendor-OEM relationship by signing a NDA (non-disclosure agreement). This new relationship allowed company F to have its new products (HD DVD-R 2X and HD DVD-RW) quickly certified by the DVD Forum. Furthermore, towards the end of 2007, company F not only acquired orders from company C5 but also started a series of co-promotion campaigns through bundle sales (company C5's HD DVD Recorders and company F's branded media). In addition to enhancing its performance, company F expected its cooperation with this format leader would enable it to increase its power in the DVD Forum in which it could participate in standardisation activities.

Not long before company F started its co-promotional programme with company C5, in July 2007 company C1 agreed to their Brand Recording Media Business being acquired by a US-based technology vendor whose business focus was placed on the areas of magnetic, optical, flash and removable hard disk storage. The acquisition allowed this US-based technology vendor to maintain its own brand and company C1's brand more effectively, in terms of sales regions, products and technology. In their definitive agreements, company C1 would continue its R&D and manufacturing operations for Blu-ray discs and retain its OEM business. The acquirer's president and CEO thought this deal would strengthen the firm's operational and strategic synergies, such as broadening its commercial and consumer product portfolio. The president of company C1 thought that by complementing each others' strengths, this acquisition was the right strategy to "*compete effectively, meet evolving market demand and profitably grow the business.*" This refocus of the attention on media manufacturing made it difficult for company F to continue its OEM business with C1.

Almost at the same time period when company C1 sold its brand business, company C2 decided to withdraw from the optical recording media industry. While the development of DVD+R DL was near its technological limit (16X) in early 2007, company C2

changed its strategy: it began to sell its manufacturing process and key materials to other media makers in order to improve its performance caused by declining sales. However, company C2's efforts were not effective. Company F's marketing head mentioned, "*Their strategy looked workable but generated too low incomes in terms of revenues and profits. Moreover, DVD DL did not become the mainstream product. The market scale was not big enough. From a strategic viewpoint, the economy of scale did not enable them afford to continue business. Finally, they decided to terminate it.*" Company F's General Manager argued, "*Company C2 had very good technology and products, but they were defeated by lack of dynamic business strategies. They endeavored to push their product to the market but failed to adjust their sales strategy to meet the changing conditions. Regarding this, we were helpless.*" Moreover, a Senior Manager at company C2 thought that they were only a "follower" in the high definition battlefield, unlike their leading positions in CD and DVD. It was almost impossible for them to sustain their business by developing the next generation of technology. Finally, company C2 decided to end its optical recording media business.

8.6.2 Relationships dynamics within the focal net from mid 2006 to mid 2008

It was a general view in the optical recording media industry that the format rivalry between HD DVD and BD would not come to an end easily. However in January, 2008, Warner Bros. Home Entertainment Group, a major supporter of HD DVD format, announced it would only release all of its titles in Blu-ray. This announcement gave the HD DVD camp a fatal strike, leading a chain effect; the major retailers, such as Wal-Mart and Best Buy, said they would stop selling HD DVD movies and players. These reactions in the industry forced Toshiba to hand the triumph to its rival camp led by Sony by making an announcement on February 19 2008, that it would no longer make and market HD DVD players and recorders. Subsequently, the HD DVD Promotion Group, formed by a group of manufacturers and studios to promote the format worldwide, officially dissolved in March. Due to the surrender of the HD DVD camp, company F's relationship with company C5 discontinued, having lasted for only a few months.

Company F's General Manager thought that Toshiba gave up too soon, but he thought Toshiba's exit did not generate a great impact on their operation. He noted, "*Our R&D expenditure did make us suffer from the defeat of HD DVD. But in addition to this expenditure, we lost nothing. We did not have an inventory of HD DVD discs because the production in this early stage was based on the market demand. Moreover, company C5 asked us to produce more discs for their last purchase [...] I am glad to see the*

win-out of Blu-ray because now we can concentrate on only one format, saving more expenses from future development. On the other hand, if two formats co-existed, I would be also happy because we had gained a lead in HD DVD manufacturing." Regarding this event, the Deputy General Manager at company F's Research Centre thought that it was pity that company F did not come up with a more concrete and aggressive strategy to co-promote HD DVD with company C5. He expressed his opinions, saying "*When we now look at the result of the format competition, our attitude of sitting on the fence seems a right strategy. But at that time, if we could have reached an inter-departmental consensus and formulated an active strategy to co-promote HD DVD, the competitive stance might have been changed. The point was that we were able to produce high quality HD DVD-R discs at very low cost. Say, if we launched a "one-dollar disc" promotional programme with company C5, it would have been almost impossible for the BD camp to counterattack […] However, we don't have a suitable platform in our company to facilitate the discussion of strategies.*"

Company C1 thought that it could improve its position in the industry by migrating to the high definition recording technology in which it had bet their resources on Blu-ray technology. In order to consolidate its resources, company C1 sold its Brand Recording Media Business, transferred a number of its employees to the acquiring company and re-positioned the firm as an OEM. C1's strategic change not only ended its relationship with company F (see Figure 8.14) but also meant they collided with each other in terms of BD OEM business. According to a QA Manager from company C1, the reason why they were able to do so was that they had occupied a strong position in the BD market in which they owned patents and had developed key materials and superior manufacturing technology. They were in a position to be a powerful OEM. Based on their investigation, this manager also noted that although the size of the BD market would be much smaller than CD and DVD, few makers could share this pie due to very high entry barrier with regard to capital and technical know-how. Moreover, because of the negative image of Taiwanese manufacturers (price killers in CD and DVD businesses), the Japan-based technology vendors would be more conservative towards the cooperation with these manufacturers on BD businesses.

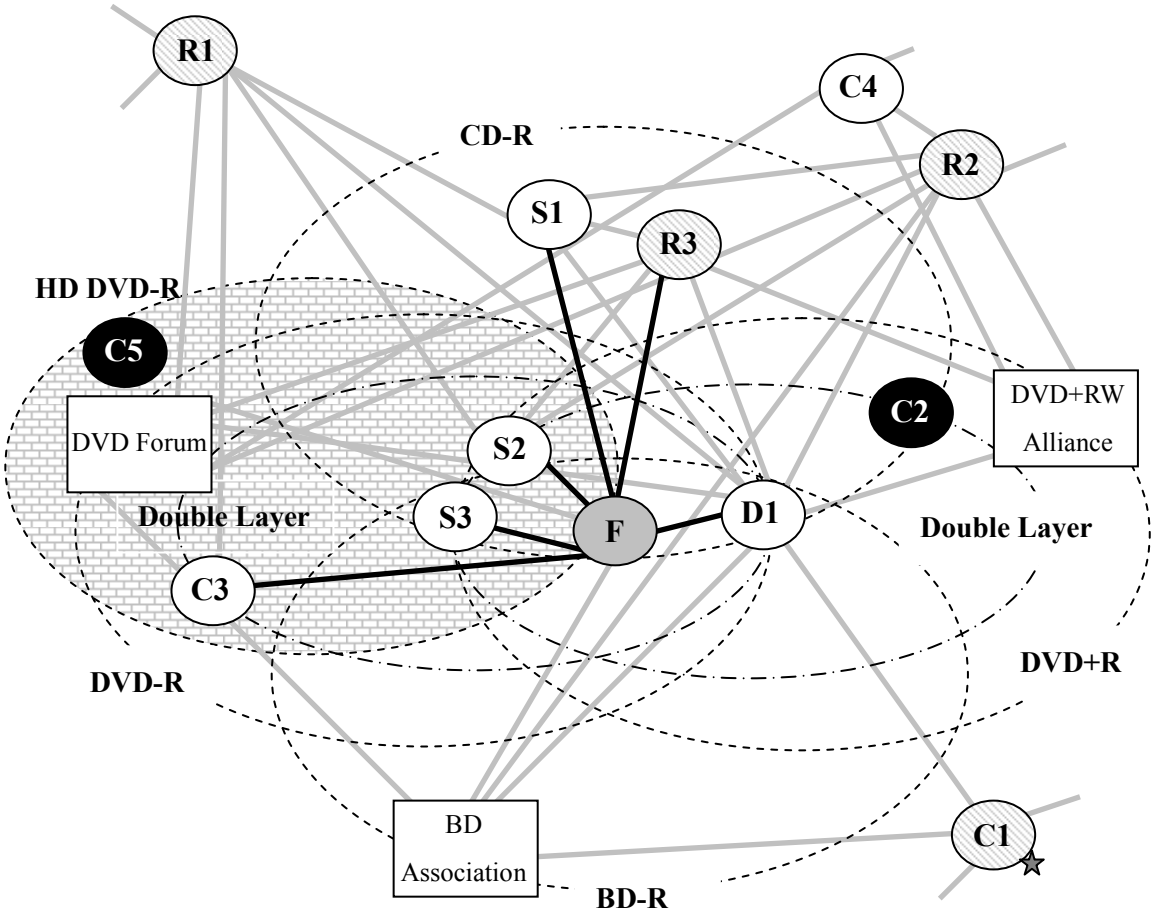
In addition to the discontinuation of the relationship with company C1, company F's relationship with company C2 was broken because of C2's retreat from the industry. Company C2 failed to retain its competitiveness when technological change (from DVD DL to BD) took place. As a Senior Manager from company C2 stressed, "*From the point of view of technology, it is important to initiate the R&D activity for necessary technology early and in the right direction.*" He continued to explain why they could sustain their advantages from CD to DVD, "*We were able to get the newest information*

about the next generation of technology, or able to determine the key technology for the next generation by ourselves, because we joined standardisation activities." Without these two major brands' support, company F had to rely on their own brand and develop a more active strategy to market their BD discs. The company expected its aggressiveness could instigate some changes in the competitive stance towards the BD market, such as creating OEM business chances. Company F's General Manager argued, "*You have to invade their market with the supply of your products and sway their pricing, the channel prices, and then they will approach you for business. You need to wait for that timing to come. The current situation is the market is still small and each product has its own price level. The stance remains little changed. When business conflicts occur and they are forced to change their way of doing business, there will be changes in business connections."*

As shown in Figure 8.14, a snapshot of the focal net in mid 2008, the exit of a long-term partner (company C2) and company C1's sale of its brand business brought about the fourth reconfiguration of the focal net. In the restructured focal net, company F's relationships with other net members continued. But its relationships with companies S1 and C3 remained in CD and DVD businesses respectively. Both companies S1 and C3 hoped that they could better their positions by developing dye solutions for the high definition optical recording media, in which the former betted on HD DVD format while the latter placed their attention solely on Blu-ray. For company S1, it thought the hurdle to migrating to HD DVD technology was to get the product using its dye solution certified by the laboratory under the DVD Forum which was controlled by Toshiba. According to a Senior Sales Manager from company S1, they approached Toshiba for business cooperation but failed to have their solution approved due to "non-technical reasons". On the other hand, company C3 endeavored to develop dye materials for BD-R production. However, it was still struggling to commercialize it.

The reconfiguration of the focal net also resulted in changes of net members' roles. As shown in Figure 8.15, company F relied more on its in-house developed solutions and its own brands alike in order to perform value-creating activities for CD, DVD and BD businesses. Although companies S1 and C3's solutions were adopted, their contribution to the focal net was limited. For example, according to an Account Manager from company F, company C3 gradually shifted its focus on DVD-R and DVD-R DL products after the appearance of DL technologies. For some reason, company C3 was reluctant to market DVD+R and DVD+R DL products. Moreover, company F tried to decrease its dependence on company C3's dye material because C3's material was not cost-efficient.

Figure 8.14 A snapshot of the focal net in mid 2008



Focal actor

Company F's rival

F's ex-partner, but now exited from the industry

Net boundary based on one technological generation

Ex-net boundary based on HD DVD recording technology

Sub-net based on advanced technology

To company F, company C1 became a rival in the BD market due to its sale of brand business

International organisation for standardisation activities and product verification

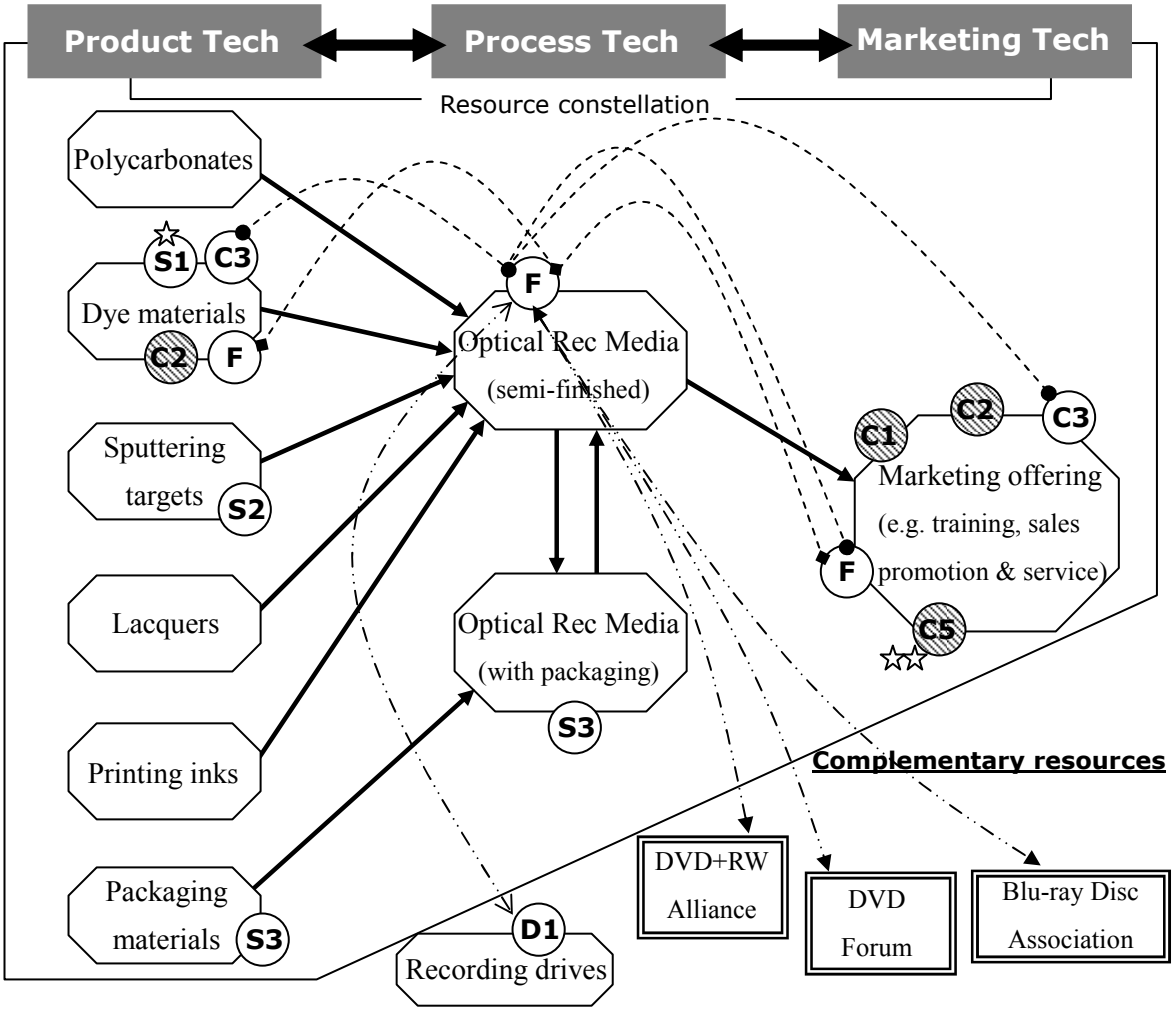
Focal exchange relationship

Other exchange relationship

Remark

The purpose of this figure is to illustrate the evolution of the focal net since its first appearance in 2001, especially when in comparison with its previous state (e.g. Figure 8.11). This figure does not suggest that company F has only one customer (company C3) in their DVD business or that it has no customers in BD business. It is an artificial boundary drawn by the author.

Figure 8.15 Roles performed by the focal net members in mid 2008



Materials or products that are produced using a certain type of technology (e.g. process tech)

Focal net member — New role of the focal net member — Stop playing the role

Combination of resources and connection of activities

F used C3's dye materials to produce DVD-Rs for themselves and C3

F used its own solutions to provide its brand business with all types of optical recording media, including Blu-ray discs.

☆ S1 only supplied CD-R dye materials for F

☆☆ F once provided HD DVD discs for C5 using its in-house dye materials. However, their cooperation only lasted for several months due to C5's exit from the industry

Compatibility evaluation and exchange of product information and market intelligence

Product verification

C2 joined standardisation activities at the DVD+RW Alliance

International organisation for standardisation

8.7 Conclusion: the evolution of a business net triggered by technological change

The case study reports the evolution of a business net embedded in the optical recording media industry, which is based on a focal net perspective and which covers a time period between 1998 and 2008. Using the points of view from the focal actor (company F, a manufacture of optical recording media) and its interacting parties (including three business customers, three suppliers and a complementor), which constitute a focal net perspective, a history of the business net evolution centred on the focal actor is reconstructed. The evolution of the focal net is marked by three arrivals of major technological change: DVD, DVD DL and high definition recording technologies. Each technological arrival results in relationship dynamics (e.g. establishment, enhancement, dissolution and reactivation of interfirm relationships) that render the reconfiguration of the focal net.

As exhibited in Figure 8.16[11], the reconstruction of focal net evolution begins with the identification of a relatively stable, technology-bundled value net based on CD-R technology (see Phase I in Figure 8.16). This CD-R created value net serves as a starting point to compare the subsequent changes in the formation of focal net triggered by the arrival of technological change. Moreover, the reconfiguration of the focal net (outcome) caused by technological change (input) cannot be captured without studying the interactive process between focal net members that characterises the net evolution and that changes in technology are introduced. Figure 8.16 shows that the picture of the focal net evolution is pieced together by significant events embedded in time. These events carry change influences that twist the interactive process within the focal net where both incremental and radical changes of relationships are observed, such as F's relationship ending with C1 and C3 while maintaining indirect connections via C2 (see Phase II in Figure 8.16). Another example of lumpy interaction is that C1's sale of its brand recording media business in July 2007 disconnected its cooperative relationship with the focal actor, which was reactivated after C3's dye material was introduced in the focal actor's DVD-R manufacturing in mid 2004.

Another feature that can be observed in the evolution of the focal net driven by the arrival of technological change, as presented in Figure 8.16, is the co-existence of optical recording technologies (e.g. in Phase III CD-R, DVD+/-R and DVD+/-R DL technologies co-existed). An exception is HD DVD's being defeated by Blu-ray Disc.

[11] For the convenience of the illustrations of the focal net evolution and the changes in net members' roles, international organisations of standardisation (e.g. DVD Forum) are not included in Figure 8.16 and Figure 8.17.

However, not all focal net members were able to successfully migrate to a newer generation of technology. For instance, after three arrivals of main technological change (from CD-R to DVD, DVD DL and BD-R), company S1 left its dye material business in CD-R territory. In addition, despite being a technology leader in DVD+R and DVD+R DL, company C2 failed to sustain its competitive advantage during the appearance of Blu-ray recording technology and finally exited from the industry. On the other hand, the way company C1 maintained its competitive advantage in BD-R business was to reposition as an OEM, which forced them to compete with the focal actor. These were network dynamics that accompanied the arrivals of technological change.

This case study also illustrates that network dynamics that resulted from the arrival of technological change at the focal net are associated with changes in the roles played by the focal net members, as shown in Figure 8.17. The focal net in the study can be seen as a technology-bundled value net, systematically bundled with a variety of resources that apply product, process and marketing technologies. Within the value net, as a minimum, each focal net member played a role that signified its provision of resource for value creation. Some actors even played multi-roles, e.g. S3's roles in providing packaging materials and packaging services. Relationship dynamics that resulted in the configuration of the focal net (see Figure 8.16) can be linked to changes in the net members' roles. For example, C2's acting as an OEM (after the arrival of DVD+R technology, see Figure 8.17) not only strengthened its relationship with F but also built its relationships with its competitors, C1 and C3. These changes in roles also mirror the change or adjustment of resource combination in the technology-bundled value net. Thus, "changes in roles" are an important aspect of network dynamics.

Figure 8.16 The evolution of the focal net triggered by the arrivals of technological change

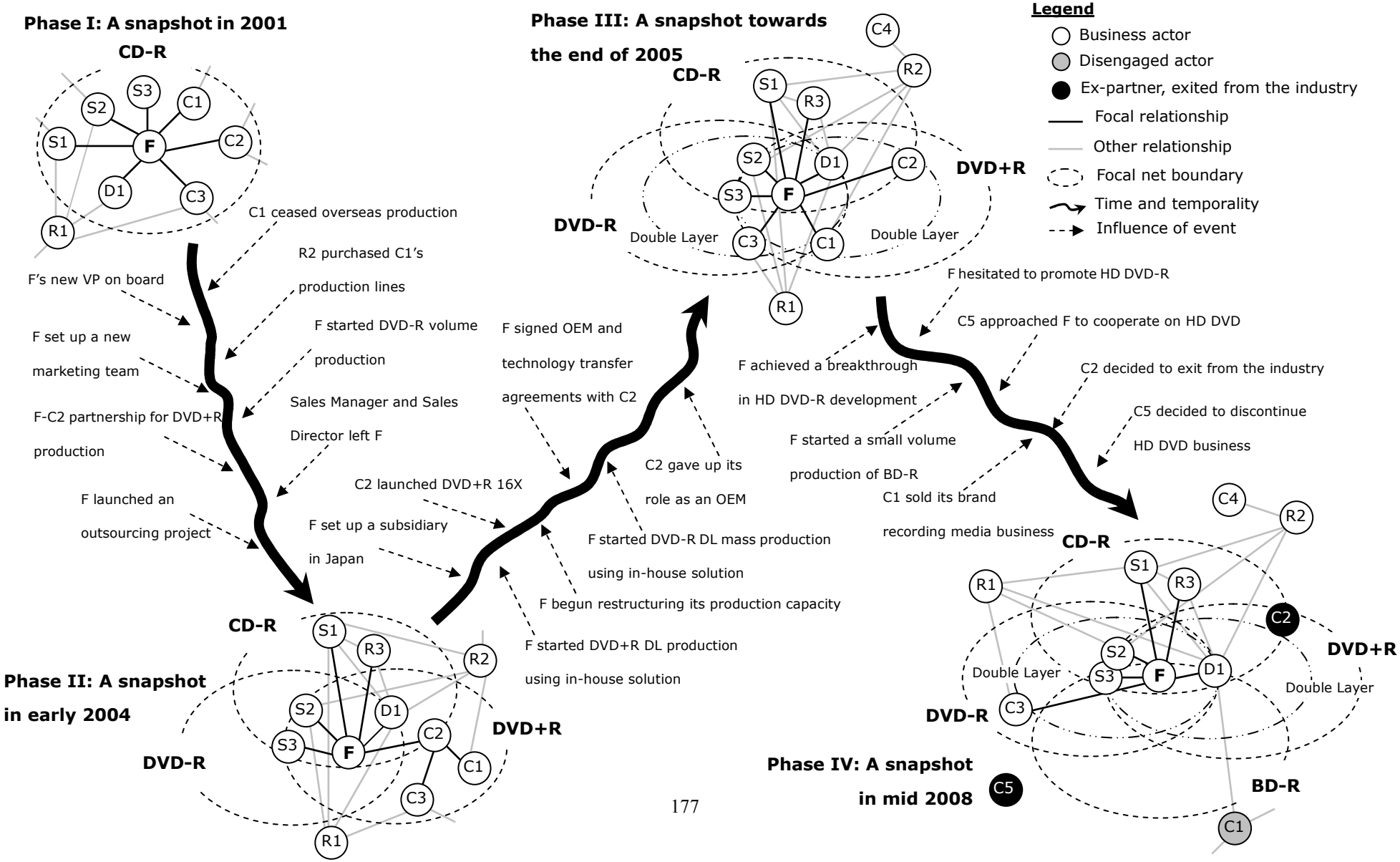
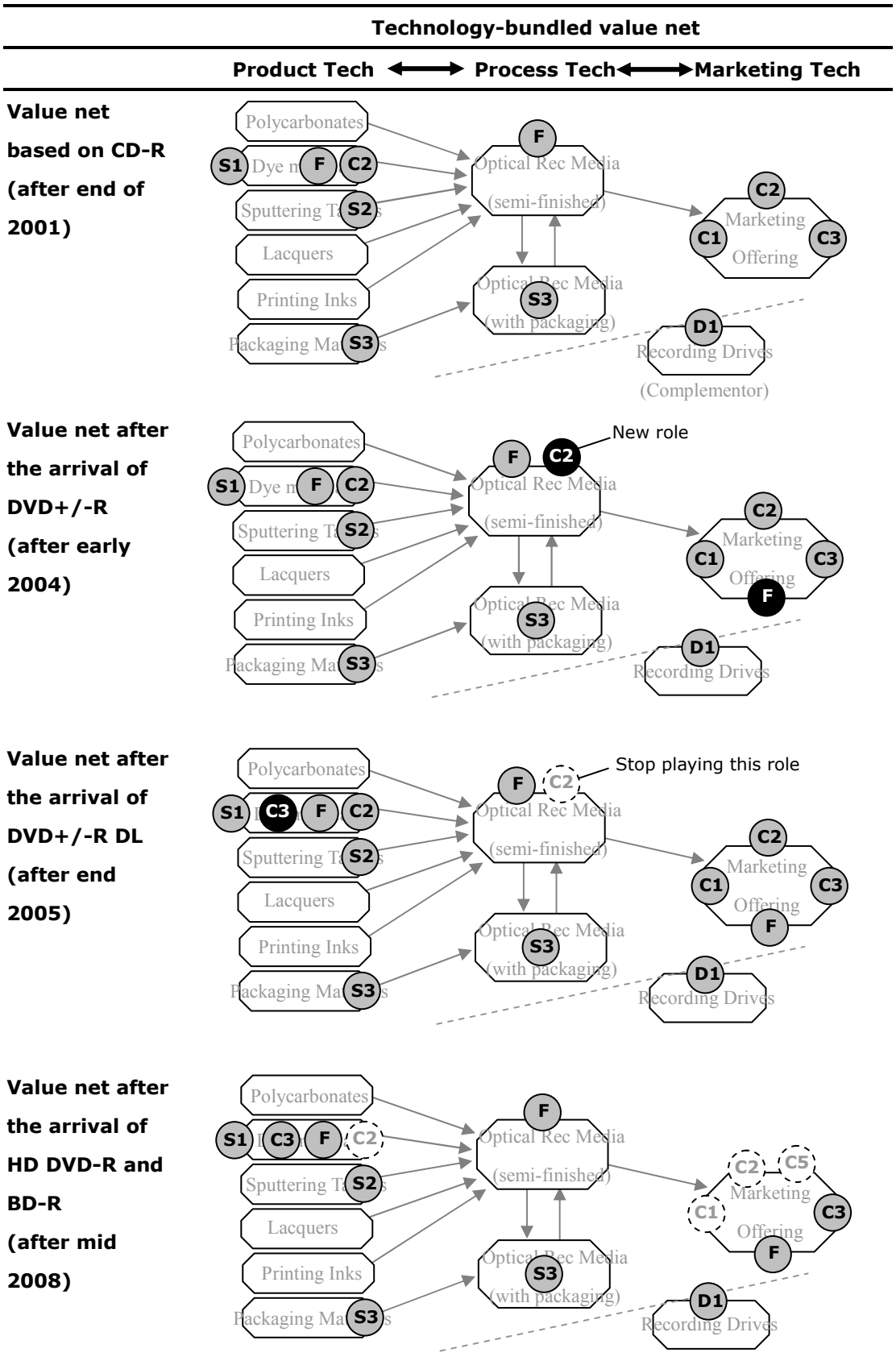


Figure 8.17 Changes in roles after the arrivals of technological change



Part IV Discussion, Implications and Conclusions

9 Case study analysis

9.1 Introduction

This chapter reports the analysis of the case study which is conducted in the optical recording medial industry based on an input-process-output model. This discussion chapter begins with the provision of four empirical observations: 1) technological change as both a trigger and a process; 2) roles of actors as the dynamic aspect of resource interaction; 3) resource compatibility determines the co-existence of old and new generations of technology; and 4) the evolution of technology-based net is path-dependent, path-shifting and path-weakening. Then, the chapter presents the empirical findings in line with the research enquiries, including: a) the process of the arrival of technological change; b) the reconfiguration of the focal net affected by this technological arrival; c) relationship dynamics caused by the arrival of technologic change; and d) coping with relationship dynamics. Finally, the chapter ends with an attempt to offer an integrated model of the evolution of a technology-based business net.

9.2 An overview of the arrivals of technological change at the focal net

Using a processual analysis, which is characterised by an input-process-output model (Pettigrew, 1997; Van de Ven and Huber, 1990) and which is based on a focal net perspective (Alajoutsijärvi *et al.*, 1999), proves to be a beneficial way of examining the interrelationship between technological change and network evolution, as demonstrated by Figure 8.16 and Figure 8.17 in Chapter 8. In Figure 8.16, each arrival of major technological change renders the reconfiguration of the focal net, in which the net members' network positions are altered as the result of relationship dynamics (e.g. the establishment, ending or reactivation of relationships) occasioned by this technological arrival. Moreover, the coexistence of old and new technological generations after the arrival of technological change is observed. In Figure 8.17, the arrival of technological change accompanies changes in some net members' roles in the focal net that is characterised as a value-creating and technology-bundled system. More details of empirical observation are discussed below.

9.2.1 Empirical observation I: Technological change as both a trigger and a process

The empirical investigation of this research observes that technological change is not

only a key trigger that drives the evolution of a technology-based business net but also an accumulative process. Retrospectively, the appearance of technological change did bring about critical effects that disconnected an established relationship (e.g. the ending of F-C1 and F-C3 relationships after appearance of DVD+/-R technologies) or even reactivated a previously ended relationship (e.g. the reactivation of F-C3 relationship when F attempted to introduce high speed DVD-R products). These radical changes of interfirm relationships brought about the reconfiguration of the focal net. Using the ARA framework (Håkansson and Snehota, 1995), the broken bonds also resulted in changes in resource ties and activity links. For instance, the reactivation of the F-C3 relationship permitted F to use C3's resource (dye materials) in its production activities and to develop new routines in logistic activities not only for C3 but also for C1 who re-gave OEM orders to F after this relationship reactivation. These changes in a formation structured by actor bonds, resource ties and activity links are where network dynamics originate. In this view, technological change functions as an important trigger in the evolution of a business network.

Viewing technological change as a trigger partly explains its relationship with network evolution; technological change itself is also part of network evolution. The empirical data shows that the criticality of technological change, which brings about radical changes of relationships, arises from an accumulation of effects transmitted by significant events between interconnected actors (see Figure 8.16). Each significant event contains a temporal profile of business activities and temporal orientation of actors (Andersson and Mattsson, 2010) which produce positive or negative effects based on the perceptions of the counterparts (Schurr *et al.*, 2008), affecting the subsequent significant events. And consequently, a business relationship is enhanced or endangered. For example, F's inability to source C4's dye material in mid 2004 resulted from its reluctance to adopt C4's dye materials in early 2002 and its partnership with C2 as an OEM entity in August of the same year. However, these negative effects that resulted from F's interaction with C4 may be seen as positive for C3 who competed with C4 in the dye material business and who was in search of support from large-scale optical media manufacturers, e.g. F. Thus, it is more adequate to view technological change as a series of significant events rather than a single critical event.

Apart from the influences that affect the radical changes of relationships, the empirical results show that significant events affect how resources are combined and used in the focal net. From a perspective of resource interaction (Håkansson *et al.*, 2009), each significant event may hinder or facilitate the combination between new and existing resources. For example, after less than one-year's development F was able to manufacture HD DVD-R (a product in 4R) using in-house dye materials (a product in

4R) in the existing production lines (facilities in 4R) from April 2006. However, F's marketing team's (an organisational unit in 4R) hesitance to introduce this new product to its own brand business as well as to business customers (through business relationships, another resource entity in 4R) made F unable to gain advantage from preemptive actions. Using the concept of technology bundles (Ford and Saren, 2001) where each type of technology can be seen as the consequence of resource interaction, this example reveals that a successful introduction of a new product to markets requires a systematic combination between product, process and marketing technologies. As a result, technological change is a process of combining or recombining existing resources with new ones, which marks the evolution of a technology-based business net or network.

9.2.2 Empirical observation II: The roles of actors as the dynamic aspect of resource interaction

Another empirical observation achieved by this research is that the roles of actors reveal the dynamic aspect of resource interaction which is closely associated with the arrival of technological change. As discussed in the first empirical observation, technological change results from changes in resource interaction, in which radical changes of relationships are usually important indicators of the reconfiguration of a business net (see Figure 8.16). Radical changes of relationships are more easily detected after the arrival of technological change because they are a combination of tangible and intangible resources across firm boundaries (Håkansson *et al.*, 2009) and these changes of relationships affect other connected relationships (Ritter, 2000). However, these radical changes of relationships provide limited understanding of changes in resource interaction that render technological change. As demonstrated by Figure 8.17, this understanding of changes in resource interaction (e.g. newness in resource combination) can be deepened by investigating actors' roles acting on an array of value-creating activities. For instance, after the arrival of DVD+/-R technologies, the F-C2 relationship was strengthened by a new partnership where both F and C2 adjusted their organisational units to function as an OEM entity and allowed C2 to gain orders from its competitors (e.g. C1) through new relationships. While C2 acted on a new role as an OEM, F started its new own brand business after setting up its marketing team.

The above example shows that resource interaction within established relationships is an importance source for the arrival of technological change; thus, illustrating that technological change is not always brought about through radical changes in relationships as a mechanism to acquiring or releasing resources. This suggests that the

dynamic aspect of resource interaction that contributes to the technological arrival can be revealed by tracing the changes in actors' role sets in a technology-based business net. This research also suggests that in order to trace the changes in actors' role sets, taking value-creating and technology-bundled characteristics of a technology-based net (Ford and Saren, 2001; Parolini, 1999) into account becomes important. As shown by S1's failure to migrate into the next generations of technology and F's loss of opportunity to promote its in-house developed HD DVD-R, resources used or combined under product, process and marketing technologies (Ford and Saren, 2001) have to be systematically connected so as to understand how value (e.g. an innovation) is co-produced by different economic actors who may carry out one or more activities which exhibit their roles for the counterparts (Parolini, 1999).

9.2.3 Empirical observation III: Co-existence of old and new generations of technology depends on resource compatibility

The empirical results illustrate that the higher the compatibility of resources, the higher the possibility for old and new generations of technology to co-exist. As exhibited in Figure 8.16, the arrival of a new technological generation did not drive the old generations of technology out of the value net, except for HD DVD recording technology. The co-existence of different generations of technology hinges on "resource compatibility". Resource compatibility here refers to when a single resource, which is used in the activities for promoting the existing generation of technology can also fit in the resource combination developed for a new generation of technology. The notion of resource compatibility is extended from Cooper (1979) where he points out that the resource compatibility measures are highly related to success in industrial product innovation. By stressing the compatibility between the resource base of the firm and new product venture's requirements, Cooper (1979) tends to focus on intangible resources, such as the skills of R&D, Marketing and Management. This is different from the notion of resources adopted in this research, which is based on an interactive perspective (e.g. Håkansson *et al.*, 2009).

Based on the notion of resource compatibility, an explanation for the co-existence of different optical recording technologies in the focal net is offered. Firstly, company F was able to modify its CD-R production lines for DVD+/-R, DVD DL and HD DVD-R manufacturing, based on the same production and engineering teams and extending its knowhow accumulated from previous generation of technology. Secondly, most of materials used in CD-R manufacturing can also be used in the production of other types of optical recording media, such as polycarbonates, sputtering targets, printing inks and

packaging materials. Moreover, these materials can be sourced from established relationships, see Figure 8.17. Despite the incompatibility between dye materials for optical recording media manufacturing, F was able to develop and source dye materials in-house that could fit its modified production system. Thirdly, most drive makers, including D1 (F's complementor), were willing to release new products that were backward compatible with former formats and even with competing formats. This product strategy provided optical media marketers with more flexibility in tailoring their market offerings.

From a technical perspective, the HD DVD format would have had a good change to survive format rivalry. For company F, they were able to produce HD DVD-R discs based on their own, competitive solution and to market these discs using existing sales and marketing resources. However, an increased number of marketers (e.g. distribution channels) and complementors (e.g. drive makers and studios) intentionally made their resources "incompatible" with other resources devoted to the development of HD DVD (including its recordable type). The heightened blockage at the marketing side finally forced the HD DVD camp to discontinue their businesses. This example also reveals that organisational units play crucial roles in determining the compatibility of resources because they possess not only knowledge but also interaction experience which leads to different interpretation of surroundings and which affects the subsequent resource interaction (Ford and Håkansson, 2006; Håkansson *et al.*, 2009; Johnston *et al.*, 2006).

9.2.4 Empirical observation IV: Path-dependent, path-shifting and path-weakening evolution of the focal net

The empirical study observes that the evolution of the focal net is characterised as path-dependent, path-shifting and path-weakening. Path-dependence is evident in the focal net as well as in the optical recording media industry because the actions of actors were towards collective goals, such as boosting recording speed of the media and drives and assuring their compatibility. Moreover, the specifications of each type of optical recording media are defined (e.g. by the DVD Forum), resulting in limited freedom for actors to differentiate between their offerings in terms of dye solutions, cost, quality, designs of printing and packaging and the speediness of new product launch. Each major path (e.g. a path based on CD-R technology) accrued through a continuation of coordination and adaptation between business actors in order to exploit the aggregate resources (e.g. Wilkinson and Young, 2002). Examples of this include F's operation of different production areas and processes for key customers, the regular communication between F and D1 on product compatibility and F's technical discussion with its

suppliers of sputtering targets and lacquers to fine tune production parameters. That is, it is actors' collective efforts and investments that pave a major or broad technological path (e.g. Håkansson and Lundgren, 1997).

In the empirical investigation it has been noticed that within such a broader path the rule of the game in the industry was well defined and actors' roles in the division of labour became clearer. However, it was also this broader path that permitted the existence of turnkey solution providers (e.g. company S1 allied with an equipment supplier and a technical consultancy) who spread the mainstream technology and caused the industry competition to become fiercer. Due to these turnkey solution providers, the pace of technological development was accelerated, driving major players to bridge technological change. It is also noticed that the path-dependent process contains uncertainty and such a process is difficult to foresee (Araujo and Harrison, 2002). For instance, F considered boosting the recording speed of its DVD-R crucially important, but the discontinuation of using in-house dye materials and failure to acquire C4's dye solution forced them to find new solutions. That is, path-dependent process is not pre-determined.

The empirical results show that the evolution of the focal net is not only path-dependent but path-shifting and path-weakening. The appearance of a new path (e.g. based on BD-R technology) did not break old paths (e.g. based on CD-R, DVD+/R and DVD DL) but weakened them. The weakening mainly arose from actors' elimination of resources. For instance, F modified its CD-R lines in order to increase the production capacity of DVD+Rs and DVD-Rs. Besides, the diversity of CD-R packaging in the market had significantly decreased after the arrivals of DVD and DVD DL technologies because the drastically squeezed margins made marketers reluctant to invest more in the CD-R business. This is in line with what Kash and Rycoft (2000) argue that making a transition from an existing path to a new one requires some new resources (including capabilities) to be explored and acquired while some existing or updated resources need to be eliminated. In this circumstance, therefore, the arrival of technological change brings about both path-shifting and path-weakening effects.

A noticeable observation here is that a path-shifting or even a path-breaking effect is occasioned by introducing new "critical resources" into the existing value net. From the case study, critical resources include dye materials and production equipment. It is bringing these new critical resources into interaction with other existing resources (e.g. other materials, know-how in production and management and marketing skills) that allows a new path based a new generation of technology to appear. The critical resources are not only important in facilitating technological innovation but also closely

related to a firm's success in bridging technological change. Company C2's ability to develop DVD+R dye solution and to access F's production and management resources is an example. Thus, this notion of "critical resources" enhances the knowledge of how path-dependence facilitates technological development (Håkansson and Waluszewski, 2002b) and why some actors' capabilities are rendered obsolete in the face of technological change (Afuah, 2000).

9.3 Towards understanding the process of the arrival of technological change at a business net

9.3.1 The technological arrival as a transition period characterised by disturbance in resource interaction

The case study suggests that the arrival of technological change should be treated as an interactive process which can be seen as a transition period that separates two major technological paths or trajectories. The transition refers to a period of change from an existing pattern of resource combination and activity connection to a new or adjusted pattern on which a value-creating and technology-bundled business net rests. This transition period involves the mobilisation of resources across firm boundaries through unbundling inadequate resources as well as activities performed by particular actors and through re-bundling resources, particularly critical resources, such as F's modification of production lines, testing C2's and C3's dye materials and re-engineering of processes. Consequently, the transition period results in the reconfiguration of the value net marked by radical changes of relationships (see Figure 8.16 for example).

The arrival of technological change is not a smooth process but causes disturbance in resource interaction. The disturbance arises from the exploration of new resources (e.g. Harryson *et al.*, 2008; Kash and Rycroft, 2002) and the subsequent mobilisation of existing and new resources, which is similar to Lundgren's (1992) *network changing mobilisation*, an unstable and tumultuous period that "disturbs and disrupts coordinated activities and threatens the existing resource structure in the network" (p. 163). In addition, the exploration and mobilisation of resources is affected by individual but interconnected organisational units who have developed their respective network theories or pictures from the past interaction (Henneberg *et al.*, 2006), where some of these theories are contradictory. In other words, both positive and negative temporal influences are brought into this transition period via relational linkages, hindering mobilised resources from being easily re-bundled or recombined with other resources in the value net. Such disturbance can be exemplified by company C1's dissatisfaction

caused by F's reluctance to purchase their used product lines and to expand more CD-R product capacity in which F transferred some of the CD-R lines to DVD+R manufacturing in order to meet C2's requirements. Another example is F's relationship discontinuation with C1 and C5, in which the former repositioned itself as an OEM while the latter exited the industry, forcing F to concentrate on its BD-R own brand business. In this period of disturbance, the interaction atmosphere (e.g. competition-cooperation) is usually altered (Håkansson, 1982).

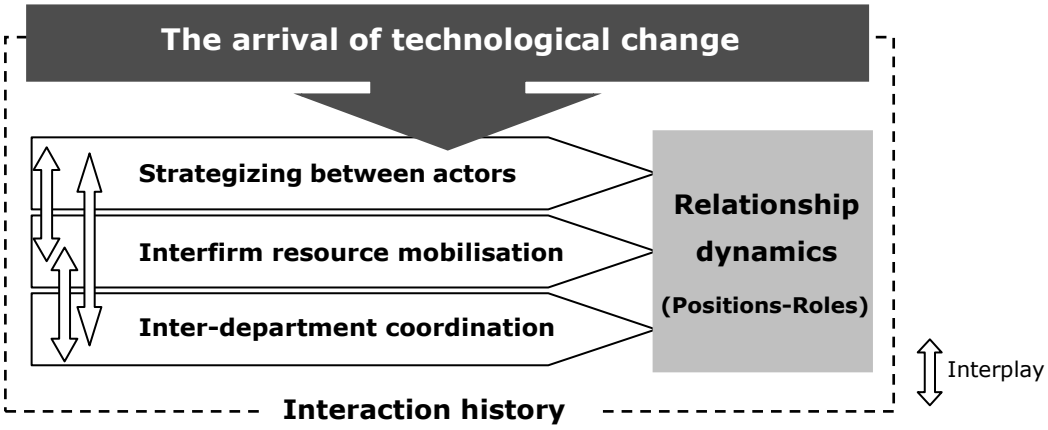
The mobilised resources have to be eventually recombined with other resources and reintegrated into the existing value net; this is where the transition period ends. As indicated by Lundgren (1995, p. 96), "Changes emerge from pre-existing structures and, if viable, they will eventually be re-integrated with the structures from which they originated." Furthermore, the purpose of recombination is to enlarge the value of bundled resources (Ford and Saren, 2001; Gadde and Håkansson, 2008) while the reintegration aims to enhance the effectiveness of a value-creating system (Hertz, 1992). While the transition period comes to an end, what can be observed are the reconfiguration of the value net (e.g. Figure 8.16) and changes in actors' roles in an array of activities (e.g. Figure 8.17). Thus, the process of the arrival of technological change can be seen as a period of disturbance in resource interaction, which consists of resource mobilisation, recombination and reintegration.

9.3.2 A relational chasm posed by the arrival of technological change

The case study illustrates the existence of a relational chasm exposed by the arrival of technological change. The changes of material and organisational resources in the process of the arrival of technological change are as the result of a series of significant events which produce change forces based on organisational units' respective intentions of being better and based on their strategising efforts. The arrival of technological change is characterised as disturbance in resource interaction, where some resources (including outdated, critical and complementary resources) become "mobilisable", waiting to be taken by particular counterparts through resource recombination and integration into a value-creating system (e.g. C1's proposal of equipment sale to F and the hesitance of F's marketing team to promote HD DVD-R developed by R&D department). The recombination and reintegration of resources with the existing structure requires the coordination between functional departments and firms in order to achieve positional fit or domain consensus (Johnston *et al.*, 2006; Thorelli, 1986) in a value-creating system. Chou and Zolkiewski (2010) describe the arrival of technological change at a business net as a "relational chasm", which is an iteration between three

interconnected elements: strategising between actors, interfirm resource mobilisation and inter-department coordination, see Figure 9.1. This relational chasm begets turmoil in resource interaction that produces changes in relationship dynamics and in turn, results in the reconfiguration of the established structure.

Figure 9.1 A model of the arrival of technological change



Source: Chou and Zolkiewski (2010)

These three elements that comprise the arrival of technological change, as shown in Figure 9.1, do not take place in a sequential order, they are intertwined instead. The interplay between these elements may cause an actor to be stuck in the relational chasm without achieving technological cooperation with others in a value-creating system in terms of functional fit, strategic fit, organisational fit and time fit (Laage-Hellman, 1997). This is because business actors have incomplete knowledge of networking which is connected to their own interaction histories, and thus, they produce their respective interpretations of surroundings (Ford and Håkansson, 2006; Ritter and Ford, 2004). Actors' strategising based on their respective understanding of the interactive environment may hinder inter-department coordination towards the arrival of technological change. Examples include the conflict between company F's marketing team, sales department and F's OEM customers concerning new policies for the arrival of DVD recordable technologies; the dispute between F's R&D and production departments over the adoption of external dye material for DVD production; and the R&D department's dissatisfaction with the marketing team's being neutral in the format war between HD DVD and Blu-ray DVD. Therefore, the interplay of change forces, which are produced by actors' strategising, is often the source of intrafirm as well as interfirm conflicts.

It has to be mentioned that a technological change does not take place in a vacuum, in

other words, it cannot escape from its historical development (Håkansson and Waluszewski, 2002a; Lundgren, 1995). Based on the empirical investigation, the arrival of technological changes not only brings changes in product and process technologies but also, more importantly, is conditioned by past interaction (see Figure 9.1). This lumpy process of technological arrival reflects the actors' learning nature: they are engaged in a process of trial and error, using their limited knowledge (including what they have learned from the past) to cope with perceived change influences (e.g. new ideas of using resources) which are carried out in a form of interaction episodes where some of them are seen as signification events. These episodes represent actors' capabilities and attitudes towards technological change. In this sense, a successful arrival of technological change at a business net hinges on how many change forces the existing relationships can absorb by adjusting the structure of resource ties and activity links, otherwise, the radical changes of relationships are not avoidable. Utilising the absorptive function of business relationships is not only a crucial means to shortening the period of the relational chasm but also an embodiment of network competence (Ritter and Gemünden, 2003) or absorptive capacity (Cohen and Levinthal, 1990; Zahra and George, 2002).

9.4 Towards understanding the reconfiguration of the focal net affected by the arrival of technological change

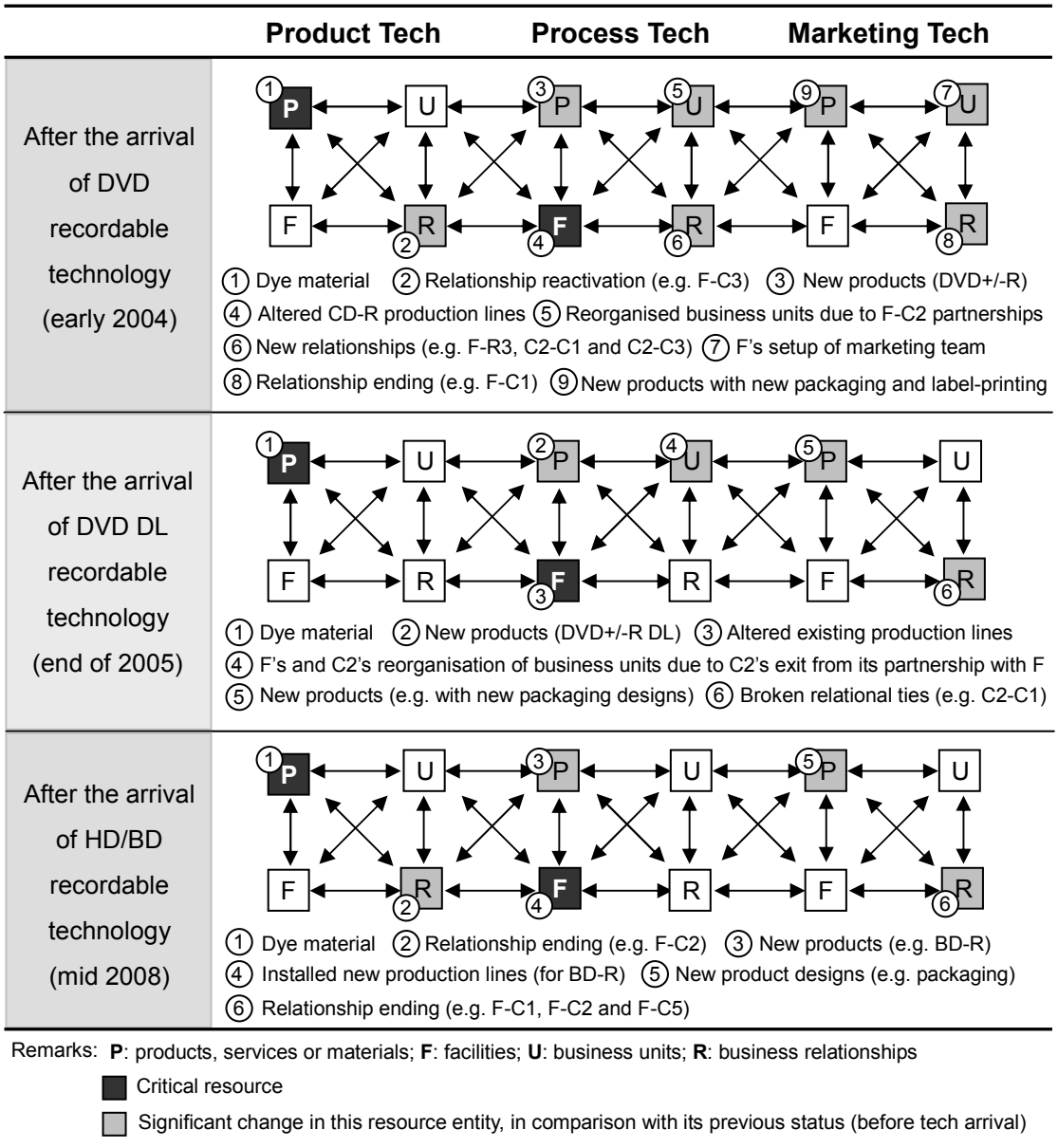
9.4.1 Net reconfiguration driven by critical resources

The empirical examination of this research finds that the reconfiguration of the focal net is driven by critical resources which generate path-shifting effects. On the basis of the previous discussion, the focal net can be regarded as a business net systematically bundled with product technology, process technology and marketing technology, under each of which four types of resources entity interact to co-produce economic value (Ford and Saren, 2001; Håkansson *et al.*, 2009; Möller and Svahn, 2006; Parolini, 1999). In this view, the reconfiguration of the focal net as the consequence of the arrival of technological change can be investigated by looking at how critical resources are associated with significant changes in resource interaction within the focal net, see Figure 9.2.

In the three arrivals of technological change, as shown in Figure 9.2, the "product" entity (e.g. dye material) under the categorisation of product technology and "facility" entity (e.g. manufacturing equipment or production line) under the categorisation of process technology are essential elements for technological change to occur. For optical

recording media manufacturers, without acquiring or building these two types of resource entity, bridging technological change is impossible. This is why few manufacturers are able to produce BD-R discs due to high capital barrier to installing new production lines and the difficulty in sourcing or in-house developing key materials (e.g. dye materials). These new facilities are used to produce and freeze new features of products which are contributed by new materials (Håkansson and Waluszewski, 2002a). From this point of view, technological change can be described using the dimensions of resources necessary for designing and producing the product and physical changes in the product itself (Ehrnberg, 1995).

Figure 9.2 Critical-resource-driven arrival of technological change



Owing to the importance of these two critical resources, significant changes in resource interaction are initiated. Take the arrival of DVD recordable technologies for example, the interaction between materials, production facilities and engineers in the production department permitted F to produce new products (DVD-R and DVD+R) with new label-printing and packaging designs, as the product entity under the categorisation process technology in Figure 9.2. F also conducted organisational restructuring so as to partner with C2 as an OEM entity. In the organisational restructuring, F transferred some of its CD-R production capacity to DVD manufacturing, resulting in a shortage of CD-R supply which displeased C1. Later on, F built its trading relationship with R3 to tide over this shortage. Moreover, in order to promote its newly developed DVD-R in a timely manner, F set up a marketing team whose new policies (e.g. CD-R markup) disappointed C1 and C3. The above example suggests that the arrival of technological change requires critical resources to be introduced in the existing technology-bundled value net while some significant changes in interaction between four types of resource entity in an array of product, process and marketing technologies are a must. Thus, these changes in resource interaction beget the reconfiguration of a business net, where the manner of resource combination and activity connection are altered.

9.4.2 Net reconfiguration marked by radical changes of relationships

The case study exhibits that the reconfiguration of the focal net is marked by radical changes of relationships, especially when seeing threads/relationships and nodes/actors as constituents of a business net (Easton and Lundgren, 1992; Halinen *et al.*, 1999). As shown by II, III, IV and V in Figure 9.3, the arrival of technological change results in the reconfiguration of the focal net due to the occurrence of radical changes of relationships, including the establishment, dissolution and reactivation of relationships.

Figure 9.3 shows that the radical changes of relationships take place in F's relationships with its business customers (C1, C2, C3 and C5) and a competitor (R3), while its relationships with suppliers (S1, S2 and S3) and a complementor (D1) stay relatively stable. Regarding radical changes of relationships, the empirical data suggests that they are closely associated with the function of business relationships in "absorbing" and "mediating" the impact of technological change. For example, the absorbability of change influences in the F-C1 relationship was eroded by a series of significant events (e.g. F's reluctance to purchase C1's production lines and to expand more CD-R production capacity), causing the relationship to come to an end. In addition, the impact of technological change on F's operation, e.g. the shortage of CD-R capacity and loss of OEM orders from C1 and C3, was mediated by its relationship enhancement with C2

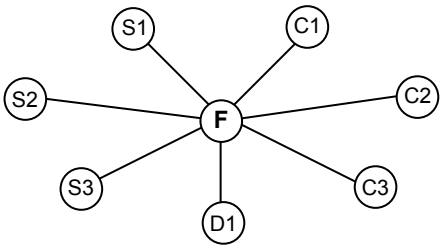
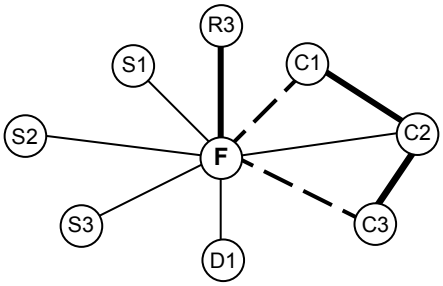
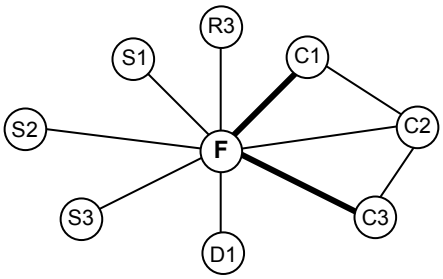
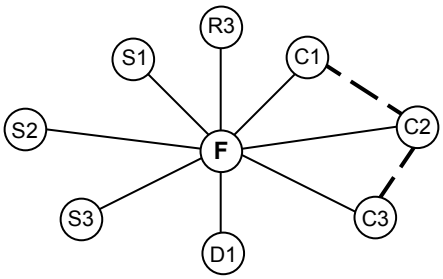
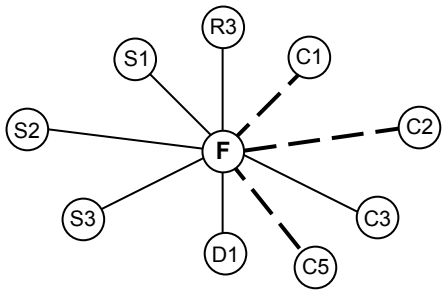
and relationship establishment with R3. Another example is the failure of C2's OEM relationships with C1 and C3 to absorb change influences (e.g. squeezed profit margins) occasioned by the arrival of DVD DL technologies, forcing C2 to change its business model via partnering with F. Meanwhile, this change was mediated by the F-C2 relationship where F was still able to produce competitive products for C2 as well as for C1 and C3 using C2's dye solution. Similarly, F's short-lived relationship with C5 signifies that this relationship was unable to absorb change influences initiated by C5's decision to discontinue the development of HD DVD format.

The case study suggests that the absorbability of change forces in a business relationship is related to adaptation between interacting parties. The absorption of change forces within a dyad signifies that both parties are able to adapt to the other's needs and capabilities by adjusting their resource combination and activity cycles. Change forces are thus confined within the relationship without spreading to other connected dyads (Halinen *et al.*, 1999). This can be labeled "network adaptation" (Easton and Lundgren, 1992). The adaptation involves knowledge sharing, team learning, coordination, trust building and investing in order to achieve fit (Brennan and Turnbull, 1997; Johnston *et al.*, 2006; Lundgren, 1992). For example, company F's partnership with C2 was built on the mutual trust and understanding (which they had accumulated from doing CD-R business), F's willingness to invest new resources for C2, and C2's sharing of its technical know-how. It was this adaptive behaviour that allowed the relationship to survive technological change. Just as Brennan and his colleagues (2003, p. 1638) argue, the adaptation is "an effective way of maintaining or developing a single, valued business relationship."

Apart from the radical changes in F's relationships with its customers, F's supplier relationships remained quite stable in the face of technological change. There are several reasons for these stable relationships. In the first place, the competences of some suppliers (e.g. S2 and S3) did not become out of date after technological change. To S2 and S3, a more challenging task brought by technological change was not about technical but management capabilities: how to effectively manage existing and new product lines. Secondly, the co-existence of old and new technologies could allow a relationship to survive the technological change. For example, although S1 failed to move in on DVD and Blu-ray businesses, its relationship with F continued because its dye material had become the dominant solution for CD-R manufacturing. Thirdly, these suppliers (except S1) did not control key resources in technology bundling which would drive actors to change their relational ties to pursue competitive advantage. For instance, some of F's OEM customers (e.g. C2 and C3) possessed not only product technology (e.g. dye material) but also marketing technology (e.g. media brand). Both stable

relationships and radical changes of relationships demonstrate that “interdependence” is a prerequisite for a business relationship to come into being (Ford *et al.*, 1998; Pfeffer and Salancik, 1978).

Figure 9.3 Net reconfiguration after the arrival of technological change

I 	• F's focal net in 2001, based on CD-R technology • The net contains F's customer relationships (C1, C2, C3), supplier relationships (S1, S2, S3) and complementor relationship (D1)
II 	• F's focal net in early 2004, based on CD-R, DVD-R and DVD+R technologies • F sustained its partnership with C2, co-working as an OEM entity
III 	• F's focal net in the end of 2004, based on CD-R, DVD-R and DVD+R technologies • F continued its partnership with C2 • F adopted C3's dye material for DVD-R production
IV 	• F's focal net in the end of 2005, based on CD-R, DVD-R/+R and DVD double layer technologies • C2 gave up its business model but remained its supplier relationship with F
V 	• F's focal net in mid 2008, based on the existing and Blu-ray technologies • C1 repositioned as an OEM manufacturer • C2 withdrew from the industry • F-C5 relationship ended not long after its establishment

Exchange relationship

Fading or ended relationship

New or reactivated relationship

9.5 Towards understanding relationship dynamics in the focal net

9.5.1 Relationship dynamics driven by profit-seeking behaviours

An important finding from the empirical data is that the relationship dynamics within the focal net (e.g. enhancement or reactivation of relationships) are driven by net members' networking behaviours which are motivated by their intentions of improving the current status where profitability is a key indicator. Examples of this include C2's partnership with F as an OEM entity and C3's investment in developing the business of dye materials which later contributed to its relationship activation with F. Regarding this profit-seeking behaviour, some studies have pointed out that the lack of profitability or a negative benefit-cost-ratio is a crucial factor that determines the continuation of an exchange relationship (Dwyer *et al.*, 1987; Helm *et al.*, 2006; Tuusjärvi and Blois, 2004). As Dwyer *et al.* (1987, p. 14) contend, relationship ending becomes a choice of staying competitive if the "real or anticipated costs outweigh the benefits of relational exchange."

However, the case study shows that radical changes of relationships in the focal net are not the direct result of profitability issues. But rather, profitability acts as a trigger, driving actors to carry out episodes (actions or reactions) to improve their current states. These episodes, in turn, may be in conflict with other parties' expectations and interests and therefore be perceived as dissatisfactory or critical events, which are antecedents of relationship ending (Ping, 1997; Stewart, 1998; Tähtinen and Halinen, 2002). For instance, although both companies F and C1 viewed bridging of DVD recordable technologies as an important means to enhance their profitability, some of the countermeasures they took were incompatible with each other, in which C1 closed its US-based CD-R factory and retained its DVD-R manufacturing in Japan while F was reluctant to purchase C1's used equipment and expand more CD-R production capacity and asked for CD-R price markup. These episodes finally led to a fading relationship.

The empirical data also shows that the relationship dynamics within the focal net involve the interplay between relationship burden and relationship energy (Håkansson and Snehota, 1998; Havila and Wilkinson, 2002). The relationship dynamics caused by such interplay can be exemplified by the F-C2 partnership as an OEM which on one hand enhanced F's competitive advantage but on the other hand created a disadvantage hindering F from sourcing C4's dye material to solve its technical problem. Moreover, this partnership turned out to be a burden after the arrival of DVD DL recordable technology, forcing C2 to disconnect its seller-buyer relationships with C1 and C3. This example illustrates what Håkansson and Snehota (1998, p. 18) argue, "A conclusion

must be that a relationship which is perceived as good at a certain point in time can become a burden both through the development within the relationship and through the development of other relationships." Another example is F's reactivation of relationships with C1 and C3 (which were ended after the arrival of DVD recordable technologies) due to F's reliance on C3's dye materials. While in the period of so-called "relationship aftermath", C1 and C3 became important customers of the C2-F partnership as an OEM entity. This partnership permitted C1 and C3 to access F's resources through indirect relational linkages via C2.

The above empirical examples offer two suggestions. Firstly, it is the interdependence between two actors in a relationship that renders relationship burden but the harm and disadvantage caused by this burden can also be mitigated by appropriately altering the interdependency structure, permitting the exploitation of disengaged parties' resources via indirect relational linkages. Secondly, the interdependence within a business net, even through indirect relationships, is a concrete form of relationship energy, enabling an involved actor to strategise or exercise power to adjust its portfolio of relationships, including the reactivation of previously ended relationship.

9.5.2 Relationship dynamics resulted from actors' attempts to occupy favourable network positions

The case study illustrates that relationship dynamics result from actors' attempts to occupy favourable network positions via enhancing or changing their roles in an array of value-creating activities in the technology-bundled focal net. The definition of a "favourable" position depends on an actor's interpretation of the interaction history and surroundings and its expectation for the future, which result in a confined view of prioritising its inter-organisational relationships where dynamics originate. For example, perceiving the importance of possessing dye materials from doing CD-R-business, C3 developed its own dye solution for DVD manufacturing and sought to cooperate with major media makers, e.g. with company F. As for F, due to their confidence in R&D and manufacturing capabilities, they thought they were able to establish their own brand business in disregard of their OEM customers' requirements. Different from C3 and F, C2 played a new role acting as an OEM and viewed gaining production orders from its competitors crucially important. C2's discontinuation of its OEM business after the arrival of DVD DL technologies and C1's re-positioning as an OEM by selling its brand business after the arrival of BD-R technology are additional examples to show these actors' efforts to maintain or enhance their network positions which bring about relationship dynamics. This is similar to Andersen's (2008) emphasis that rivalry is as a

process of occupying incompatible positions.

Roles are not only the dynamic aspect of network positions (Anderson *et al.*, 1998) but also reveal the dynamics in resource interaction, as discussed in section 9.2.2. The changes in roles which accompany the changes in the combination of resources within existing relationships or through new relationships, particularly related to critical resources, signify actors' "dynamic" capabilities of addressing changing conditions, e.g. technological change. However, being able to dynamically or flexibly renew or change roles does not guarantee organisational success or survival. For instance, S1 was able to renew its role as a supplier of dye materials by providing new solutions for DVD and HD DVD manufacturing. However, its dye business stagnated in the CD-R domain for political reasons. Moreover, C2's business model (partnering with F as an OEM) did achieve some advantages in terms of good product quality and quick new product launch, but was soon challenged by its competitors after the arrival of DVD DL recordable technologies. These two examples accord to what Zahra *et al.* (2006, p. 924) contend, "the possession of dynamic capabilities per se does not necessarily lead to superior organizational performance". The above examples reveal that the enhancement or maintenance of a network position requires fits with positions of other actors embedded in a value-creating and technology-bundled business net.

9.6 Towards understanding coping with relationship dynamics caused by technological change in the focal net

9.6.1 Surmounting a relational chasm

As discussed in section 9.3.2 and presented by Figure 9.1, coping with relationship dynamics requires a firm to surmount a relational chasm which is exposed by the arrival of technological change. A firm may easily lose its momentum in the face of technological change owing to disturbance in resource interaction which results from the interplay between actors' strategising, interfirm resource mobilisation and inter-departmental coordination. Following a logic of bundles of technology (Ford and Saren, 2001), a relational chasm may hinder an actor's specialised technology (e.g. product technology) from being re-bundled with actors' technologies in a value-creating net. The loss of momentum caused by a relational chasm can be demonstrated by S1's failure to promote its dye materials for DVD+/-R manufacturing and by F's disruption of HD DVD-R business because of C5's exit from the industry. Therefore, it is crucial for a firm to shorten the period in which it is in the relational chasm.

The concept of relational chasm is analogous to Moore's (1991) technological chasm where a chasm, caused by technological change, can be surmounted when the firm's resources are used or combined with other resources, forming a "whole product" which is a prerequisite for the penetration of the mainstream market. Tackling the relational chasm involves the identification of four types of actors for the focal net based on the new technological path and the mobilisation of resources. Identifying these four types of actors (customers, suppliers, complementors and competitors), which can be seen as part of strategising, aims at "dividing the overall value creation system into work packages" (Ritter *et al.*, 2004, p. 180), while mobilising network resources is to move other organisations to work within the actor's own plans through relational linkages (Mouzas and Naudé, 2007). For the firms who encounter the relational chasm, the priority is to shorten the period of staying in the chasm, so as to create possibilities of exploiting the aggregate resources, that is, to use the recombined resources in an effective and efficient way.

9.6.2 Achieving A-M-I ability

From a perspective of resource interaction, the empirical results indicate that coping with relationship dynamics resulting from the arrival of technological change involves acquisition, mobilization and integration (A-M-I) of resources. Acquisition of resources

refers to identifying and acquiring new valuable resources that enables a firm to transit to a new path or new pattern of interaction. Acquiring resources can be achieved through either new product development (e.g. F's in-house developed dye materials) or accessing external resources (F's usage of C2's and C3's dye materials) and involves the activation of existing, new or even dormant relationships. Mobilization of resources emphasizes the importance of relationships in connecting physical (e.g. products) and organizational resources (e.g. business units). For example, despite their launches of HD DVD products, F and C5 were unable to mobilize other actors (e.g. customers) to accept their products. This provides an alternative explanation to why technological prowess fails to reach markets.

Integration of resources relates to combining new or mobilized resources with exiting ones to establish new resource interfaces (e.g. the interface between new dye materials with altered production equipment), and more importantly, creating fit (e.g. functional, strategic or time) within and between these interfaces. This integration of resources will determine a firm's success in the bridging of technological change. For example, the viability of the F-C2 partnership lies in achieving fits between a variety of connected interfaces, such as C2's materials with F's Production Dept. and C2's products (manufactured by F) with C1's Sales Dept. As a result, this A-M-I ability in resource interaction determines a firm's success in responding to the arrival of technological change.

The A-M-I ability highlights two important things. On one hand, this ability stresses the utilisation of business relationships (where relationships can be ended, strengthened, reactivated or newly established) to reconfigure a firm's resource pool. Following this vein, the understanding of how to manage a firm's portfolio of relationships (e.g. Möller and Halinen, 1999; Zolkiewski and Turnbull, 2001) is also enhanced. On the other hand, the ability stresses the importance of achieving fit and flexibility in resource interaction. The concept of fit can be defined as "the degree to which the needs, goals, objectives, and/or structure of one component are consistent with the needs, demands, goals, objectives, and/or structure of another component" (Nadler and Tushman, 1980, p. 40), while flexibility can be viewed as a firm's "abilities to respond to various demands from dynamic competitive environments" (Sanchez, 1995, p. 138). Achieving fit allows an actor to exploit combined resources and pursue efficiency but it does not suggest there is no friction between interfaces (Håkansson and Waluszewski, 2002a). When fit cannot be maintained, interfaces are broken and resources are freed, such as C2 stopping partnering with F as an OEM entity. Having flexibility permits a firm to address emergent needs in resource interaction and to reduce negative influences caused by opposing organizational resources (e.g. business units). For example, despite being

turned down by C4, F was able to acquire new dye materials from C3 to resolve its technical bottleneck in DVD manufacturing.

9.7 Towards understanding the evolution of a technology-based net

The case study enhances our understanding of the evolution of a technology-based net, which is marked by the arrival of technological change. This understanding is enhanced by investigating the process of this technological arrival which can be seen as a transition period, separating two formations of the net respectively based on a major technological path. In conjunction with the review of literature, the empirical findings permit the development of an integrated model of the evolution of a technology-based business net triggered by technological change. The model, as exhibited by Figure 9.4, comprises three connected components along a dimension of time: an existing value-creating and technology-bundled business net, the arrival of technological change and a reconfigured business net after the integration of resources.

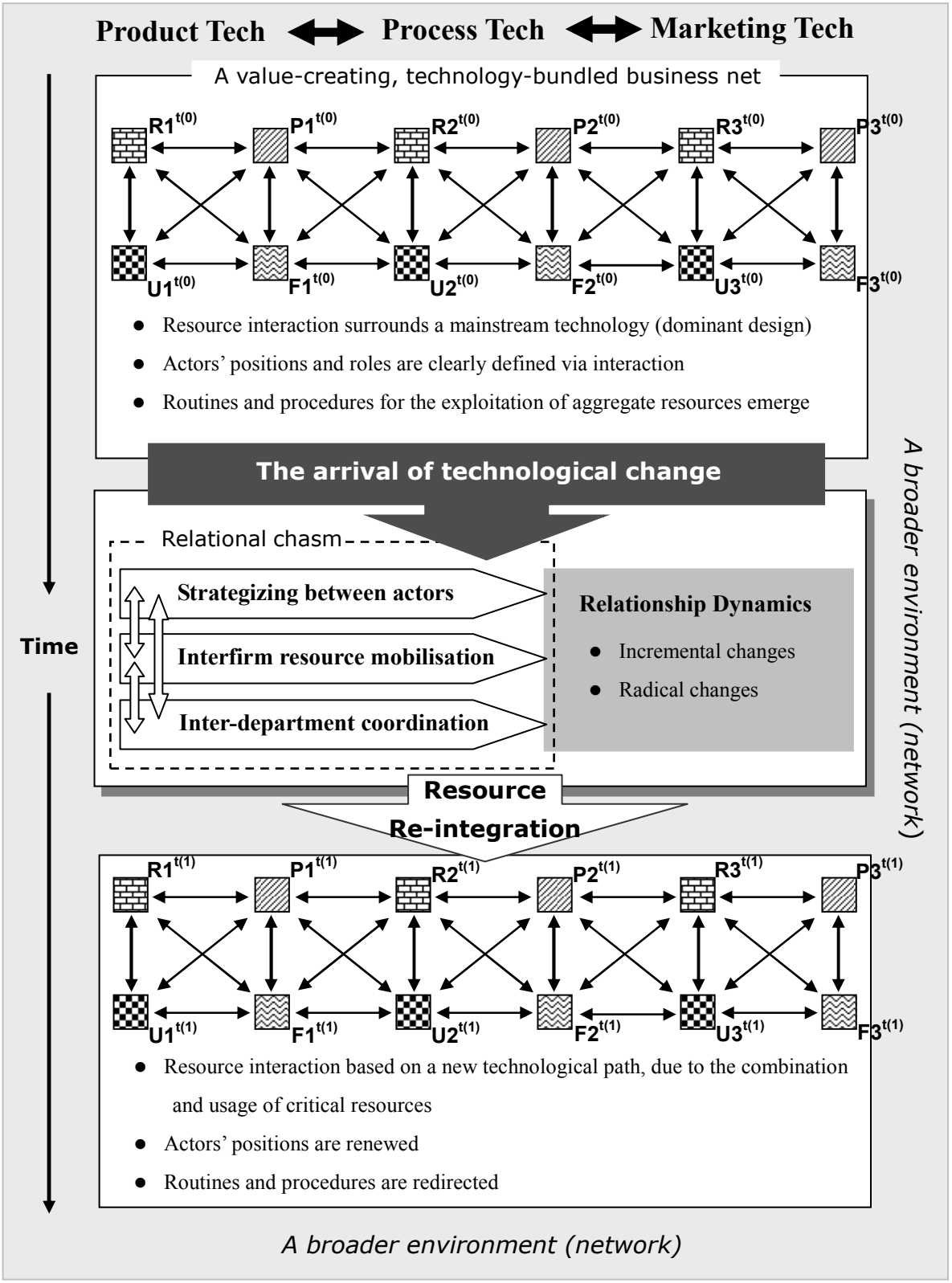
A technology-based business net can be depicted by several important aspects. In the first instance, the central concept on which the model rests is business interaction (Håkansson, 1982). Without developing exchange relationships, an aggregation structured by actor bonds, resource ties and activity links cannot be formed (Håkansson and Snehota, 1995); that is, it is impossible for economic value to be jointly created through a process of interaction between physical and organisational resources (Håkansson *et al.*, 2009). Secondly, this business net can be disassembled by three types of technology (Ford and Saren, 2001), in which each technology is as the result of the interaction between four resource entities (see Figure 9.4). Through bundling of and interaction between these three types of technology (product, process and marketing technologies), value is co-created and technological development is facilitated (Ford and Saren, 2001; Håkansson and Waluszewski, 2002a; Möller and Svahn, 2006; Normann and Ramirez, 1993; Parolini, 1999). Thirdly, the consequence of interaction within the net gives net participants relatively defined network positions (including their roles) in the division of labour for the purpose of the exploitation of aggregate resources (Anderson *et al.*, 1998; Johanson and Mattsson, 1992; Wilkinson and Young, 2002). Lastly, this net is embedded in a broader environment (network) and it cannot be controlled by any single actor. Its boundary is subject to the subsequent interaction between net members.

This technology-based net has an evolving characteristic because involved actors have their respective knowledge, learning capabilities and interaction histories that affect

their ways and attitudes concerning the resource combination and usage. It is also this interactive environment that permits the arrival of technological change. However, the process of the arrival of technological change at the established system is not smooth, mainly because the actors develop their own interpretations of linking the past and future expectation to the present state, which in turn, result in a relational chasm (a period of disturbance in resource interaction) that hinders actors from achieving effectiveness and efficiency. During the arrival of the technological change, actors strive to enhance or protect their positions based on their incomplete knowledge of the network, where disturbance in resource interaction as well as relationship dynamics originate. Because of the interplay between actors' strategising, interfirm resource mobilisation and inter-departmental coordination, a firm may easily be swamped in this tumultuous period and consequently fail to migrate to the next generation of technology.

The last part of the model shows that what has been introduced (e.g. critical resources) and mobilised during the arrival of technological change needs to be re-integrated into the existing system, see Figure 9.4. The integration allows the separate resource entities to be reconnected with the main structure, which is a prerequisite for the exploitation of aggregate resources based on the new technological path (Hertz, 1992; Kash and Rycroft, 2002). In the reconfiguration of the business net, actors' positions are renewed due to radical changes of relationships which are usually viewed as the impact of technological change. Their roles may also change because of new ways of combining or using resources. These new elements (e.g. critical resources, role change and radical changes of relationships) are disclosed by time and temporality. In other words, after the arrival of technological change, something new or different in a business net can be distinguished from its previous configuration (Lundgren, 1995). Moreover, from an interaction perspective, each of these new things has its historical part that affects how it comes into being (Håkansson and Lundgren, 1997). In this vein, time is a significant and fundamental dimension of the evolution of technology-based business nets (Halinen, 1998; Pettigrew, 1997).

Figure 9.4 An integrated model of the evolution of a technology-based net



10 Conclusions

10.1 Theoretical contribution

This research addresses the interrelationship between technological change and network dynamics. In particular, this research investigates the evolution of a business net triggered by the arrival of technological change using a processual analysis. The research enquiries of this research are concerned with the process of the arrival of technological change, the net reconfiguration affected by this arrival, relationship dynamics derived from this technological arrival and coping with relationship dynamics. The contribution of this longitudinal network research is twofold. Firstly, the contribution to existing theory is made by theoretical conceptualisation of a technology-based business net and technological change. Secondly, another contribution of this research is achieved by gaining novel insights derived from the empirical examination that is built on an input-process-output model.

With regard to the contribution achieved in the theoretical elaboration, this research conceptualises a technology-based business net as a "technology-bundled" (Ford and Saren, 2001) and "value-creating" (Parolini, 1999) business net or system. Within this net an actor's specialised technology (e.g. process technology) is systematically bundled with other technologies of other actors (e.g. product and marketing technologies) through resource interaction (Håkansson *et al.*, 2009), allowing value to be co-created and technological development to be advanced. This value-creating net emphasizes the complementarity and interaction between different economic actors (e.g. suppliers, customers, complementors and competitors) and thus it does not follow a linear logic of value creation. This theoretical conceptualisation proves to be beneficial in the case study because it facilitates the investigation of the arrival of technological change in which some actors may change their roles in the systematical bundles of technology.

In addition, this research conceptualises technological change as a "process" based on an interactive perspective (e.g. Håkansson and Waluszewski, 2002a) rather than treating it as a critical event that usually results in the dissolution of business relationships owing to competence-destroying or strategy-misfit effects occasioned by that change (e.g. Afuah, 2000; Christensen, 1997; Knoben *et al.*, 2006; Moriarty and Kosnik, 1989). The value of this conceptualisation is illuminated by adopting an input-process-output model (Van de Ven and Huber, 1990) and by using a focal net perspective (Alajoutsijärvi *et al.*, 1999; Brito, 1999) for empirical examination. The empirical results indicate that technological change is manifested in an interactive process which

is twisted by temporal influences produced by a series of significant events. It is in this interactive process that new resources and/or new ideas of using a single resource are proposed through relational linkages in a technology-based business net, rendering the arrival of technological change.

Another vital part of the contribution of this research is the novelty developed from the case study, which can be divided into the empirical observations and answers to research questions. Regarding the empirical observations, this research finds that technological change not only functions as a trigger driving the evolution of a technology-bundled value net but also represents a transitional process that results in the reconfiguration of the value net. The research also uncovers that the dynamic aspect of resource interaction can be revealed by the roles of net members at different points in time in an array of value-creating activities (including resources used and combined), see Figure 8.17 in Chapter 8 for example. The novelty of this empirical finding lies in linking resource interaction (Håkansson *et al.*, 2009) to the concept of role in network research, in which the latter is traditionally related to the concept of network position (Andersen, 2008; Anderson *et al.*, 1998; Johanson and Mattsson, 1992).

Additional novelty gained from the empirical observations is the discovery of "critical resources" and "resource compatibility", which are based on a perspective of business interaction. This research finds that the appearance of a new technological path in a business net requires critical resources to be introduced and brought into interaction with other existing resources. It is through the introduction of critical resources into the existing net that changes in resource interaction take place, which in turn, beget net restructuring, relationship dynamics and effects on involved actors' abilities to address the changing conditions. Apart from critical resources, this research finds that it is resource compatibility that allows some resources to remain valuable after the arrival of technological change and to be used in relation to critical resources. With the discovery of critical resources and resource compatibility, the knowledge of technological change and path dependence is advanced, especially in explaining why an old technological path is weakened rather than being broken and why old and new generations of technology coexist. This discovery also offers explanations about why an actor is able to bridge technological change and why an actor who fails to migrate to a new path stays viable in the value net.

Regarding the contribution made in the answers to research questions, it can be demonstrated by new insights into the transition period of technological arrival, net reconfiguration and relationship dynamics. This research finds that the transition period of technological arrival is characterised by disturbance of resource interaction, forming

a “relational chasm”. This chasm may hinder the resources of particular actors from being combined or recombined with other resources that are brought together for carving a new technological path or trajectory. That is, an actor’s failure to migrate to the next generation of technology can be explained by its being swamped in the relational chasm without having its resources reintegrated into the value net. On the other hand, this research finds that the extent of net reconfiguration resulting from the transition period hinges on two things: 1) how business relationships are able to absorb and mediate the impact of technological change, and 2) how critical resources are used in the value net through business relationships.

Furthermore, this research finds that it is profit-seeking behaviours of actors and their attempts to occupy favourable network positions during the arrival of technological change that bring about relationship dynamics, including both incremental and radical changes of relationships. It is also these behaviours and attempts that allow relationship ending and relationship reactivation to be options for improving competitive stances, although they are conditioned by actors’ respective interaction histories. Based on a processual analysis with a network lens, this research reveals that adequately altering the structure of interdependence within the value net not only permits the exploitation of disengaged parties’ resources via indirect business relationships but also creates the possibility for a previously ended relationship to be reactivated. The findings contribute to the existing knowledge of relationship dynamics by bridging literature between relationship ending (e.g. Halinen and Tähtinen, 2002; Tähtinen and Halinen, 2002) and reactivation (Havila and Wilkinson, 2002) in a technology-intensive network setting.

Last but not least, this research puts forth the A-M-I ability (acquisition, mobilisation and integration of resources) for handling relationship dynamics which are derived from the relational chasm posed by the arrival of technological change. The A-M-I ability emphasizes the importance of business relationships in resource interaction, especially in acquiring, mobilising and integrating resources that are crucial to an actor’s bridging of technological change. This ability also stresses the importance of achieving “fit” and “flexibility” to tide over the disturbance in resource interaction that characterises the arrival of technological change. The new insights contribute to existing theory in two ways. On one hand, it enhances the knowledge of coping with technological change by managing resource interaction. On the other hand, it offers an alternative method to review a firm’s portfolio of business relationships in the face of technological change.

10.2 Managerial implications

This research deals with the interrelationship between technological change and the evolution of a business net, in which particular attention is focused on the process of the arrival of technological change at the net, rendering disturbance in resource interaction as well as relationship dynamics that impact on a firm's viability and sustainability in the face of technological change. During the arrival of technological change, the priority for involved actors is to shorten the period of staying in "relational chasm" which prevents them from sustaining their momentum. Surmounting a relational chasm involves handling relationship dynamics and achieving fit and flexibility in the resource interaction. Towards this, three managerial implications are developed from the empirical results.

The first managerial implication is about the importance of the network-level analysis for addressing changing conditions. While a firm is developing countermeasures to respond to technological change, the attention should be focused not only on the firm-level and dyadic-level (the firm's individual relationships) but also on the network-level analysis which takes into account the characteristics of embeddedness and connectedness. There are two reasons for this suggestion. One is that a firm's markets are treated as networks of which it is a part (Mattsson, 1997; McLoughlin and Horan, 2002). The other is that the technological development is a matter of the interaction between connected dyads rather than an issue that can be handled by a single party. More specifically, as revealed by the empirical results, technological change arises from the efforts contributed by different economic actors, who devote their resources and specialised technologies to form a value-creating and technology-bundled system (Ford and Saren, 2001; Möller and Svahn, 2006; Parolini, 1999).

Therefore, the value of an exchange relationship in a business net should be considered through a network-level analysis. Maintaining an important relationship may obstruct a firm's growth via cooperating with others. This is because a firm's profitability may be impeded by a customer's drain on its account management, product and production resources (Ford *et al.*, 1996), especially in the face of intensifying competition and the emergence of a new technological generation, such as the purchase of used CD-R production equipment and expansion of more CD-R production capacity at company C1's requests. On some occasions, indirect relationships with positive interdependence between parties embedded in a value net are beneficial to the exploitation of aggregate resources (including bundled technologies), so as to maximize the co-created value, such as the increase of market share of a mainstream product (e.g. C2's DVD+Rs produced by F for C1, C2, C3, F and other brands).

It is crucial to gain timely and relevant information from both intrafirm and interfirm levels so as to achieve a complete analysis of a value-creating and technology-bundled business net. The analysis has to cover the interaction between business units connected through relationships (e.g. A's sales with B's procurement contact and A's R&D team with C's production department), which allows the understanding of the importance of a particular resource and how this resource is embedded in a web of relationships. The network-level analysis facilitates a firm's ability to devise its make-or-buy strategies and to design its portfolio of relationships by which its competitive position in the network is defined. A possible way to carry out this analysis is to build a linkage between departmental interfaces (e.g. R&D-marketing within the firm) and interfirm interfaces (e.g. A's sales with B's procurement), then to study and understand their interdependencies before making decisions (Araujo *et al.*, 1999). Another advantage of understanding the interdependencies between interfaces is to learn from others (Håkansson *et al.*, 1999), knowing the possibilities and restrictions of resource usage and combination. In this way, moreover, the impact of relationship burdens, such as preclusion from other opportunities or resource demanding, can be mitigated by adjusting the interdependence structure after the analysis (Håkansson and Snehota, 1998).

The second managerial implication is about building a capability to permit emergent strategies. The longitudinal case study reveals that business actors involved in the arrival of technological change have to emergently react to other parties' strategising or exercise of power based on their respective interpretations of surroundings, so as to tide over the period of disturbance in resource interaction. Examples that call for emergent strategies include company F's reluctance to purchase C1's used equipment, C4's declining to offer F its dye material, and C5's discontinuation of its business with F due to Toshiba's exit. These events conflicted with the counterparts' expectations and forced actors to develop alternative strategies. That is to say, a planned strategy, which is called the "design school" by Mintzberg (2008), may not guarantee a firm's success in utilising its interfirm relationships to cope with the changing conditions. Thus, a capability for emergent strategy formation is required.

The concept of a mechanism for emergent strategy formation captures the notion that strategies emerge from business interaction (Baraldi *et al.*, 2007). This mechanism has to comprise at least three components: gaining knowledge, achieving commitment and generating action (Ford *et al.*, 1998). Regarding the acquisition of knowledge, it can be achieved by carrying out a network-level analysis (see the first implication above). But this mechanism has to permit the prioritisation of strategic actions and commitments

within the organisation, since resources within the firm are limited and each business unit may base their past interaction with other units (both within and across the firm boundary) to develop their own theories about business environments (Ford and Håkansson, 2006; Henneberg *et al.*, 2006). Because actors involved in business interaction are engaged in a process of trial and error (Ritter and Ford, 2004), the mechanism also should include a "knowledge feedback loop" that enables a timely amendment of strategies.

The third managerial implication is about maintaining a positional flexibility. The empirical data suggests that a firm's success in coping with technological change hinges not only on its technological capability but also on its ability to handle complementary resources controlled by other parties, and if necessary, to release some of its own resources in order to accommodate new resources of an important partner (e.g. company F's transfer of its CD-R production lines to receive C2's DVD+R technology). This ability emphasizes the importance of dynamically acquiring, assimilating and exploiting external knowledge through relational linkages. This ability thus can be seen as an embodiment of "absorptive capacity" (Cohen and Levinthal, 1990; Zahra and George, 2002) or "network competence" (Ritter and Gemünden, 2003).

In order to dynamically use, handle and exploit interfirm relationships, maintaining a flexible network position is strategically important. During the arrival of technological change, new resources or new ways of resource combination need to be developed. A positional flexibility means that a firm is able to be a part of new resources or new ways of resource combination through resource mobilisation and re-integration, in which the firm's position may be adjusted. The case study shows that being able to mobilise others' resources and activities, and when necessary, to be mobilised by others is a crucial factor for company F to survive technological changes. The case also suggests that the ability to control or access a key product entity (e.g. dye material) or facility entity (e.g. production capacity) in the resource interaction will determine a firm's positional flexibility. The possession of the key physical resources equips a firm with power to create the dependence of other parties and their willingness for resource combination mainly because these resources would affect the quality of relationships, such as needs fulfillment and profit (Naudé and Buttle, 2000).

10.3 Limitations: Capturing network dynamics

Capturing network dynamics in a technology-intensive environment is a central issue of this research. Understanding network dynamics and being able to handle them have been considered important for a firm to stay competitive (Gadde *et al.*, 2003; Johnston *et al.*, 2006; Möller and Halinen, 1999; Ritter and Gemünden, 2003). In spite of knowing its importance, capturing network dynamics remains difficult mainly due to the connectedness of relationships (which are the key constituents of a network) and these relationships' interactive and evolving nature. In particular, this research is confronted by two limitations: the definition of an exchange relationship and the delimitation of the network boundary for empirical investigation.

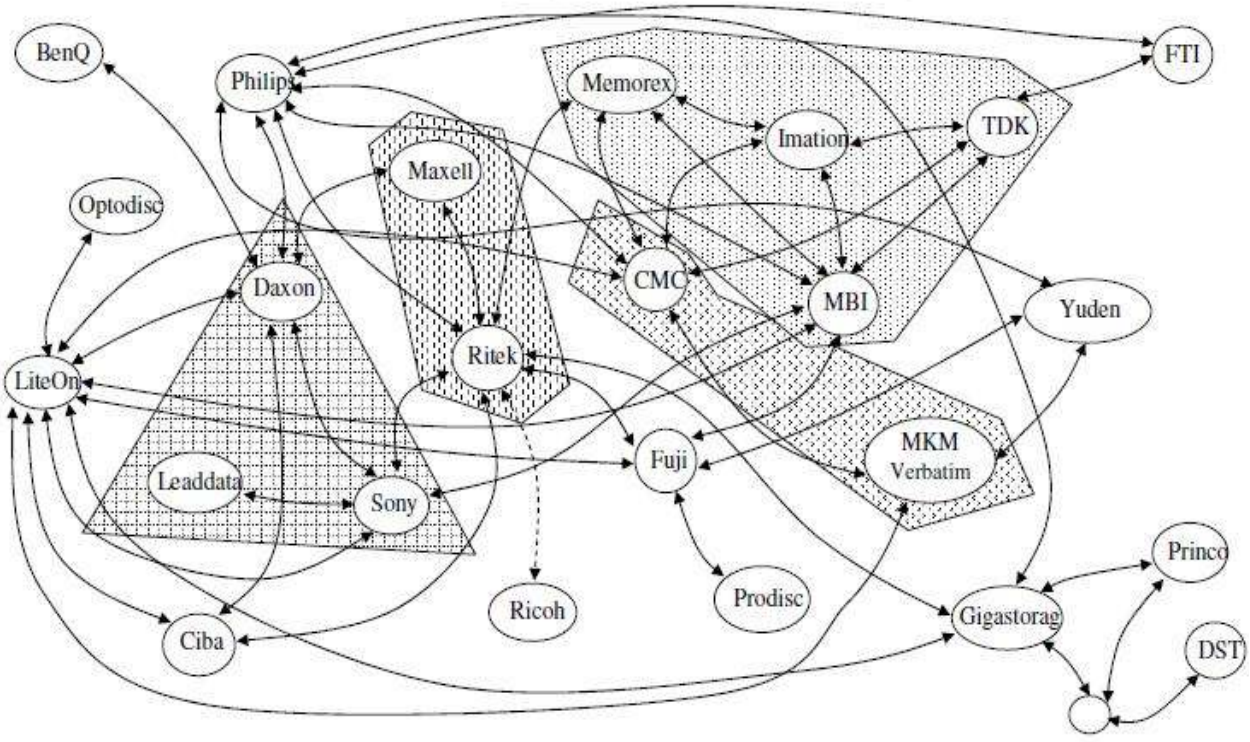
The first limitation is concerned with what constitutes an exchange relationship. The findings of this research accords with what has been emphasized in the literature that it is impossible for firms not to have relationships (e.g. Araujo *et al.*, 1999; Blois, 1997; Håkansson and Snehota, 1989). However, how the definition of a relationship is given remains unsolved (Zolkiewski, 2004). That is to say, the criteria used in judging the existence and discontinuation of business relationships may differ among researchers and practitioners. Only when a definition of relationships is given is it possible to capture relationship dynamics, including the establishment, enhancement, dissolution and reactivation of relationships. Once relationship dynamics are captured, network dynamics can be studied and understood. Although "ceasing to trade", which is suggested in Havila and Wilkinson's work (2002), is employed to define a relationship that has faded away or an ended relationship throughout this research, the understanding of network dynamics, including the factors behind the change, is constrained by this dispute over the definition of business relationships.

Delimiting the network boundary for empirical investigation is another limitation encountered by this research. Theoretically, the boundary of each piece of network research has to be intentionally delimited, with attempts to examine the content of the research problem, and at the same time, to retain the characteristics of connectedness and embeddedness (Anderson *et al.*, 1994; Easton, 1992; Halinen and Törnroos, 2005). Methodologically and empirically, a purposeful setting of network boundary is required, so as to make sure that the accessibility to the field is guaranteed and the collection of data can be completed within limited time, meeting the objectives of the study (Halinen and Törnroos, 2005; Patton, 2002; Silverman, 2005).

To tackle the research problem, a focal net perspective, an intermediary boundary setting (Brito, 1999), is adopted to investigate network dynamics which contain the

characteristics of connectedness and embeddedness. Such a focal net perspective is claimed to be able to study important relationships to which the focal actor is directly and indirectly connected (Alajoutsijärvi *et al.*, 1999). However, as to which relationships are important and how many relationships should be included in a focal net; the answers may vary among researchers (due to different analytical and empirical purposes) and practitioners (both the focal company and its counterparts). Moreover, the employment of a focal net perspective has to sacrifice, to some extent, the understanding of the complicatedness of the network in order to facilitate the empirical investigation. For example, Figure 10.1 is a Japanese-based technology vendor's network picture about the business relationships between media makers (OEMs) and technology vendors after the win-out of the Blu-ray camp in the optical recording media industry. In this picture, four major OEM-vendor partnerships were identified by this Japanese-based vendor. These partnerships were simultaneously interconnected and embedded in a broader environment; but many of them were not covered in this research. This example is to illustrate the difficulty in conducting network research, especially when a network boundary has to be delimited.

Figure 10.1 A network picture by a Japanese-based vendor



Note: This picture is reproduced from the interview with this Japanese-based vendor.

10.4 Future research directions

Being grounded in the IMP Group's Interaction and Network approach and using an input-process-output model, this research looks at the evolution of a technology-based business net driven by the arrival of technological change from a focal net perspective. Despite the new insights that are developed from the longitudinal case study in terms of the process of the arrival of technological change, the net reconfiguration and relationship dynamics, there are some avenues for future research. An obvious direction is to continue this research in the optical recording media industry. Another beneficial direction is to carry out additional processual studies within different empirical settings. Possible empirical settings include the optical recording drive industry and the mobile telephony industry in which the former has high business relevance with the optical recording media industry while the latter is characterised by several technological changes. Researchers should be encouraged to undertake a multiple-case research using a processual design and a focal net perspective to gain insights into similarities and differences in the evolution of value-creating and technology-bundled business nets, allowing theory to be developed (Dubois and Gadde, 2002; Eisenhardt, 1989; Yin, 2003).

In addition to the above research directions, developing emergent strategies based on the IMP's approach is an avenue for future research. This research shows that network dynamics resulted from relationship dynamics where actors embedded in the value net strategised to protect or maintain their positions in the face of technological change. Retrospectively, embracing the next generation of technology had become a "planned" strategy, at least to major players like F and C1, to improve profitability and enhance competitive advantage. Due to the guidance by DVD Forum and DVD+RW Alliance which standardised the formats of optical recording media, the direction of such a planned strategy was comparatively clear, e.g. migrating from CD-R to DVD-R or DVD+R or both in a timely manner. However, net members developed their respective interpretations of how to best carry out this strategy in line with their own interaction histories and expectations for the future. This is why the arrival of technological change poses a relational chasm which may easily trap an actor. Therefore, it is beneficial to research how to develop emergent strategies in the process of executing a planned strategy, especially in the IMP area.

Within the IMP field, strategy-making has recently received increasing attention although prior IMP studies have revealed its importance. For instance, Johanson and Mattsson (1992) contends that "[…] strategic actions are efforts by actors to influence (change or preserve) their position(s) in network(s)" (p. 214). Ford (2002) argues that

what happens to a firm internally and externally "[…] is as much a function of unplanned events as of analysis and strategy" (p. 232). Moreover, Håkansson and Ford (2002) view the consequence of a strategy process as "interactive, evolutionary and responsive, rather than independently developed and implemented" (p. 137). In spite of these insightful thoughts on strategy, this area of research remains poorly examined. As Baraldi *et al.* (2007) point out, "there are comparatively few studies in the industrial networks literature that deal explicitly with the strategy process, there are many in-depth case studies that may deal with the strategy process implicitly […] there is a scope to define a new empirical project designed specifically to illuminate the strategy process within industrial networks" (p. 891).

Recent studies that explicitly deal with strategy subjects based on the IMP approach can be found in Baraldi (2008), Baraldi *et al.* (2007) and Harrison and Prenkert (2009). In their theoretical comparison of the IMP perspective on strategy with five important schools of thought in strategy, Baraldi *et al.* (2007) provide IMP researchers with a fruitful avenue to research on how strategies are formed and emerge in a network context. By analysing the experience of IKEA in dealing with its industrial network, Baraldi (2008) discusses "network strategy" that stresses the utilisation of the external network to pursue the company goals. Moreover, in the work that investigates how the effects of network connections are considered within the process of forming a planned strategy, Harrison and Prenkert (2009) introduce the concept of "network strategising trajectories" which is underpinned by the IMP's ARA model and which uses the ARA model as a tool for analysis. They also argue that three types of network strategising can be distinguished from the current IMP literature: cognitive strategising, positioning strategising and adaptations as strategising.

With the above explicit studies on strategy in the IMP area, researchers are encouraged to conduct research to investigate how emergent strategies are formed while executing a planned strategy, e.g. bridging technological change. And thus, it is beneficial to revisit the field in which the empirical data of this doctoral research is based. This direction for future research will contribute not only to the IMP field but also to a broader research community in which "strategy-as-practice", "micro strategy" and "strategising" are of particular interests (e.g. Johnson *et al.*, 2003; Whittington, 2003).

BIBLIORGRAPHY

Afuah, A. (2000), "How much do your co-opetitors' capabilities matter in the face of technological change?" *Strategic Management Journal,* Vol. 21 No. 3, pp. 387-404.

Afuah, A. (2001), "Dynamic boundaries of the firm: Are firms better off being vertically integrated in the face of a technological change?" *Academy of Management Journal,* Vol. 44 No. 6, pp. 1211-1228.

Alajoutsijärvi, K., Möller, K. and Tähtinen, J. (2000), "Beautiful exit: how to leave your business partner", *European Journal of Marketing,* Vol. 34 No. 11/12, pp. 1270-1290.

Alajoutsijärvi, K., Möller, K. and Rosenbröijer, C.-J. (1999), "Relevance of focal nets in understanding the dynamics of business relationships", *Journal of Business-to-Business Marketing,* Vol. 6 No. 3, pp. 3-35.

Andersen, P. (2008), "Generic rivalry strategies in business networks: Towards a conceptualization", *Journal of Business Market Management,* Vol. 2 No. 2, pp. 99-117.

Anderson, E. and Jap, S. D. (2005), "The dark side of close relationships", *MIT Sloan Management Review,* Vol. 46 No. 3, pp. 75-82.

Anderson, H., Havila, V., Andersen, P. and Halinen, A. (1998), "Position and role-conceptualizing dynamics in business networks ", *Scandinavian Journal of Management,* Vol. 14 No. 3, pp. 167-186.

Anderson, J. C. (1995), "Relationships in business markets: Exchange episodes, value creation, and their empirical assessment", *Journal of the Academy of Marketing Science,* Vol. 23 No. 4, pp. 346-350.

Anderson, J. C., Håkansson, H. and Johanson, J. (1994), "Dyadic business relationships within a business network context", *Journal of Marketing,* Vol. 58 No. 4, pp. 1-15.

Anderson, P. and Tushman, M. L. (1990), "Technological discontinuities and dominant designs: A cyclical model of technological change", *Administrative Science Quarterly,* Vol. 35 No. 4, pp. 604-633.

Andersson, P. and Mattsson, L.-G. (2010), "Temporal profiles of activities and temporal orientations of actors as part of market practices in business networks", *The IMP Journal,* Vol. 4 No. 1, pp. 57-81.

Ansoff, H. I. (1965), *Corporate Strategy*, McGraw-Hill, New York.

Araujo, L., Dubois, A. and Gadde, L.-E. (1999), "Managing interfaces with suppliers", *Industrial Marketing Management,* Vol. 28 No. 5, pp. 497-506.

Araujo, L., Dubois, A. and Gadde, L.-E. (2003), "The multiple boundaries of the firm",

Journal of Management Studies, Vol. 40 No. 5, pp. 1255-1277.

Araujo, L. and Harrison, D. (2002), "Path dependence, agency and technological evolution", *Technology Analysis & Strategic Management,* Vol. 14 No. 1, pp. 5-19.

Arthur, W. B. (1994), *Increasing Returns and Path Dependence in the Economy*, University of Michigan Press, Ann Arbor.

Awaleh, F. and Harrison, D. (2009), "Re-organising relationship interaction by stabilising a new interaction form", paper presented at the 25th annual IMP conference, Marseille.

Axelsson, B. (1992a), "Corporate Strategy Models and Networks - Diverging Perspectives", in Axelsson, B. and G. Easton (Eds.), *Industrial Networks: A New View of Reality,* Routledge, London, pp. 184-204.

Axelsson, B. (1992b), "Network research - future issues", in Axelsson, B. and G. Easton (Eds.), *Industrial Networks: A New View of Reality,* Routledge, London, pp.

Axelsson, B. and Easton, G. (Eds.) (1992), *Industrial Networks: A New View of Reality,* Routledge, London.

Baraldi, E. (2008), "Strategy in industrial networks: Experiences from IKEA", *California Management Review,* Vol. 50 No. 4, pp. 99-126.

Baraldi, E., Brennan, R., Harrison, D., Tunisini, A. and Zolkiewski, J. (2007), "Strategic thinking and the IMP approach: A comparative analysis", *Industrial Marketing Management,* Vol. 36 No. 7, pp. 879-894.

Barney, J. (1991), "Firm resources and sustained competitive advantage", *Journal of Management,* Vol. 17 No. 1, pp. 99-120.

Bengtsson, M. and Kock, S. (2000), ""Coopetition" in business networks - to cooperate and compete simultaneously", *Industrial Marketing Management,* Vol. 29 No. 5, pp. 411-426.

Blankenburg, D. and Johanson, J. (1992), "Managing network connections in international business", *Scandinavian International Business Review,* Vol. 1 No. 1, pp. 5-19.

Blois, K. (1997), "When is a relationship "a relationship"?" in Gemünden, H. G., et al. (Eds.), *Relationships and Networks in International Markets,* Pergamon, Oxford, pp. 53-64.

Bonoma, T. V. (1985), "Case research in marketing: Opportunities, problems, and a process", *Journal of Marketing Research,* Vol. 22 No. 2, pp. 199-208.

Bowman, C. and Ambrosini, V. (2003), "How the resource-based and the dynamic capability views of the firm inform corporate-level strategy", *British Journal of Management,* Vol. 14 No. 4, pp. 289-303.

Brennan, R., Gressetvold, E. and Zolkiewski, J. (2008), "Towards a taxonomy of strategic research in the IMP tradition", paper presented at the 24th annual IMP

Conference, Uppsala.
Brennan, R. and Turnbull, P. (1999), "Adaptive behavior in buyer-supplier relationships", *Industrial Marketing Management,* Vol. 28 No. 5, pp. 481-495.
Brennan, R., Turnbull, P. and Wilson, D. (2003), "Dyadic adaptation in business-to-business markets", *European Journal of Marketing,* Vol. 37 No. 11/12, pp. 1636-1665.
Brito, C. M. (1999), "Issue-based nets: a methodological approach to the sampling issue in industrial networks research", *Qualitative Market Research: An International Journal,* Vol. 2 No. 2, pp. 92-102.
Burt, R. (1992), *Structural Holes: The Social Structure of Competition*, Harvard University Press, Cambridge.
Campbell, A. J. and Wilson, D. T. (1996), "Managed Networks: Creating Strategic Advantage", in Iacobucci, D. (Ed.), *Networks in Marketing,* SAGE, London, pp. 125-143.
Chandy, R. K. and Tellis, G. J. (2000), "The incumbent's curse? Incumbency, size, and radical product innovation", *Journal of Marketing,* Vol. 64 No. 3, pp. 1-17.
Chou, H.-H. and Zolkiewski, J. (2008a), "How embracing technological discontinuities disrupted relationships in a business network", paper presented at the 3rd International Conference on Business Market Management, St. Gallen.
Chou, H.-H. and Zolkiewski, J. (2008b), "Relationship turbulence in bridging technological discontinuities: A network strategy perspective", paper presented at the 24th annual IMP conference, Uppsala.
Chou, H.-h. and Zolkiewski, J. (2010), "The arrival of technological changes at the business net: A learning process", *Journal of Business & Industrial Marketing,* Vol. 25 No. 6, pp.
Christensen, C. M. (1997), *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*, Harvard Business School Press, Boston.
Cohen, W. M. and Levinthal, D. A. (1990), "Absorptive capacity: A new perspective on learning and innovation", *Administrative Science Quarterly,* Vol. 35 No. 1, pp. 128-152.
Cook, K. S. and Emerson, R. M. (1978), "Power, equity and commitment in exchange networks", *American Sociological Review,* Vol. 43 No. 5, pp. 721-739.
Cooper, R. G. (1979), "Identifying industrial new product success: Project NewProd", *Industrial Marketing Management,* Vol. 8 No. 2, pp. 124-135.
Creswell, J. W. (2009), *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches,* 3rd ed., SAGE, London.
Cusumano, M. A., Mylonadis, Y. and Rosenbloom, R. S. (1992), "Strategic maneuvering and mass-market dynamics: The triumph of VHS over Beta", *Business History Review,* Vol. 66 No. 1, pp. 51.

Dahl, R. A. (1957), "The concept of power", *Behavioral science,* Vol. 2 No. pp. 201-215.

Danneels, E. (2002), "The dynamics of product innovation and firm competences", *Strategic Management Journal,* Vol. 23 No. 12, pp. 1095-1121.

Danneels, E. (2004), "Disruptive technology reconsidered: A critique and research agenda", *Journal of Product Innovation Management,* Vol. 21 No. 4, pp. 246-258.

David, P. A. (1985), "Clio and the economics of QWERTY", *American Economic Review,* Vol. 75 No. 2, pp. 332-337.

Denzin, N. K. and Lincoln, Y. S. (2003), "Introduction: The Discipline and Practice of Qualitative Research", in Denzin, N. K. and Y. S. Lincoln (Eds.), *Strategies of Qualitative Inquiry,* SAGE, London, pp. 1-45.

Dittrich, K. and Duysters, G. (2007), "Networking as a means to strategy change: The case of open innovation in mobile telephony", *Journal of Product Innovation Management,* Vol. 24 No. 6, pp. 510-521.

Dosi, G. (1982), "Technological paradigms and technological trajectories", *Research Policy* Vol. 11 No. 3, pp. 147-162.

Dubois, A. and Araujo, L. (2004), "Research methods in industrial marketing studies", in Håkansson, H., et al. (Eds.), *Rethinking marketing: Developing a new understanding of markets,* John Wiley & Sons, Chichester, pp. 207-227.

Dubois, A. and Gadde, L.-E. (2002), "Systematic combining: an abductive approach to case research", *Journal of Business Research,* Vol. 55 No. 7, pp. 553-560.

Dwyer, F. R., Schurr, P. H. and Oh, S. (1987), "Developing buyer-seller relationships", *Journal of Marketing,* Vol. 51 No. 2, pp. 11-27.

Easingwood, C. and Harrington, S. (2002), "Launching and re-launching high technology products", *Technovation,* Vol. 22 No. 11, pp. 657-666.

Easingwood, C., Moxey, S. and Capleton, H. (2006), "Bringing high technology to market: Successful strategies employed in the worldwide software industry", *Journal of Product Innovation Management,* Vol. 23 No. 6, pp. 498-511.

Easton, G. (1992), "Industrial Networks: A Review", in Axelsson, B. and G. Easton (Eds.), *Industrial Networks: A New View of Reality,* Routledge, London, pp. 3-27.

Easton, G. (1995), "Methodology and Industrial Networks", in Möller, K. and D. Wilson (Eds.), *Business Marketing: An Interaction and Network Perspective* Kluwer Academic Publishers, Boston, pp. 411-492.

Easton, G. and Lundgren, A. (1992), "Changes in industrial networks as flow through nodes", in Axelsson, B. and G. Easton (Eds.), *Industrial Networks: A New View of Reality,* Routledge, London, pp. 89-104.

Ehrnberg, E. (1995), "On the definition and measurement of technological

discontinuities ", *Technovation,* Vol. 15 No. 7, pp. 437-452

Eisenhardt, K. M. (1989), "Building theories from case study research", *Academy of Management Review,* Vol. 14 No. 4, pp. 532-550.

Eisenhardt, K. M. and Martin, J. A. (2000), "Dynamic capabilities: What are they?" *Strategic Management Journal,* Vol. 21 No. 10/11, pp. 1105-1121.

Emerson, R. M. (1962), "Power-dependence relations", *American Sociological Review,* Vol. 27 No. 1, pp. 31-41.

Ford, D. (1980), "The development of buyer-seller relationships in industrial markets", *European Journal of Marketing,* Vol. 14 No. 5/6, pp. 339-53.

Ford, D. (Ed.) (1997), *Understanding Business Markets,* The Dryden Press, London.

Ford, D. (2002), "Distribution, internationalisation and networks", *International Marketing Review,* Vol. 19 No. 3, pp. 225-235.

Ford, D. (2009), "IMP and service dominant logic: Divergence, Convergence and development", paper presented at the 25th annual IMP conference, Marseille.

Ford, D., Gadde, L.-E., Håkansson, H., Lundgren, A., Snehota, I., Turnbull, P. and Wilson, D. (1998), *Managing Business Relationships*, John Wiley & Sons, Chichester.

Ford, D., Gadde, L.-E., Håkansson, H., Snehota, I. and Waluszewski, A. (2010), "Analysing business interaction", *The IMP Journal,* Vol. 4 No. 1, pp. 82-103.

Ford, D. and Håkansson, H. (2006), "The idea of business interaction", *The IMP Journal,* Vol. 1 No. 1, pp. 4-27.

Ford, D., Håkansson, H. and Johanson, J. (1997), "How Do Companies Interact?" in Ford, D. (Ed.), *Understanding Business Markets,* 2nd ed., The Dryden Press, London, pp. 55-67.

Ford, D., McDowell, R. and Tomkins, C. (1996), "Relationship Strategy, Investments, and Decision Making", in Iacobucci, D. (Ed.), *Networks in Marketing,* SAGE, London, pp. 144-176.

Ford, D. and Redwood, M. (2005), "Making sense of network dynamics through network pictures: A longitudinal case study", *Industrial Marketing Management,* Vol. 34 No. 7, pp. 648-657.

Ford, D. and Saren, M. (2001), *Managing and Marketing Technology,* 2nd ed., Thomson Learning, London.

Gadde, L.-E. and Håkansson, H. (1992), "Analysing Change and Stability in Distribution Channels - A Network Approach", in Axelsson, B. and G. Easton (Eds.), *Industrial Networks: A New View of Reality,* Routledge, London, pp. 166-179.

Gadde, L.-E. and Håkansson, H. (2008), "Business relationships and resource combining", *The IMP Journal,* Vol. 2 No. 1, pp. 31-45.

Gadde, L.-E., Huemer, L. and Håkansson, H. (2003), "Strategizing in industrial

networks", *Industrial Marketing Management,* Vol. 32 No. 5, pp. 357-364.

Gadde, L.-E. and Mattsson, L.-G. (1987), "Stability and change in network relationships", *International Journal of Research in Marketing,* Vol. 4 No. 1, pp. 29-41.

Gawer, A. and Cusumano, M. A. (2002), *Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry innovation*, Harvard Business School Press, Boston, Mass.

Giller, C. and Matear, S. (2001), "The termination of inter-firm relationships", *The Journal of Business & Industrial Marketing,* Vol. 16 No. 2, pp. 94-112.

Glaser, B. G. and Strauss, A. L. (1967), *The discovery of grounded theory: Strategies for qualitative research*, Aldine de Gruyter, New York.

Goldenberg, J., Libai, B. and Muller, E. (2002), "Riding the saddle: How cross-market communications can create a major slump in sales", *Journal of Marketing,* Vol. 66 No. 2, pp. 1-16.

Grønhaug, K., Henjesand, I. J. and Koveland, A. (1999), "Fading relationships in business markets: an exploratory study", *Journal of Strategic Marketing,* Vol. 7 No. 3, pp. 175-190.

Grönroos, C. (2004), "The relationship marketing process: communication, interaction, dialogue, value", *Journal of Business & Industrial Marketing,* Vol. 19 No. 2, pp. 99-113.

Granovetter, M. S. (1973), "The strength of weak ties", *American Journal of Sociology,* Vol. 78 No. 6, pp. 1360-1380.

Håkansson, H. (Ed.) (1982), *International Marketing and Purchasing of Industrial Goods,* John Wiley & Sons, Chichester.

Håkansson, H. (1997), "Product development in networks", in Ford, D. (Ed.), *Understanding Business Markets,* 2nd ed., The Dryden Press, London, pp. 475-496.

Håkansson, H. and Ford, D. (2002), "How should companies interact in business networks?" *Journal of Business Research,* Vol. 55 No. 2, pp. 133-139.

Håkansson, H., Ford, D., Gadde, L.-E., Snehota, I. and Waluszewski, A. (2009), *Business in Networks*, John Wiley, Chichester.

Håkansson, H. and Gadde, L.-E. (1997), "Supplier Relations", in Ford, D. (Ed.), *Understanding Business Markets,* 2nd ed., The Dryden Press, London, pp. 400-429.

Håkansson, H., Harrison, D. and Waluszewski, A. (Eds.) (2004), *Rethinking marketing: Developing a new understanding of markets,* John Wiley & Sons, Chichester.

Håkansson, H., Havila, V. and Pedersen, A.-C. (1999), "Learning in networks", *Industrial Marketing Management,* Vol. 28 No. 5, pp. 443-452.

Håkansson, H. and Henders, B. (1995), "Network Dynamics: Forces And Processes

Underlying Evolution And Revolution In Business Networks", in Möller, K. and D. Wilson (Eds.), *Business Marketing: An Interaction and Network Perspective,* Kluwer Academic Publishers, Boston, USA, pp. 139-154.

Håkansson, H. and Johanson, J. (1992), "A Model of Industrial Networks", in Axelsson, B. and G. Easton (Eds.), *Industrial Networks: A New View of Reality,* Routledge, London, pp. 28-34.

Håkansson, H. and Lundgren, A. (1995), "Industrial Networks and Technological Innovation", in Möller, K. and D. Wilson (Eds.), *Business Marketing: An Interaction and Network Perspective,* Kluwer Academic Publishers, Boston, pp. 291-320.

Håkansson, H. and Lundgren, A. (1997), "Paths in Time and Space - Path Dependence in Industrial Networks", in Magnusson, L. and J. Ottosson (Eds.), *Evolutionary Economics and Path Dependence,* Edward Elgar, Cheltenham, pp. 119-137.

Håkansson, H. and Snehota, I. (1989), "No business is an island: the network concept of business strategy", *Scandinavian Journal of Management,* Vol. 4 No. 3, pp. 187-200.

Håkansson, H. and Snehota, I. (1995), *Developing Relationships in Business Networks*, Routledge, London.

Håkansson, H. and Snehota, I. (1998), "The Burden of Relationships or Who's Next", in Naudé, P. and P. Turnbull (Eds.), *Network Dynamics in International Marketing,* Pergamon, Oxford, pp. 16-25.

Håkansson, H. and Waluszewski, A. (2002a), *Managing Technological Development: IKEA, the Environment and Technology*, Routledge, New York.

Håkansson, H. and Waluszewski, A. (2002b), "Path dependence: restricting or facilitating technical development?" *Journal of Business Research,* Vol. 55 No. 7, pp. 561-570.

Halinen, A. (1997), *Relationship marketing in professional services: a study of agency-client dynamics in the advertising sector*, Routledge, London.

Halinen, A. (1998), "Time and Temporality in Research Design: A Review of Buyer-seller Relationship Models", in Naudé, P. and P. Turnbull (Eds.), *Network Dynamics in International Marketing,* Pergamon, Oxford, pp. 112-139.

Halinen, A., Salmi, A. and Havila, V. (1999), "From dyadic change to changing business networks: An analytical framework", *Journal of Management Studies,* Vol. 36 No. 6, pp. 779-794.

Halinen, A. and Tähtinen, J. (2002), "A process theory of relationship ending", *International Journal of Service and Industry Management,* Vol. 13 No. 2, pp. 163-80.

Halinen, A. and Törnroos, J.-Å. (1995), "The Meaning of Time in the Study of Industrial Buyer-Seller Relationships", in Möller, K. and D. Wilson (Eds.), *Business*

Marketing: An Interaction and Network Perspective, Kluwer Academic Publishers, Boston, pp. 493-530.

Halinen, A. and Törnroos, J.-Å. (1998), "The role of embeddedness in the evolution of business networks", *Scandinavian Journal of Management,* Vol. 14 No. 3, pp. 187-205.

Halinen, A. and Törnroos, J.-Å. (2005), "Using case methods in the study of contemporary business networks", *Journal of Business Research,* Vol. 58 No. 9, pp. 1285-1297.

Harrison, D. (2001), "Network effects following multiple relationship dissolution", paper presented at the 17th annual IMP conference, Oslo.

Harrison, D. and Prenkert, F. (2009), "Network strategising trajectories within a planned strategy process", *Industrial Marketing Management,* Vol. 38 No. 6, pp. 662-670.

Harryson, S. J., Dudkowski, R. and Stern, A. (2008), "Transformation networks in innovation alliances - The development of Volvo C70", *Journal of Management Studies,* Vol. 45 No. 4, pp. 745-773.

Havila, V. and Wilkinson, I. F. (2002), "The principle of the conservation of business relationship energy: or many kinds of new beginnings", *Industrial Marketing Management,* Vol. 31 No. 3, pp. 191-203.

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M. A., Singh, H., Teece, D. J. and Winter, S. G. (2007), *Dynamic capabilities: Understanding strategic change in organizations*, Blackwell, Oxford.

Henderson, R. (2006), "The innovator's dilemma as a problem of organizational competence", *Journal of Product Innovation Management* Vol. 23 No. 1, pp. 5-11.

Henderson, R. and Clark, K. B. (1990), "Architectural innovation: the reconfiguration of existing product technologies and the failure of established firms", *Administrative Science Quarterly,* Vol. 35 No. 1, pp. 9-30.

Henneberg, S. C., Mouzas, S. and Naudé, P. (2006), "Network pictures: concepts and representations", *European Journal of Marketing,* Vol. 40 No. 3/4, pp. 408-429.

Hertz, S. (1992), "Towards more integrated industrial systems", in Axelsson, B. and G. Easton (Eds.), *Industrial Networks: A New View of Reality,* Routledge, London, pp. 105-128.

Hertz, S. (1996), "Drifting Closer and Drifting Away in Networks: Gradual Changes in Interdependencies of Networks", in Iacobucci, D. (Ed.), *Networks in Marketing,* SAGE, London, pp. 179-204.

Hertz, S. (1998), "Domino effects in international networks", *Journal of Business-to-Business Marketing,* Vol. 5 No. 3, pp. 3-31.

Hibbard, J. D., Kumar, N. and Stern, L. W. (2001), "Examining the impact of

destructive acts in marketing channel relationships", *Journal of Marketing Research,* Vol. 38 No. 1, pp. 45-61.

Hill, C. W. L. (1997), "Establishing a standard: Competitive strategy and technological standards in winner-take-all industries", *Academy of Management Executive,* Vol. 11 No. 2, pp. 7-25.

Hirschman, A. O. (1970), *Exit, Voice, and Loyalty: Responses to Decline in Firms, Organizations and States*, Harvard University Press, Cambridge, MA.

Holm, D. B., Eriksson, K. and Johanson, J. (1999), "Creating value through mutual commitment to business network relationships", *Strategic Management Journal,* Vol. 20 No. 5, pp. 467-486.

Holmen, E. and Pedersen, A.-C. (2003), "Strategizing through analyzing and influencing the network horizon", *Industrial Marketing Management,* Vol. 32 No. 5, pp. 409-418.

Holmlund, M. and Törnroos, J.-Å. (1997), "What are relationships in business networks?" *Management Decision,* Vol. 35 No. 4, pp. 304-309.

Johanson, J. and Mattsson, L.-G. (1992), "Network Positions and Strategic Action - An Analytical Framework", in Axelsson, B. and G. Easton (Eds.), *Industrial Networks: A New View of Reality,* Routledge, London, pp. 205-217.

Johanson, J. and Mattsson, L.-G. (1997), "Internationalisation in Industrial Systems - A Network Approach", in Ford, D. (Ed.), *Understanding Business Markets,* 2nd ed., The Dryden Press, London, pp. 194-213.

John, G., Weiss, A. M. and Dutta, S. (1999), "Marketing in technology-intensive markets: Toward a conceptual framework", *Journal of Marketing,* Vol. 63 No. Special Issue, pp. 78-91.

Johnson, G., Melin, L. and Whittington, R. (2003), "Micro strategy and strategizing: towards and activity based view", *Journal of Management Studies,* Vol. 40 No. 1, pp. 3-22.

Johnston, W. J., Peters, L. D. and Gassenheimer, J. (2006), "Questions about network dynamics: Characteristics, structures, and interactions", *Journal of Business Research,* Vol. 59 No. 8, pp. 945-954.

Kash, D. E. and Rycoft, R. W. (2000), "Patterns of innovating complex technologies: a framework for adaptive network strategies", *Research Policy,* Vol. 29 No. 7-8, pp. 819-831.

Kash, D. E. and Rycroft, R. (2002), "Emerging patterns of complex technological innovation", *Technological Forecasting and Social Change,* Vol. 69 No. 6, pp. 581-606.

Knoben, J., Oerlemans, L. A. G. and Rutten, R. P. J. H. (2006), "Radical changes in inter-organizational network structures: The longitudinal gap", *Technological Forecasting and Social Change,* Vol. 73 No. 4, pp. 390-404.

Kothandaraman, P. and Wilson, D. T. (2001), "The future of competition: Value-creating networks", *Industrial Marketing Management,* Vol. 30 No. 4, pp. 379-389.

Kumar, N. (2005), "The power of power in supplier - retailer relationships", *Industrial Marketing Management,* Vol. 34 No. 8, pp. 863-866.

Kuo, L.-P. (2006), "The evolutionary dynamics of write-once optical disk industry in Taiwan", unpublished master dissertation, National Taiwan University, Taipei.

Kutschker, M. (1985), "The multi-organizational interaction approach to industrial marketing", *Journal of Business Research,* Vol. 13 No. 5, pp. 383-403.

Laage-Hellman, J. (1997), *Business networks in Japan: supplier-customer interaction in product development*, Routledge, London.

Low, B. K. H. (1997), "Managing business relationships and positions in industrial networks", *Industrial Marketing Management,* Vol. 26 No. 2, pp. 189-202.

Lundgren, A. (1992), "Coordination and Mobilisation Processes in Industrial Networks", in Axelsson, B. and G. Easton (Eds.), *Industrial Networks: A New View of Reality,* Routledge, London, pp. 144-165.

Lundgren, A. (1995), *Technological Innovation and Network Evolution*, Routledge, London.

Möller, K. and Halinen, A. (1999), "Business relationships and networks: Managerial challenge of network era", *Industrial Marketing Management,* Vol. 28 No. 5, pp. 413-427.

Möller, K. and Rajala, A. (2007), "Rise of strategic nets - New modes of value creation", *Industrial Marketing Management,* Vol. 36 No. 7, pp. 895-908.

Möller, K., Rajala, A. and Svahn, S. (2005), "Strategic business nets - their type and management", *Journal of Business Research,* Vol. 58 No. 9, pp. 1274-1284

Möller, K. and Svahn, S. (2006), "Role of knowledge in value creation in business nets", *Journal of Management Studies,* Vol. 43 No. 5, pp. 985-1007.

March, J. G. (1991), "Exploration and exploitation in organizational learning", *Organization Science,* Vol. 2 No. 1, pp. 71-87.

Mattsson, L.-G. (1987), "Management of Strategic Change in a "Markets-as-Networks" Perspective", in Pettigrew, A. (Ed.), *The Management of Strategic Change,* Basil Blackwell, London, pp. 234-256.

Mattsson, L.-G. (1997), ""Relationship Marketing" and the "Markets-as-Networks Approach": A comparative analysis of two evolving streams of research", *Journal of Marketing Management,* Vol. 13 No. 5, pp. 447-461.

Medlin, C. J. (2004), "Interaction in business relationships: A time perspective", *Industrial Marketing Management,* Vol. 33 No. 3, pp. 185-193.

Miles, M. B. and Huberman, A. M. (1994), *Qualitative data analysis: An expanded sourcebook*, SAGE, London.

Mintzberg, H. (1994), *The rise and fall of strategic planning*, Prentice Hall, New York.

Mintzberg, H., Ahlstrand, B. and Lampel, J. (2008), *Strategy safari: Your complete guide through the wilds of strategic management,* 2nd ed., Prentice Hall, London.

Mohr, J., Sengupta, S. and Slater, S. (2004), *Marketing of High-Technology Products and Innovations*, Pearson Prentice Hall, Upper Saddle River, New Jersey,

Moore, G. A. (1991), *Crossing the Chasm: Marketing and Selling Technology Products to Mainstream Customer*, Harper Collins, New York.

Morgan, R. M. and Hunt, S. D. (1994), "The commitment-trust theory of relationship marketing", *Journal of Marketing,* Vol. 58 No. 3, pp. 20-38.

Moriarty, R. T. and Kosnik, T. J. (1989), "High-tech marketing: Concepts, continuity, and change", *Sloan Management Review,* Vol. 30 No. 4, pp. 7-17.

Mouzas, S. and Naudé, P. (2007), "Network mobilizer", *Journal of Business & Industrial Marketing,* Vol. 22 No. 1, pp. 62-71.

Nadler, D. A. and Tushman, M. L. (1980), "A model for diagnosing organizational behavior", *Organizational Dynamics,* Vol. 9 No. 2, pp. 35-51.

Naudé, P. and Buttle, F. (2000), "Assessing relationship quality", *Industrial Marketing Management,* Vol. 29 No. 4, pp. 351-361.

Normann, R. and Ramirez, R. (1993), "From value chain to value constellation: Designing interactive strategy", *Harvard Business Review,* Vol. 71 No. 4, pp. 65-77.

Ogawa, K. (2005), "光ディスク産業の興隆と発展 (The prosperity and development of the optical disc industry)", MMRC Discussion Paper (The University of Tokyo), No. 28.

Orlikowski, W. J. and Yates, J. (2002), "It's about time: Temporal structuring in organizations", *Organization Science,* Vol. 13 No. 6, pp. 684-711.

Parolini, C. (1999), *The Value Net: A Tool for Competitive Strategy*, John Wiley, Chichester.

Patton, M. Q. (1987), *How to use qualitative methods in evaluation*, SAGE, London.

Patton, M. Q. (2002), *Qualitative research and evaluation methods,* 3rd ed., SAGE, London.

Pels, J., Möller, K. and Saren, M. (2009), "Do we really understand business marketing? Getting beyond the RM and BM matrimony ", *Journal of Business & Industrial Marketing,* Vol. 24 No. 5, pp. 322-336.

Penrose, E. T. (1995), *The theory of the growth of the firm,* 3rd ed., Oxford University Press, Oxford.

Perry, C. (1998), "Processes of a case study methodology for postgraduate research in marketing", *European Journal of Marketing,* Vol. 32 No. 9/10, pp. 785-802.

Peters, L. D. and Johnston, W. J. (2009), "Understanding absorptive capacity from a network perspective", *Journal of Business Market Management,* Vol. 3 No. 1, pp.

29-50.

Pettigrew, A. M. (1995), "Longitudinal Field Research on Change: Theory and Practice", in Huber, G. P. and A. H. Van de Ven (Eds.), *Longitudinal Field Research Methods: Studying Processes of Organizational Change,* SAGE, London, pp. 91-125.

Pettigrew, A. M. (1997), "What is a processual analysis?" *Scandinavian Journal of Management,* Vol. 13 No. 4, pp. 337-348.

Pfeffer, J. and Salancik, G. R. (1978), *The External Control of Organizations: A Resource Dependence Perspective*, Harper & Row, New York.

Ping, R. A. (1993), "The effects of satisfaction and structural constraints on retailer exiting, voice, loyalty, opportunism, and neglect", *Journal of Retailing,* Vol. 69 No. 3, pp. 320-352.

Ping, R. A. (1995), "Some uninvestigated antecedents of retailer exit intention", *Journal of Business Research,* Vol. 34 No. pp. 171-180.

Ping, R. A. (1997), "Voice in business-to-business relationships: Cost-of-exit and demographic antecedents", *Journal of Retailing,* Vol. 73 No. 2, pp. 261-281.

Ping, R. A. (1999), "Unexplored antecedents of exiting in a marketing channel", *Journal of Retailing,* Vol. 75 No. 2, pp. 218-241.

Pittaway, L., Robertson, M., Munir, K., Denyer, D. and Neely, A. (2004), "Networking and innovation: a systematic review of the evidence", *International Journal of Management Reviews,* Vol. 5/6 No. 3/4, pp. 137-168.

Porter, M. E. (1980), *Competitive strategy: Techniques for analyzing industries and competitors*, The Free Press, New York.

Porter, M. E. (1985), *Competitive advantage: Creating and sustaining superior performance*, The Free Press, New York.

Powell, W. W., Koput, K. W. and Smith-Doerr, L. (1996), "Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology", *Administrative Science Quarterly,* Vol. 41 No. 1, pp. 116-145.

Pressey, A. D. and Qiu, X. X. (2007), "Buyer-supplier relationship dissolution: the Chinese context", *Journal of Business & Industrial Marketing,* Vol. 22 No. 2, pp. 107-117.

Priem, R. L. and Butler, J. E. (2001), "Is the resource-based "view" a useful perspective for strategic management research?" *Academy of Management Review,* Vol. 26 No. 1, pp. 22-40.

Ritter, T. (2000), "A framework for analyzing interconnectedness of relationships", *Industrial Marketing Management,* Vol. 29 No. 4, pp. 317-326.

Ritter, T. and Ford, D. (2004), "Interactions between suppliers and customers in business markets", in Håkansson, H., et al. (Eds.), *Rethinking marketing: Developing a new understanding of markets,* John Wiley & Sons, Chichester, pp.

99-116.

Ritter, T. and Gemünden, H. G. (2003), "Network competence: Its impact on innovation success and its antecedents", *Journal of Business Research,* Vol. 56 No. 9, pp. 745-755.

Ritter, T. and Gemünden, H. G. (2004), "The impact of a company's business strategy on its technological competence, network competence and innovation success", *Journal of Business Research,* Vol. 57 No. 5, pp. 548-556.

Ritter, T., Wilkinson, I. F. and Johnston, W. J. (2004), "Managing in complex business networks", *Industrial Marketing Management,* Vol. 33 No. 3, pp. 175-183.

Saldaña, J. (2003), *Longitudinal qualitative research: Analyzing change through time*, AltaMira Press, Walnut Creek, CA.

Sanchez, R. (1995), "Strategic flexibility in product competition", *Strategic Management Journal,* Vol. 16 No. Summer, pp. 135-159.

Schilling, M. A. (2003), "Technological leapfrogging: Lessons from the U.S. video game console Industry", *California Management Review,* Vol. 45 No. 3, pp. 6-32.

Schurr, P. H. (2007), "Buyer-seller relationship development episodes: Theories and methods ", *Journal of Business & Industrial Marketing* Vol. 22 No. 3, pp. 161-170.

Schurr, P. H., Hedaa, L. and Geersbro, J. (2008), "Interaction episodes as engines of relationship change", *Journal of Business Research,* Vol. 61 No. 8, pp. 877-884.

Sheth, J. N. and Sharma, A. (1997), "Supplier relationships: Emerging issues and challenges", *Industrial Marketing Management,* Vol. 26 No. 2, pp. 91-100.

Shintaku, J., Ogawa, K. and Yoshimoto, T. (2006), "光ディスク産業の競争と国際的協業モデル (The model of competition and international collaboration in the optical disc industry)", MMRC Discussion Paper (The University of Tokyo), No. 68.

Silverman, D. (2005), *Doing qualitative research,* 2nd ed., SAGE, London.

Slater, S. F. and Mohr, J. J. (2006), "Successful development and commercialization of technological innovation: Insights based on strategy type", *Journal of Product Innovation Management* Vol. 23 No. 1, pp. 26-33.

Smith, P. C. and Laage-Hellman, J. (1992), "Small group analysis in industrial networks", in Axelsson, B. and G. Easton (Eds.), *Industrial Networks: A New View of Reality,* Routledge, London, pp. 37-61.

Sood, A. and Tellis, G. J. (2005), "Technological evolution and radical innovation", *Journal of Marketing,* Vol. 69 No. pp. 152-168.

Stabell, C. B. and Fjeldstad, Ø. D. (1998), "Configuring value for competitive advantage: on chains, shops, and networks", *Strategic Management Journal,* Vol. 19 No. 5, pp. 413-437.

Stake, R. E. (2003), "Case Studies", in Denzin, N. K. and Y. S. Lincoln (Eds.), *Strategies of Qualitative Inquiry,* SAGE, London, pp. 134-164.

Stewart, K. (1998), "The Customer exit process - A review and research agenda", *Journal of Marketing Management,* Vol. 14 No. 4/5, pp. 235-250.

Suárez, F. F. and Utterback, J. M. (1995), "Dominant designs and the survival of firms", *Strategic Management Journal,* Vol. 16 No. 6, pp. 415-430.

Tähtinen, J. and Halinen-Kaila, A. (1997), "The Death of Business Triads: The Dissolution Process of a Net of Companies", paper presented at the 13th annual IMP conference, Lyon.

Tähtinen, J. and Halinen, A. (2002), "Research on ending exchange relationships: A categorization, assessment and outlook ", *Marketing Theory,* Vol. 2 No. 2, pp. 165-188.

Tähtinen, J. and Vaaland, T. I. (2006), "Business relationships facing the end: Why restore them?" *Journal of Business & Industrial Marketing,* Vol. 21 No. 1, pp. 14-23.

Törnroos, J.-Å. and Elo, M. (2005), "Relationships and networks - events enabling and inhibiting corporate internationalisation", paper presented at the 21st annual IMP conference, Rotterdam, Netherlands.

Tabrizi, B. and Walleigh, R. (1997), "Defining Next-Generation Products: An Inside Look", *Harvard Business Review,* Vol. 75 No. 6, pp. 116-124.

Teece, D. J., Pisano, G. and Shuen, A. (1997), "Dynamic capabilities and strategic management", *Strategic Management Journal,* Vol. 18 No. 7, pp. 509-533.

Thomas, R. and Ford, D. (1995), "Technology and Networks", in Möller, K. and D. Wilson (Eds.), *Business Marketing: An Interaction and Network Perspective* Kluwer Academic Publishers, Boston, pp. 263-290.

Turnbull, P., Ford, D. and Cunningham, M. (1996), "Interaction, relationships and networks in business markets: An evolving perspective", *Journal of Business & Industrial Marketing,* Vol. 11 No. 3/4, pp. 44-62.

Turnbull, P. and Valla, J.-P. (Eds.) (1986), *Strategies for international industrial marketing: the management of customer relationships in European industrial markets,* Croom Helm, London.

Turnbull, P. and Zolkiewski, J. (1997), "Profitability in customer portfolio planning", in Ford, D. (Ed.), *Understanding Business Markets,* 2nd ed., The Dryden Press, London, pp. 305-325.

Tushman, M. L. and Anderson, P. (1986), "Technological discontinuities and organizational environments", *Administrative Science Quarterly,* Vol. 31 No. 3, pp. 439-65.

Tuusjärvi, E. and Blois, K. (2004), "Interpretations of fairness in dissolution of complex relationships", *Journal of Marketing Management,* Vol. 20 No. 9/10, pp.

959-975.

Uzzi, B. (1997), "Social structure and competition in interfirm networks: The paradox of embeddedness", *Administrative Science Quarterly,* Vol. 42 No. 1, pp. 35-67.

Van de Ven, A. H. and Huber, G. P. (1990), "Longitudinal field research methods for studying processes of organizational change", *Organization Science,* Vol. 1 No. 3, pp. 213-219.

Welch, C. and Wilkinson, I. F. (2005), "Network perspectives on interfirm conflict: reassessing a critical case in international business", *Journal of Business Research,* Vol. 58 No. 2, pp. 205-213.

Whittington, R. (2003), "The work of strategizing and organizing: For a practice perspective", *Strategic Organization,* Vol. 1 No. 1, pp. 117-125.

Wilkinson, I. F. (2006), "The evolution of an evolutionary perspective on B2B business", *Journal of Business & Industrial Marketing,* Vol. 21 No. 7, pp. 458-465.

Wilkinson, I. F. and Young, L. C. (1997), "Business Dancing - The Nature and Role of Interfirm Relations in Business Strategy", in Ford, D. (Ed.), *Understanding Business Markets,* 2nd ed., The Dryden Press, London, pp. 82-97.

Wilkinson, I. F. and Young, L. C. (2002), "On cooperating: firms, relations and networks", *Journal of Business Research,* Vol. 55 No. 2, pp. 123-132.

Williamson, O. E. (1975), *Markets and Hierarchies: Analysis and Antitrust Implications*, Free Press, New York.

Wilson, D. T. (1995), "An integrated model of buyer-seller relationships", *Journal of the Academy of Marketing Science,* Vol. 23 No. 4, pp. 335-345.

Yin, R. K. (2003), *Case Study Research: Design and Methods,* 3rd ed., Sage, Thousand Oaks, CA.

Zaheer, A. and Bell, G. G. (2005), "Benefiting from network position: Firm capabilities, structural holes, and performance", *Strategic Management Journal,* Vol. 26 No. 9, pp. 809-825.

Zahra, S. A. and George, G. (2002), "Absorptive capacity: A review, reconceptualization, and extension", *Academy of Management Review,* Vol. 27 No. 2, pp. 185-203.

Zahra, S. A., Sapienza, H. J. and Davidsson, P. (2006), "Entrepreneurship and dynamic capabilities: A review, model and research agenda", *Journal of Management Studies,* Vol. 43 No. 4, pp. 917-955.

Zolkiewski, J. (1999), "Purchaser/Provider Relationships in the UK National Health Service: A Marketing Perspective", unpublished PhD thesis, University of Manchester Institute of Science and Technology, Manchester.

Zolkiewski, J. (2004), "Relationships are not ubiquitous in marketing", *European Journal of Marketing,* Vol. 38 No. 1/2, pp. 24-29.

Zolkiewski, J. and Turnbull, P. (2002), "Do relationship portfolios and networks provide the key to successful relationship management?" *Journal of Business &*

Industrial Marketing, Vol. 17 No. 7, pp. 575-597.

APPENDIX 1

List of Interviews

F: Focal actor (a Taiwan-based media maker; also an OEM)

C: F's business customer (all based in Japan; also technology vendors)

S: F's supplier (S1 based in Swiss; S2 and S3 based in Taiwan)

D: F's complementor (also drive makers)

R: F's rivals

The first stage of data collection: from September to October 2007 (10 interviews)

Respondent	Company and position	Type of interview	Date and duration of interview
Wei, H.C.	F's Section Mgr.	Face-to-face	27.09.2007, 1hr 40min
Lo, Winston	F's General Mgr.	Face-to-face	28.09.2007, 2hr (interviewed
Chang, Eric	F's Deputy General Mgr.		together)
Huang, Evan*	F's ex-QA Mgr.	Face-to-face	01.10.2007, 40min
Cheng, Jack	F's Account Mgr.	Face-to-face	05.10.2007, 1hr 20min
Chu, Eric*	F's ex-Sales Mgr.	Face-to-face	12.10.2007, 1hr
Sun, Stuart	F's Project Deputy Mgr.	Face-to-face	26.10.2007, 2hr
Chen, Philips	F's Production Mgr.	Face-to-face	25.10.2007, 50min
Sekiyama, Takayuki	C1's QA leader	Telephone	03.10.2007, 35min
Shirai, Masami	C1's Procurement Mgr.	Face-to-face	12.10.2007, 1hr
Oishi, Naoki	C1's Sales Mgr.	Face-to-face	29.10.2007, 45min

* These two informants were interviewed because they had close interaction with company C1.

The second stage of data collection: from April to September 2008 (50 interviews)

Respondent	Company and position	Type of interview	Date and duration of interview
Chang, Eric	F's Deputy General Mgr.	Face-to-face	16.04.2008, 2hr 30min
Chen, Amy	F's Sales Director	Face-to-face	16.04.2008, 1hr 30min
Lo, Winston	F's General Mgr.	Face-to-face	17.04.2008, 1hr 45min
Huang, Evan	F's ex-QA Mgr.	Face-to-face	22.05.2008, 30min
Sun, Stuart	F's Project Deputy Mgr.	Face-to-face	28.05.2008, 1hr 45min
Cheng, Jack	F's Account Mgr.	Face-to-face	05.05.2008, 1hr 20min
Chan, Andy	F's Customer Quality Eng.		(interviewed together)
Ku, W.K.	F's Global Logistics Mgr.	Face-to-face	05.05.2008, 1hr 40min
Kuo, Justin	F's Process Div. Mgr.	Face-to-face	05.05.2008, 1hr 40min
Wang, Wayne	F's R&D Div. Mgr.	Face-to-face	28.05.2008, 1hr 30min
Chiu, Mike	F's Customer Quality Eng.	Face-to-face	25.06.2008, 1hr 20min
Lai, July	F's QA Section Mgr.	Face-to-face	25.06.2008, 1hr 10min

Sun, Stuart	F's Project Deputy Mgr.	Face-to-face	17.07.2008, 3hr (interviewed
Wang, S.Y.	F's Deputy General Mgr. (Research Centre)		together)
Sun, Stuart	F's Project Deputy Mgr.	Face-to-face	24.07.2008, 1hr 10min
Cheng, Jack	F's Account Mgr.	Face-to-face	12.08.2008, 1hr 50min
Wang, Wayne	F's R&D Div. Mgr.	Face-to-face	12.08.2008, 1hr 25min
Chang, C.T.	F's Deputy General Mgr. (Production)	Face-to-face	12.08.2008, 2hr 15min
Sun, Stuart	F's Project Deputy Mgr.	Face-to-face	25.08.2008, 2hr 30min
Lai, July	F's QA Section Mgr.		(interviewed together)
Cheng, Angel	F's Sales Mgr.	Face-to-face	14.08.2008, 1hr 30min
Chen, G.H.	F's Production Director	Face-to-face	29.08.2008, 2hr
Lo, Winston	F's General Mgr.	Face-to-face	30.08.2008, 40min
Oishi, Naoki	C1's Sales Mgr.	Face-to-face	02.06.2008, 45min
Shirai, Masami	C1's Procurement Mgr.	E-mail	08.07.2008
Sekiyama, Takayuki	C1's QA leader	Face-to-face	31.07.2008, 2hr
Ueno, Fumitomo	C1's QA Mgr.	Face-to-face	30.07.2008, 1hr 30min
Lin, Kevin	C2's Taiwan agent (Sales Mgr.)	Face-to-face	25.07.2008, 1hr 20min
Ueda, Yataka	C2's Senior Mgr.	Face-to-face	29.07.2008, 1hr 20min
Higuchi, Jun	C3's Operations Mgr.	Face-to-face	30.07.2008, 1hr 40min
Lo, Gary	S3's QA Mgr.	Face-to-face	30.05.2008, 1hr 10min
Lo, Mano	S3's General Mgr.	Face-to-face	29.08.2008, 1hr 35min
Wang, Arvin	S1's Sales Mgr.	Face-to-face	23.06.2008, 2hr 15min
Chou, Jack	S2's Sales	Face-to-face	22.07.2008, 1hr 20min
Chang, Kevin	D1's Senior Engineer	Face-to-face	25.07.2008, 50min
Lu, David	R3's Deputy General Mgr.	Face-to-face	17.06.2008, 1hr 50min
Chen, Michael	R3's Department Mgr.	Face-to-face	24.07.2008, 50min
Wu, Johnny	R3's ex-Sales Mgr.	Face-to-face	13.08.2008, 1hr 20min
Kitamura, Takehiko	President of a technical consultancy based in JP	Face-to-face	01.08.2008, 1hr 10min
Jeng, T.R.	Industrial Tech Research Institute of TW, Director	Face-to-face	12.08.2008, 45min
Wang, S.P.	C4's Taiwan Agent for dye material business	Telephone	18.06.2008, 15min
Tai, C.L.	Vice President of a pre-recorded media maker	Face-to-face	14.08.2008, 30min
Teng, Tony	S4's* Strategic Acc. Mgr.	Face-to-face	24.07.2008, 30min
Yu, F.C.	S5's* Administrator	Face-to-face	06.08.2008, 1hr 40min

Yu, F.C.	S5's* Administrator	E-mail	07.08.2008
Liang, Stephen	D2's* Product Mgr.	Face-to-face	25.07.2008, 40min
Peng, James	R4's Senior Mgr.	Face-to-face	18.07.2008, 2hr 30min
Peng, James	R4's Senior Mgr.	Face-to-face	28.08.2008, 50min
Lin, Sarah	R4's Sales Mgr.	Face-to-face	28.08.2008, 1hr 15min
Chen, Jerry	R4's Senior Sales Mgr.		(interviewed together)
Lin, Dean	R4's Vice President	Face-to-face	28.08.2008, 40min
Yu, Eric	R5's Senior Mgr.	E-mail	27.08.2008
Chang, Pauline	R6's Finance Mgr.	Face-to-face	14.08.2008, 1hr 40min
Kameda, Takashi	C6's* Managing Director	Face-to-face	30.09.2008, 2hr
Yamagata, Hitoshi	C6's*Director		

* Although these companies were not included in the study of the focal net, their opinions were helpful reconstructing the history of the evolution of the focal net.

The third stage of data collection: from November 2008 till reporting this case study (12 interviews)

Respondent	Company and position	Type of interview	Date and duration of interview
Sun, Stuart	F's Project Deputy Mgr.	E-mail	13.11.2008
Chu, Eric	F's ex-Sales Mgr.	E-mail	14.11.2008
Chang, Eric	F's Deputy General Mgr.	E-mail	21.11.2008
Lai, July	F's QA Section Mgr.	Telephone*	12.12.2008, 30min
Cheng, Jack	F's Account Mgr.	Telephone*	15.12.2008, 40min
Wang, Arvin	S1's Sales Mgr.	E-mail	15.12.2008
Wei, H.C.	F's QA Section Mgr.	E-mail	18.12.2008
Sun, Stuart	F's Project Deputy Mgr.	Telephone*	19.12.2008, 15min
Tsai, T.T.	F's Customer Quality Eng.	E-mail	06.01.2009
Lai, July	F's QA Section Mgr.	E-mail	22.05.2009
Lai, July	F's QA Section Mgr.	E-mail	03.06.2009
Cheng, Jack	F's Account Mgr.	E-mail	16.06.2009

* These were computer-assisted telephone interviews.

APPENDIX 2

Interview guide

Objective

Extant literature has revealed that managing business relationships not only produces dynamics (both stability and change) in a business network but also determines a firm's competitive advantage is this network in which it is embedded. This research aims to gain a deep understanding of the dynamics of a business net (the subset of a network) in a technology-intensive setting, especially when the emergence of a new technological generation takes place. In order to understand how a business actor copes with technological change, a particular attention is focused on the actor's cooperative relationships.

Remark: All information provided is only for academic purposes and the data will be treated in confidentiality.

Questions

In order to address our research enquiries, we develop the following questions that cover the issues from the firm level, interfirm level and industry (or network) level. (*Note: All information will be treated as confidentiality and only for academic purpose*).

Firm-level questions

- Please describe your company's SWOT (strength, weakness, opportunities and weakness) in the optical recording media industry.
- Please describe your company's position and role in this industry. Any changes after arrival of technological change (e.g. from CD-R to DVD-/+R)? In what aspects? (May require the research to explain the difference between position and role)
- Other information (e.g. organisational structure, number of employees)

Interfirm-level questions

- What are your criteria of selecting a business partner? (e.g. supplier)
- What are key factors in maintaining a business relationship?
- Did you encounter any conflicts with your partner? What are they? (Please describe in detail, e.g. how conflicts are resolved)
- Did you need to acquire new resources (e.g. materials or equipment) or skills from other companies in order to cope with technological change? (Or did technological change or the emergence of a mainstream technology render your firm's capabilities obsolete?)
- When technological change took place, did you adjust your customer and supplier portfolios?
- In your views, what are company F's advantages and disadvantages?

Industry-level questions

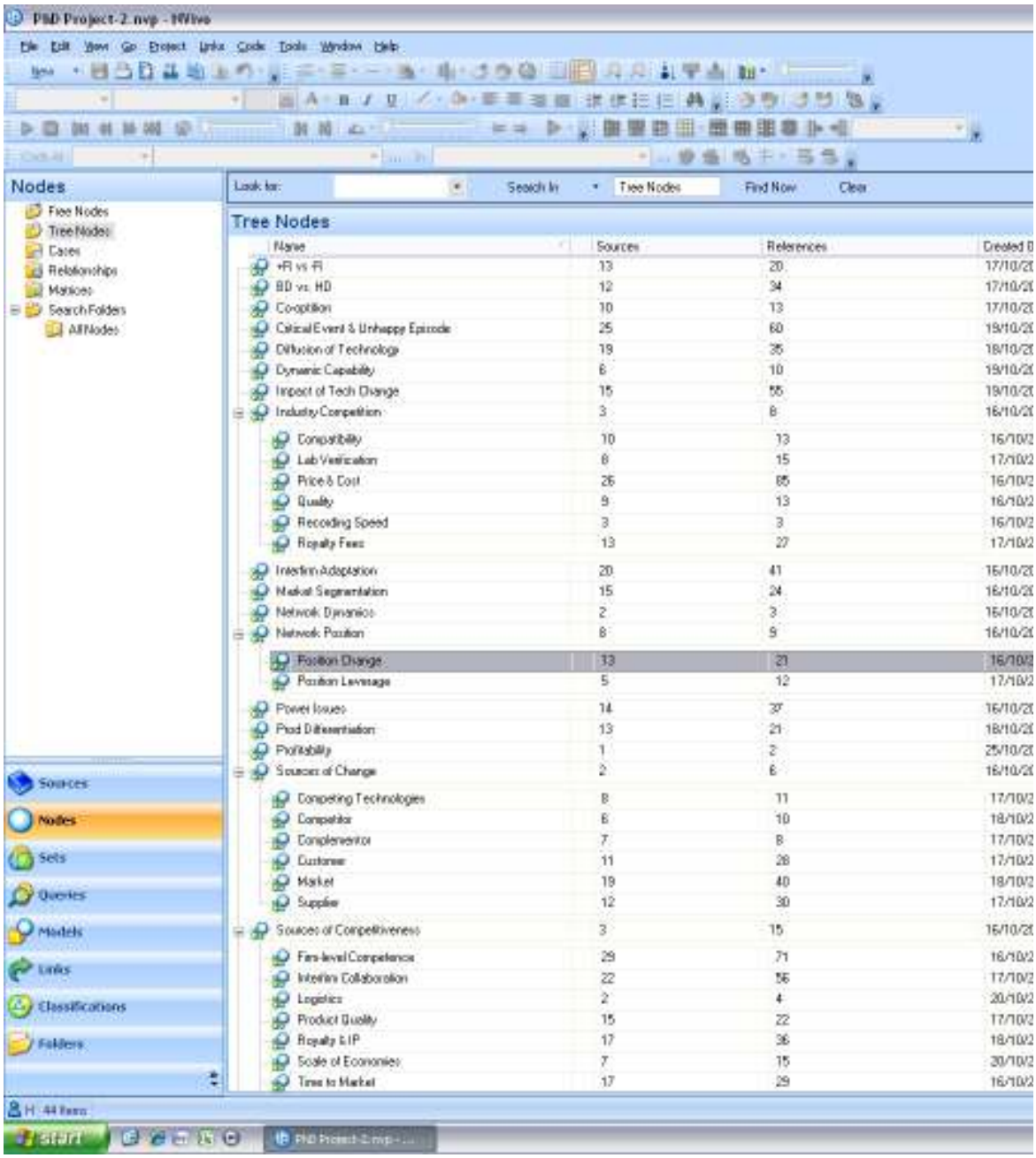
- What is the focus of competition in the optical recording media industry?
- Did this focus remain the same when a technological generation shifted?
- With what capabilities should a firm be equipped so as to stay competitive in this rapidly changing environment?
- How do you view company F's cooperation with your competitor?

Format Competition

- Please offer your views on these format wars: VHS vs. Beta, DVD-R vs. DVD+R, and HD DVD vs. Blu-ray DVD.
- Unlike the competition between HD DVD and Blu-ray DVD, why DVD-R and DVD+R are able to co-exist in the industry?

APPEXDIX 3

Codes and themes developed in QSR software NVivo 7



APPENDIX 4

Significant episodes in the optical recording media industry

Note: Most of company names are not revealed, in order to ensure confidentiality

Year	Month	Episode
1988	Dec	Company F established
1990		CD-R specification (orange book) was created by Philips and Sony
		Company F produced first CD in Taiwan
1991		Company C1 volume-produced CD-R
1996	Apr	Company F IPO
1997		Debut of CD-R recorder in the market
	Mar	First CD-RW drive by Company C2 (office equipment giant)
	Aug	DVD Forum commenced
1998		Company F as principle member of DVD Forum
1999	?	F joint-venture with a consumer electronic giant based in Netherlands
	Mar	D1's mother company set up IT Corporation
	Aug	F strategically allied with C2 for CD-R/RW businesses
2000	Jan	F acquired two small and medium sized media makers
	Oct	Yamaha launched 16x CD-R for its branded drive
2001	Jan	C1 decided to cease its CD-R production based in Europe
	Mar	Seven leading companies tuned up DVD+RW format products
	Jul	F recruited a new vice president
	Aug	Company S3 established
	Nov	Company R2 acquired C1's and C4's production equipment
2002	Jan	F expanded prod capacity in Europe for anti-dumping issue
	Feb	DVD+RW Alliance established
		Verbatim (a technology vendor) announced 2.4x DVD+R
	Mar	F recruited a new marketing head (Deputy General Manager)
	July	S1 announced certified 48x CD-R (from key drive makers)
	Aug	DVD+RW Alliance announced spec of DVD+R 4X
	Sep	Pioneer announced the first DVD recorder/burner
	Nov	S1 announced 52X CD-R dye solution
2003	?	F viewed 2003 as DVD-R Era
	Mar	F's DVD+RW 4X disc approved by C2 (a format leader)
		F's DVD-R 8X under evaluation by DVD Forum Working Group (WG6)
	Jun	Mitsui (a Japan-based media maker) quitted from the industry
	Sep	F acquired orders of DVD+R 8X from C2
		F launched its own branded 52X CD-R

	Nov	F continued restructuring production-sales activities
2004	Jan	C3 announced its patented, organic dye (1X-16X)
	Jul	DVD 16X drive/recorders available at the market
	Aug	C1 dissolved its Hong Kong subsidiary
	Sep	F set up a branch in Japan
	Oct	F succeeded in developing advanced dyes for DVD+R DL (double layer)
	Nov	C2 discontinued its drive component business
	Dec	S1 launched new generation of DVD dye solution (for DVD-/+R)
		C2 announced 16x DVD+R media
2005	Jan	C2 marketed its branded media to retailers
	Apr	F ended CD-R production in Europe (shifted equipment to Vietnam)
	May	C2 signed OEM & Technology Transfer (DVD+R/RW DL) deal with F
	Jun	Nan Ya Plastics Corporation (NPC) terminated media production
	Aug	Postech Corp, a third-tier maker, auctioned its CD-R equipment
	End	C1 reorganized Chikumagawa (Nagano, Japan) plant
2006	Jan	F's DVD+R DL 8X got approved
	Mar	C2 began shipping BD-R (Blu-ray recordable) media
		C5 started selling HD DVD players, ahead of BD machines
	Apr	DVD+RW Alliance released 12X/16X DVD+R DL spec
	May	C2 shut down EU production (completely withdraw from media prod)
	Jul	F began shipping C3-patented media
	Nov	F signed ODM (original design manufacturing) contract with C6, a Japanese-based technology vendor
2007	?	F established its branch in North Africa
	Jan	Memorex (a media brand) was acquired
	Mar	C2 announced the world's first 16X DVD+R Double Layer
	May	F received certificate of HD DVD-R/RW
	June	F got DVD DL 16X certified
	Jul	C1's brand business acquired by a US-based technology vendor
	Aug	F's HD DVD 2X media approved
	Sep	F gained orders from C5 for HD DVD 2X
	Oct	F co-marketing with C5 for HD DVD
	Nov	C1 called for OEM partners (US OEM business, Blu-ray discs)
	Dec	F was able to volume produce DVD+R DL 16X
2008	Feb	Toshiba gave up on HD DVD, end high-definition format war
		Taiwanese makers invested in blank BD disc
	Aug	F expanded its BD-R production capacity
2009	Feb	R2 acquired BD orders from C4