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Satu Pätäri

ON VALUE CREATION AT AN INDUSTRIAL INTERSECTION – BIOENERGY IN THE FOREST AND ENERGY SECTORS

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ABSTRACT

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The traditional forest industry is a good example of the changing nature of the competitive environment in many industries. Faced with drastic challenges forest-industry companies are forced to search for new value-creating strategies in order to create competitive advantage. The emerging bioenergy business is now offering promising avenues for value creation for both the forest and energy sectors because of their complementary resources and knowledge with respect to bioenergy production from forest-based biomass.

The key objective of this dissertation is to examine the sources of sustainable competitive advantage and the value-creation opportunities that are emerging at the intersection between the forest and energy industries. The research topic is considered from different perspectives in order to provide a comprehensive view of the phenomenon. The study discusses the business opportunities that are related to producing bioenergy from forest-based biomass, and sheds light on the greatest challenges and threats influencing the success of collaboration between the forest and energy sectors. In addition, it identifies existing and potential bioenergy actors, and considers the resources and capabilities needed in order to prosper in the bioenergy field. The value-creation perspective is founded on strategic management accounting, the theoretical frameworks are adopted from the field of strategic management, and the future aspect is taken into account through the application of futures studies research methodology.

This thesis consists of two parts. The first part provides a synthesis of the overall dissertation, and the second part comprises four complementary research papers. The research setting is explorative in nature, and both qualitative and quantitative research methods are used. As a result, the thesis lays the foundation for non-technological studies on bioenergy. It gives an example of how to study new value-creation opportunities at an industrial intersection, and discusses the main determinants affecting the value-creation process. In order to accomplish these objectives the phenomenon of value creation at the intersection between the forest and energy industries is theorized and connected with the dynamic resource-based view of the firm.

Keywords: Value creation, competitive advantage, strategy, bioenergy, forest industry, energy industry

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Lappeenranta, November 2009

Satu Pätäri

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PART II: PUBLICATIONS

1. Pätäri, Satu; Jantunen, Ari; and Sandström, Jaana (2008) Creating value with forest-based biomass – traditional industries seeking new business opportunities. In M.H. Sherif, T.M. Khalil (eds.): Management of Technology Innovation and Value Creation, Selected Papers from the 16th International Conference on Management of Technology, World Scientific Publishing Company Pte. Ltd.

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3. Pätäri, Satu; Puumalainen, Kaisu; Jantunen, Ari; and Sandström, Jaana (forthcoming) The interface of the energy and forest sectors – potential players in the bioenergy business. To be published in the International Journal of Production Economics

4. Pätäri, Satu (forthcoming) Profiting from inter-firm relations – a study in the evolving bioenergy industry. To be published in the International Journal of Business Environment

Satu Pätäri's contribution in the publications:

1. Made the research plan together with the co-authors. Collected and analyzed the data. Wrote most of the paper. Was mainly responsible for revising the paper during the book review process.

2. Sole author.

3. Made the research plan together with the co-authors. Collected and analyzed the data. Wrote most of the paper. Was mainly responsible for revising the paper during the journal review process.

4. Sole author.

PART I: OVERVIEW OF THE DISSERTATION

1 INTRODUCTION

1.1 Background of the study

Traditional sources of competitive advantage are no longer efficient in environments in which increasing uncertainty and the rapid speed of change have replaced stability. In many industries ongoing globalization and technological development are redefining the basis of strategic thinking and competitive advantage. This increasing dynamism is manifested in shortening product life cycles, fast-changing customer preferences, accelerating and new forms of competition, as well as the emergence of new technologies and new avenues for adding customer value (Dreyer and Grønhaug, 2004; Lei and Slocum, 2002). If firms are to build and sustain competitive advantage in this more uncertain environment they must shift the traditional focus from economies of scale and property-based resources to knowledge-based resources, flexible learning, and rapid adaptation (Dreyer and Grønhaug, 2004; Lei and Slocum, 2002; Miller and Shamsie, 1996).

The traditional forest industry is a good example of the changing competitive environment. In an era of globalization and the emergence of new markets the industry is contending with significant overcapacity due to low demand, increasing competition from low-cost global producers, downward pressure on the prices of paper products, increasing prices of the most important input factors, growing shareholder expectations and changing customer preferences, novel substitutes introduced in the markets, and a lack of capital with which to confront these challenges (Clement, 2001; Ghosal and Nair-Reichert, 2009; Pätäri, Kyläheiko and Sandström, 2009; Shaw, 2005, 2006; Toivanen, 2004). As a result of this new economic environment and increased competitive pressures many firms in the pulp and paper industry (PPI) are struggling with poor financial performance.

The recent developments in global PPI companies are illustrated in Figure 1, which groups the largest companies according to their value-creation capability. The horizontal axis depicts whether the value has been created or destroyed and the vertical axis shows how efficiently it has been created or destroyed. Interestingly, the majority

of companies have a lower return on invested capital (ROIC) than the weighted average cost of capital (WACC), and could therefore be described as value destroyers (Tapper, 2006; see also Pätäri et al., 2009).

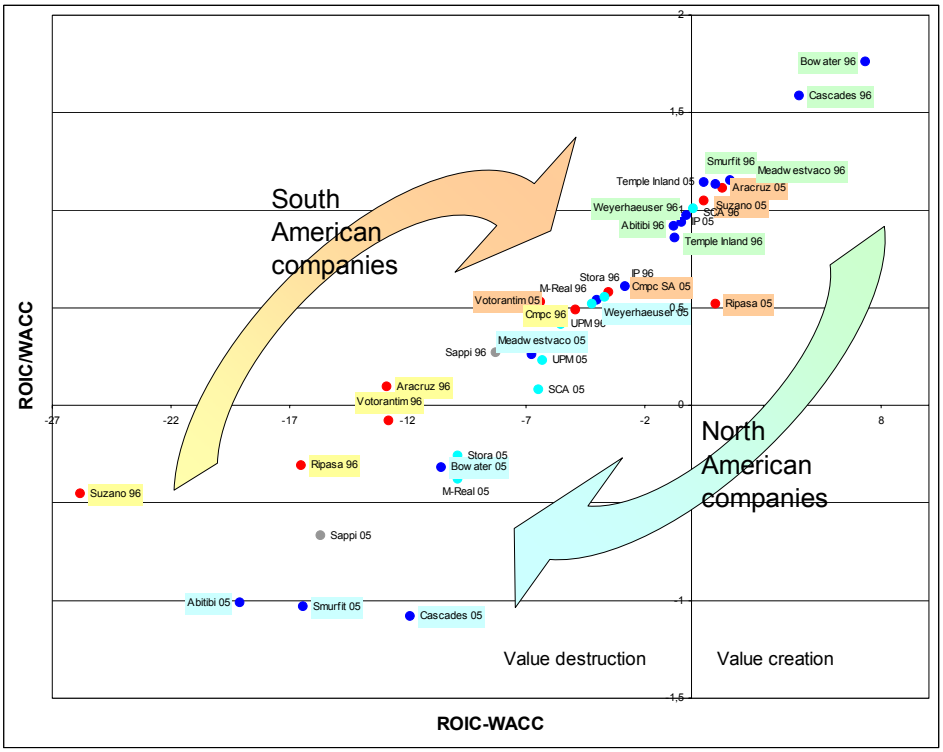

Figure 1: The shift in dynamics in the pulp and paper industry during 1996-2005 (Tapper, 2006; see also Pätäri et al., 2009)

Figure 1 also clearly shows the shift in value creation due to the change in the industry dynamics. As the 21st century begins the North American companies are destroying their value whereas the South American companies have become more successful in value creation. The main reasons for this reversal include the availability of dramatically cost-efficient pulp raw material, i.e. eucalyptus. Although many PPI companies are struggling, there are still high performers such as Kimberly Clark (excluded from Figure 1 as an extremely efficient outlier). What is typical of such successful companies is that they have taken distance from old business models and have focused strictly on unique, customer-oriented strategies. It thus seems that

traditional sources of competitive advantage are really losing their strength (Pätäri et al., 2009).

Another major issue industries are confronted with today relates to the discussion on global climate change, which calls for the increased use of renewable energy sources. In particular, the Kyoto Protocol and concerns about increasing greenhouse gas (GHG) emissions from fossil fuels have made renewable energy sources even more of a strategic resource. Vast forest resources covering about 30 per cent of the world's land area nevertheless offer the PPI a potential platform for developing novel value-creating strategies, and especially in terms of producing renewable energy from forest-based biomass the opportunities are vast. Exploitation of this emergent business opportunity will require the knowledge and resources of multiple actors, including the energy industry's know-how about producing energy from various raw-material bases and distributing it to the markets (López-Gamero, Molina-Azorín and Claver-Cortés, 2009; Pätäri et al., 2009; Rodden, 2008). Building on these thoughts, this particular study focuses on the determinants of value creation in the context of the bioenergy sector, which is emerging at the interface between the forest and energy industries (see Figure 2). *Bioenergy* is defined in this study as renewable energy derived from biomass, and in particular from forest- or wood-based biomass. *Bioenergy products* thus comprise bioenergy (e.g., heat and power) and biofuels (e.g., ethanol).

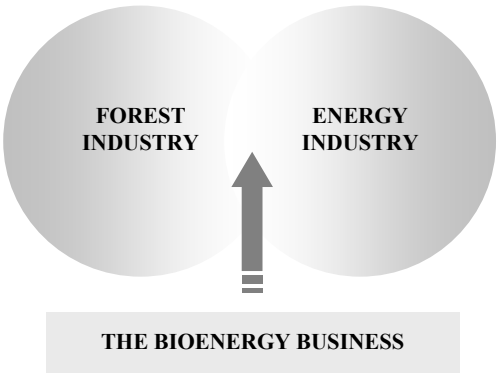

Figure 2: The emergent forest energy business

This thesis explores the novel business opportunities related to biomass-for-energy in terms of *what* they are and *how* forest and energy companies could exploit them. One of

the underlying premises is that the significant changes within the competitive environments of industries – which in this context relates to the 'hype' around bioenergy – are important because they carry the potential for a radical transformation within industry structures, and open up opportunities to new entrants and competitors (see Lei and Slocum, 2002).

1.2 The focus and positioning of the study

The research topic of this thesis is value creation at the intersection of the forest and energy industries. The special focus is on the emergent forest-based biomass for bioenergy business. In general, global interest in renewable energy has grown markedly in response to concerns about increasing greenhouse gas emissions from fossil fuels, and price and availability problems related to non-renewable energy sources (de Vries, van Vuuren and Hoogwijk, 2007). Naturally, the 1997 Kyoto Protocol[1] and the more recent '20 20 by 2020' rule set by the European Commission[2] have fuelled the interest of many parties in renewable energy sources and especially in biomass, which is expected to play a key role in the fight against climate change (Berndes and Hansson, 2007; Ericsson et al., 2004; European Commission, 2008; UNFCC, 1998).

Despite this extensive 'hype' that is surrounding bioenergy, studies related to forest-based biorefining have mainly been technological in nature, apart from a few recent exceptions (see e.g., Söderholm and Lundmark, 2009). A great deal of research has thus focused on developing processes and technologies for the conversion of biomass into various types of bioproducts (see e.g., Saxena, Adhikari and Goyal, 2009). Within the research pertaining to the whole of the forest industry or forestry the perspectives have naturally gone beyond the technological, but within this new biorefining field the studies have been mostly technologically focused.

[1] The Kyoto Protocol calls for the industrialized countries to reduce their overall GHG by at least 5.2 per cent below their 1990 levels by the years 2008–2012 (UNFCC, 1998).

[2] The '20 20 by 2020' rule set by the European Council in 2007 has two key targets: (1) to reduce GHG by at least 20 per cent, and (2) to have a 20-per-cent share of renewable energies in the energy consumption of the European Union by 2020 (European Commission, 2008).

In terms of the research on forest industries in general the main emphasis has been on *external* factors, on which firms have only limited influence. Therefore scholars working within the industrial organization (IO) economics tradition have largely focused on the competitive strategies of the companies and on how a firm can position and differentiate itself within the industry. Consequently, studies linked to the forest industry have largely neglected the influence of the firm (e.g., *internal* resources and capabilities as well as knowledge and learning) in gaining and sustaining competitive advantage, although this has attracted a lot of interest in the general management literature. Furthermore, empirical evidence is largely lacking with regard to the linkages between the strategic choices and resource usage of forest-industry firms and their financial performance (e.g., Bonsi, Gnyawali and Hammett, 2008; Bull and Ferguson, 2006; Lähtinen, 2009).

More recently, however, researchers have begun to narrow these research gaps by exploring the forest industry from the perspective of the resource-based approach. The few existing studies include Bonsi et al. (2008), Bull and Ferguson (2006), Korhonen and Niemelä (2005), and Lähtinen (2009). Furthermore, the poor performance of forest firms and the increasing global competition has led to a resurgence of studies focusing on innovation and entrepreneurship (see e.g., Hansen et al., 2006; Korhonen, 2006).

In sum, what is common to many studies that are specifically related to the bioenergy field is, first, that they are often technology-dominated and do not focus on the resource-based analysis of the new emergent business opportunity. Secondly, they dot not focus on identifying the actors within the field or expose the companies and their strategies in more detail. In other words, there seems to be a research gap between the existing studies pertaining to forest energy business and more theoretically based research focusing on the interplay between firm-specific capabilities and competitive success. There is also a lack of research identifying actors within the forest industry, which would shed more light on the strategies of these companies. The current study represents an attempt to reduce these identified research gaps (see Figure 3).

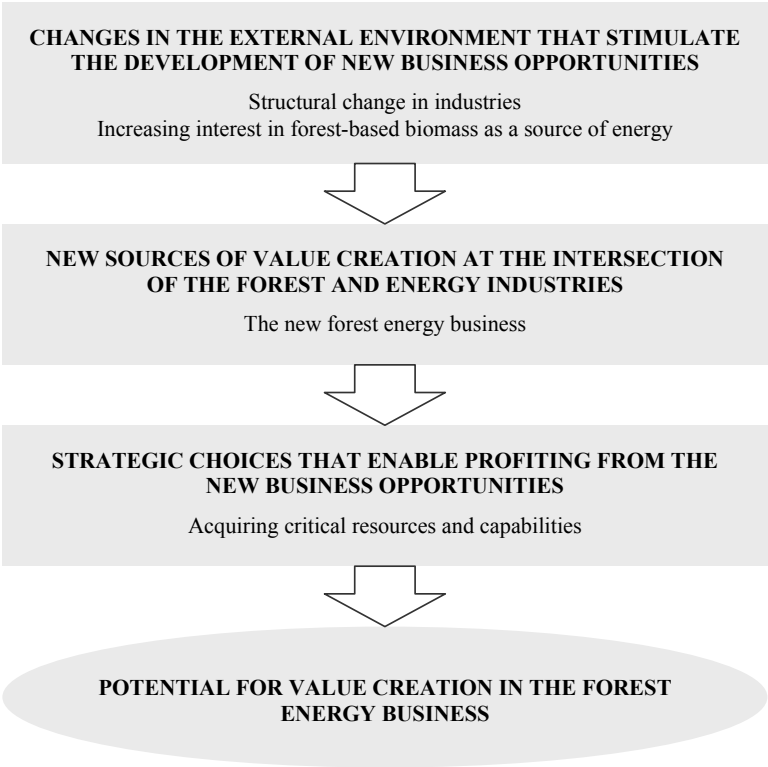

Figure 3: Research focus

By way of theoretical background the emphasis is on the impact of firm-specific resources, capabilities and knowledge in gaining and sustaining competitive advantage[3]. In addition, the study highlights the interplay between the organization's knowledge and capabilities and the environmental opportunities that are arising at the intersection of existing industries. Another key premise is that the exploitation of the new opportunities requires knowledge and resources from multiple experts. Building new sources of competitive advantage is thus becoming increasingly difficult for any single firm, and the thesis therefore examines value creation through collaboration between the forest and energy sectors.

[3] As explained later on, this study adopts a broad definition of resources: the resource base of a firm is seen to comprise tangible and intangible assets, resources, capabilities, and knowledge (Barney, 1991; Helfat et al., 2007).

There is no attempt in this research to develop theories, however. The setting is rather explorative in nature, the aim being to enhance understanding of the new industrial sector and of the new sources of competitive advantage that are emerging between industries. In order to accomplish these objectives and to gain as comprehensive an understanding of the research subject as possible, the theoretical framework of strategic management is adopted. It is a field that is largely concerned with understanding the sources of sustained competitive advantage that are increasingly to be found in knowledge and intellectual capital, and in the organizational and strategic processes through which managers manipulate resources into new productive assets (Ambrosini and Bowman, 2009; Barney, 1991; Galunic and Eisenhardt, 2001; Long and Vickers-Koch, 1995; Lubit, 2001). Another key feature of this thesis is that it applies mixed research methods, complementing futures studies with tools from strategy research. The context in which the research is positioned to is depicted in Figure 4.

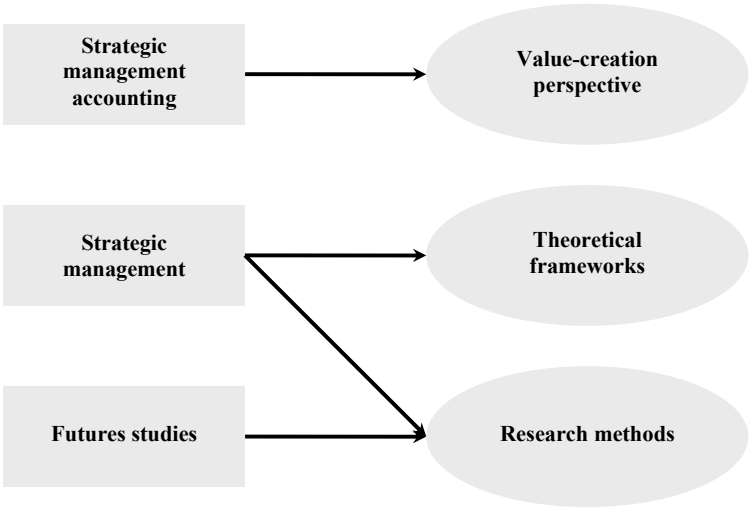

Figure 4: Research context

As Figure 4 indicates, the background of this study, i.e. the value-creation perspective, lies in the literature on strategic management accounting. Value creation refers here to increasing the competitive success and business performance of organizations within the forest-based biomass for bioenergy business. In other words, value creation with forest-based biomass is seen as a new potential source of competitive success for forest as well as for energy companies. Secondly, the theoretical frameworks are drawn mainly from

the literature on strategy research, and the underlying approach adopted is the resource-based view (RBV) of the firm, complemented with the dynamic capabilities approach. The thesis also exploits methods originating from strategy research, including analyses of strategic groups and strategic alliances. Finally, given the future-oriented aspect of the research topic futures studies methodology is applied, namely the Delphi study, in order to shed more light on the phenomenon.

In sum, this study draws on three disciplines: the background and value-creation perspective originate from the literature on strategic management accounting, the theoretical frameworks are adapted from the field of strategic management, and the future aspect is taken into account with reference to futures studies. The strategic perspective is thus used to address the emergence, nature and potential of new value-creating business opportunities.

1.3 Research objectives

The purpose of the thesis is to explore sources of sustainable competitive advantage and the value-creation opportunities that are arising at the interface between industries. Thus, the key objective is to study the evolving bioenergy value chain and to identify the forest and energy sectors' potential roles in it. In simple terms, the key operations in the emergent bioenergy value chain are biomass *collection* (i.e., procurement and the logistics involved in getting pulp-wood and fuel-wood from the forests to the mills), *production* (i.e., processing forest-based biomass into novel bioenergy products together with more conventional pulp and paper products), and *distribution* (i.e., delivering the various products of the forest biorefineries to end-users). The players involved in this chain are numerous, including owners of forest land, entrepreneurs involved in the procurement and transportation of raw material, the forest, energy and other industries, and suppliers of end-products to the markets (see e.g., TEKES, 2008). However, in this study the value chain is studied mainly from the perspectives of the forest and energy industries.

Following the industry-level analysis is a deeper examination of the actors and the resources and capabilities they need in order to prosper in the ever-more dynamic and

networked economy. Overall, the study aims at providing a comprehensive view of a phenomenon that is just emerging between the forest and energy industries. It adopts different research methods and data sets, and assesses their usefulness in studying value creation from a strategic perspective. This methodological triangulation was adopted due to the explorative nature of the research. The research perspective is primarily that of Finland and Europe, although global trends are also acknowledged. The main research question is as follows:

> *How can value be captured in the forest-based bioenergy business, and what are the determinants of value creation?*

In order to increase understanding of the value-creation opportunities and the determinants affecting the value-creation potential, this research question is addressed through the following four sub-questions:

> *Q1: What kinds of business opportunities are arising at the interface of the forest and energy sectors?*

This first sub-question was formulated in order to enhance understanding of the emergent bioenergy sector, and to discuss the business opportunities related to producing bioenergy from forest-based biomass from the perspective of the forest and energy industries. A further aim is to shed light on the greatest challenges and threats that influence the success of collaboration between the forest and energy sectors.

> *Q2: What are the industry- and company-level factors that affect the bioenergy business?*

The aim in this sub-question is to identify the key industry- and company-level factors that are most likely to influence the forest energy business, its value-creation potential, and the forest and energy sectors' future roles in it. The emphasis is on both the internal company processes and characteristics and the external industry structures and companies' competitive positions, the idea being to form a comprehensive view of the factors influencing value creation in the forest and energy industries.

Q3: Who are the actors that operate in the bioenergy field, and which ones hold the potential to operate there in the future?

The third sub-question helps to shift the focus to the actors that are currently operating in the bioenergy field and to those with the potential for conducting business in the future. The objective is to provide a strategic group analysis of the most focal, existing bioenergy actors and of the traditional forest and energy companies. This will familiarize interested parties with the potential players in the bioenergy sector and with the patterns of competition in each industrial field.

Q4: How active is the alliance formation among the forest, energy and bioenergy actors?

The final sub-question brings into the picture the cooperation activity that (1) is taking place between the forest and energy sectors who hold fruitful premises for joint efforts in the bioenergy field, and (2) is related to bioenergy but is taking place outside the forest and energy industries. The aim is to identify the nature of the firms that have entered into bioenergy-driven alliances, and in particular to examine whether forest and energy companies have already taken advantage of this opportunity.

The research focuses and key determinants explaining value creation are summarized in Figure 5.

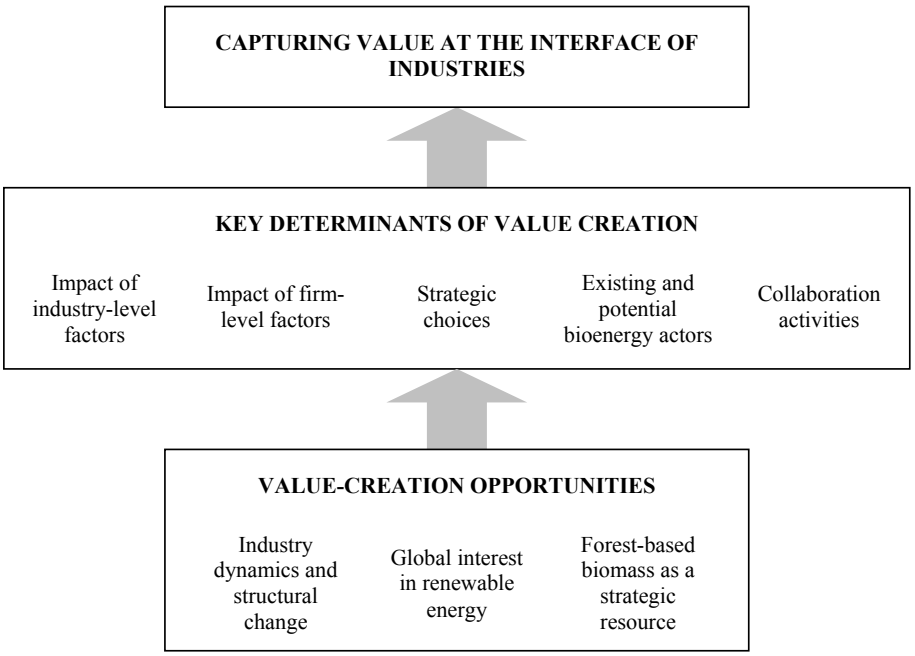

Figure 5: Outline of the study

1.4 Outline

This thesis consists of two parts. The aim in this first part, namely an overview of the dissertation, is to give a synthesis of the entire work. It comprises five chapters, this first one being an introduction that identifies the background, the motivation, the focus and positioning of the study as well as the research objectives. Chapter 2, which covers the theoretical premises of value creation at the intersection of industries, presents the theoretical discussion to which this dissertation will contribute, and synthesizes the theoretical approaches on which it builds. Chapter 3 presents the research design and methods applied in the four research publications, and Chapter 4 reviews the research papers and their key findings. Chapter 5 concludes the study with a discussion of the theoretical, methodological and managerial contributions, as well as the limitations, and suggestions for future research. The second part comprises four complementary research papers that address the research questions presented above.

2 THE THEORETICAL PREMISES OF VALUE CREATION WITHIN INDUSTRIES

2.1 Industry transformation and new sources of value creation

The field of strategic management is largely concerned with understanding the sources of sustained competitive advantage (Ambrosini and Bowman, 2009; Barney, 1991). The rise of the information-based, knowledge-driven, service-intensive economy is, however, rapidly redefining the basis of strategic thinking and the nature of competition in many industries. Companies can no longer assume that previous business models and methods of organizing – which have been based largely on efficiency and control – will be sufficient in building or sustaining competitive advantage in the future. Instead, the emphasis must be on responsiveness, flexibility, creativity and timing to facilitate rapid adaptation to changing competitive conditions (see e.g., Bartlett and Ghoshal, 2002; Bate and Johnston, 2005; Bettis and Hitt, 1995; Dreyer and Grønhaug, 2004; Galunic and Eisenhardt, 2001; Lei and Slocum, 2002; Lei, Slocum and Pitts, 1999). The basis of competition in the industries must change through the invention of totally novel industries or the dramatic reinvention of the existing ones (Hamel, 1998).

In other words, the key to sustainable competitive advantage is increasingly to be found in knowledge and intellectual capital, and in the organizational and strategic processes through which managers convert resources into new productive assets (Galunic and Eisenhardt, 2001; Long and Vickers-Koch, 1995; Lubit, 2001). Thus, *dynamic capabilities* are essential within this context (Galunic and Eisenhardt, 2001). According to Teece, Pisano and Shuen (1997), the dynamic capabilities approach has evolved in order to facilitate understanding of the sources and methods of value creation used by companies in environments of rapid (technological) change, and it stresses the ability to adapt, integrate and reconfigure internal and external organizational skills, resources and competences in order to achieve congruence with the changing business environment. Although the need for organizational innovation and renewal is increasingly important in the current fast-changing business environment, these issues have interested scholars since Joseph Schumpeter coined the notion of creative

destruction in his pioneering work from 1942 (see e.g., Danneels, 2002; Kim and Pennings, 2009).

These changes in the determinants of value creation have made adaptation to the environment more difficult in many industries. However, globalization and the structural changes taking place within industries are also opening up many novel business opportunities (Hamel, 1998). For instance, the global climate challenge may be a major catalyst for new business opportunities (Hart and Milstein, 1999; Shepard, 1999; see also Bonifant, Arnold and Long, 1995). In order thereby to create value firms must be able to react to the changes. This requires active scanning and profound understanding of the competitive landscape in which the new opportunities arise. In other words, firms must rethink themselves, their industry, their competitors and customers, and their capabilities, and find a way of matching their capabilities with the external environment in order to build competitive advantage in accordance with the new business models and strategies (Bate and Johnston, 2005; Hamel, 1998; Macmillan and Tampoe, 2001; Xiang and Formica, 2007).

According to Macmillan and Tampoe (2001), general analysis of the external environment could be considered on three broad levels: general changes in the business environment, changes within the industry, and the known activities of immediate competitors and other specific events. A variety of frameworks and analytical tools has been developed for this purpose, one of the most general approaches being the analysis of political, economic, social and technological changes (so-called PEST analysis) (Bartlett and Ghoshal, 1991; Macmillan and Tampoe, 2001). Nevertheless, the *industry structure* is considered to play a vital role in characterizing and operationalizing the external environment, although it incorporates many other aspects (Bartlett and Ghoshal, 1991). According to Bettis and Hitt (1995), it is imperative to quickly detect changes in the industry that may ensue from strategic alliances between competitors and announcements of new technology or innovative products, for instance. Such changes have immediate implications for competition and thus require appropriate measures as soon as possible.

The focus on industry as the dominant unit of analysis originates from the structure-conduct-performance (SCP) paradigm (also known as the Bain/Mason paradigm) and

Porter's influential work within the field of industrial organization economics (Barney, 1991; Galbreath and Galvin, 2008; Hoskisson et al., 1999). IO scholars typically assume that a firm's performance depends on its conduct in terms of pricing, R&D and investment policies, for instance, which in turn depend on structural industry characteristics such as concentration, entry barriers, growth and the life cycle (Caloghirou et al., 2004). Perhaps the most well known framework within the IO economics perspective, namely the 'competitive forces approach' developed by Porter (1980, 1985), explains how the industry structure determines the performance potential of firms through five structural forces driving the competition. The analytical framework also identifies three broad strategies (i.e., differentiation, cost leadership, and focus) for achieving competitive advantage, and facilitates competitor analysis. Thus, the structure is assumed to affect the competitive rules of the game and the potential strategies available to the company.

The IO economics perspective also gave rise to the rich body of research on strategic groups within the field of strategic management (Hoskisson et al., 1999; Nath and Gruca, 1997). Although the concept – first developed by Hunt in 1972 – draws on the view that all firms are similar except for size differences and thus should be pursuing one optimal strategy, it now promotes the view that both the industry structure and strategic conduct are determinants of firm performance. In other words, the attractiveness of alternative strategies varies between individual firms in accordance with their resources, competences and positions (Hoskisson et al., 1999; McGee, Thomas and Pruett, 1995; Nath and Gruca, 1997). There are many researchers who consider the theory a useful approach to management research in that it provides very rich and detailed comparison of company strategies within an industry without over-specification (Ketchen and Shook, 1996; Leask and Parker, 2006).

In more general terms, typical strategic research within the IO economics perspective emphasizes how well a firm positions and differentiates itself within an industry, and the focus has been on the analysis of opportunities and threats in its external competitive environment (Barney, 1991; Galbreath and Galvin, 2008; Hoskisson et al., 1999). The research field places little emphasis on firm-specific characteristics, resources and capabilities and their impact in gaining or sustaining competitive advantage (Barney, 1991; Hoskisson et al., 1999), although success requires interplay between the

organization's knowledge and capabilities and its environmental opportunities[4] (Bowman and Hurry, 1993; Burger-Helmchen, 2009; Teece et al., 1997). This requirement to formulate new types of competitive strategies and to build new sources of competitive advantage is becoming increasingly difficult for any single firm, however, because the risks and costs related to novel value-creation opportunities are increasing, and exploitation of the new opportunities requires knowledge and resources from multiple experts. In particular, the development of new strategies may turn out to be more difficult for forest and energy companies because, given the capital-intensive nature of the industries, mistakes may be financially devastating. As a result, value creation through inter-firm collaboration has become increasingly important (see e.g., Todeva and Knoke, 2005).

Companies can exploit such cooperation activities, or strategic alliances as they are usually called[5] (Tsang, 1998), in order to gain access to the critical resources they may not be able to obtain by themselves (Lahiri, Pérez-Nordtvedt and Renn, 2008), or develop quickly enough to meet competitive needs (Capron, Dussauge and Mitchell, 1998). In other words, in order to generate rents from its resources they must in some instances pool them with the complementary resources of another firm (Dyer and Singh, 1998). There has been a dramatic but stable increase in inter-firm cooperation in recent years (Gulati, 1995; Kale and Singh, 2007), which has resulted in increasingly blurred industry boundaries for one thing (Bettis and Hitt, 1995). According to Todeva and Knoke (2005), the spectrum of inter-organizational relations is vast, stemming from pure market transactions to hierarchical authority relations. Strategic alliances thus include joint ventures, joint R&D agreements, technology exchange, direct investment, licensing, and many other arrangements (Gulati, 1995).

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[4] The interplay between a firm's existing resources and capabilities, its investments in the capabilities as well as its perceptions of environmental opportunities is closely related to the concept of *strategic options* (see e.g., Bowman and Hurry, 1993; Kyläheiko and Sandström, 2007). Option thinking offers a useful approach to helping managers in their strategic decision-making in changing environments (Burger-Helmchen, 2009).

[5] In this context strategic alliances are used to reflect all kinds of cooperative arrangements between organizations, although some researchers make a distinction between them and other cooperative relationships (see e.g., Das and Teng, 1998).

In sum, the emergence of a new competitive environment – in which vast amounts of information and knowledge are almost immediately available due to advances in technology – is quickly changing the determinants of value creation in several industries. The sources of competitive advantage are increasingly to be found in the intellectual capital, knowledge and strategic processes with which managers transform resources into novel productive assets. In order to react to the changes and to create sustainable competitive advantage in the future it is imperative for companies actively to scan the competitive landscape and identify emerging business opportunities. In particular, the industry structure plays a vital role in characterizing the external environment. Having identified new value-creation opportunities arising externally they then need to create and renew resources in response. Pooling resources with the complementary resources of another firm, i.e. creating value through collaboration, characterizes the exploitation of the new opportunities. The literature offers many mechanisms through which companies can first identify external business opportunities, and then create and renew the resources needed to generate superior performance. These activities include examining the strategic options and strategic groups, as well as acquisitions, alliance formation and product innovation (Danneels, 2002; Eisenhardt and Martin, 2000). In sum, the emphasis in this study is on the interplay between the companies' external competitive environments, their industry structures, and internal firm-specific factors. In other words, it is suggested that all of these affect value creation at the industrial intersection between the forest and energy industries: the emerging business opportunities can be identified through scanning the competitive landscape and structural changes within the industries. Furthermore, there is a need to create and renew the resource base of the firms in order to respond to these challenges.

2.2 A dynamic resource-based approach to exploiting value-creation opportunities

2.2.1 The resource-based theory

The resource-based view of the firm has its roots in the early development of strategic management, which at the time in the 1960s was known as 'business policy' (Hoskisson et al., 1999; Peteraf, 1993). This research stream focusing on the internal analysis of

firm-specific resources emerged in particular from Edith Penrose's contribution in 1959 to business studies and her representation of the firm as a bundle of resources (Augier and Teece, 2007; Penrose, 1995). The researchers involved argued that a company's success could be solely attributed to its internal and unique competitive resources, and especially to its managerial capacities (Hoskisson et al., 1999; Peteraf, 1993). More recently the RBV has driven researchers to seek a connection between resources and sustainable competitive advantage, and to identify the necessary characteristics of company resources (Hoskisson et al., 1999; Peteraf, 1993). This is a response from contemporary strategic management to the Penrosian line that underplayed questions concerning the basis of competitive advantage and how firms can develop it. In particular, the importance of intangible assets and knowledge assets was not recognized in early theories (of the growth) of the firm (Augier and Teece, 2007).

Over the last 20 years the RBV has achieved a focal position in the field of strategy research (Lockett, Thompson and Morgenstern, 2009), and a growing body of literature highlights the influence of firm-specific factors on firm performance[6] (Amit and Schoemaker, 1993; Teece et al., 1997; see also e.g., Cool and Schendel, 1988; Galbreath and Galvin, 2008; Hansen and Wernerfelt, 1989; Jacobsen, 1988; Rumelt, 1991 for empirical studies). One of the cornerstones of the RBV is that firms within an industry or a group may be heterogeneous in terms of resources that are tied semi-permanently to the firm, and outcome in terms of competitive (dis)advantage is affected by each firm's differing resource endowments and their match with the environmental opportunities. Furthermore, these resources may not be perfectly mobile across firms and are historically determined (Barney, 1991; Helfat and Peteraf, 2003; Lockett et al., 2009; Peteraf, 1993).

In all, resources are the key focus of the RBV (Barney, 1991; Eisenhardt and Martin, 2000). Wernerfelt (1984, p. 60) defines a resource as *"anything which could be thought of as a strength or weakness of a given firm"*. More recent studies on resources suggest that they include the assets, abilities, and competences (i.e., skills, knowledge and

[6] The level of analysis in the field of strategic management shifted strongly in the 1980s. The emphasis in industrial organization economics on the industry as the main unit of analysis and the strategic focus on the firm itself have spawned a number of empirical studies investigating whether performance is driven mainly by firm- or industry-specific factors (Hawawini, Subramanian and Verdin, 2003).

information) that enable the firm to conceive of and implement unique value-creating strategies in order to create competitive advantage (Barney, 1991; Eisenhardt and Martin, 2000). Some scholars distinguish between fully appropriable and less tangible resources, or view resources as either static or dynamic (see e.g., Lockett and Thompson, 2001; Lockett et al., 2009).

Barney's (1991) classification of a firm's resources in three categories takes the different characteristics well into account. The categories include physical capital resources (e.g., specialized production facilities, access to raw materials and geographic location), human capital (e.g., the experience and relationships of individual managers and workers), and organizational capital (e.g., management skills, a formal reporting structure, control and planning systems, as well as a superior sales force) (Barney 1991; Eisenhardt and Martin, 2000; Henri, 2006). In accordance with Barney (1991) and Helfat et al. (2007), this study adopts a broad definition of resources: a firm's resource base comprises the assets, capabilities, activities, attributes, information and knowledge – whether tangible, intangible or human in nature – that enable it to generate rents, i.e. to build competitive advantage.

2.2.2 Identifying valuable resources

In order for resources to become the basis of competitive advantage they must facilitate value creation, be superior relative to those of rivals, and also discourage imitative efforts from rivals (Barney, 1991; Fahy, 2002; Wernerfelt, 1984). Several typologies have been presented in the literature in attempts to understand the nature of advantage-generating resources (Fahy, 2002; see also e.g., Amit and Schoemaker, 1993; Grant, 1991 for the typologies). Barney's (1991) identification of four attributes (so-called VRIN attributes) that a resource must have is perhaps the most well-known and widely adopted categorization. In short, the resource must be simultaneously valuable, rare, inimitable and non-substitutable. According to Bowman and Ambrosini (2007), *valuable* resources are involved in the creation of a product or service that has use value to customers. Barney (1991), for one, defines resources as valuable if they can be used to exploit opportunities and/or neutralize threats in a firm's environment. Secondly, resources are *rare* if their supply is limited or quasi-limited in the factor markets and they are therefore uncommon across competing companies (Bowman and Ambrosini,

2003; Pereraf, 1993). *Inimitability*, in turn, refers to the characteristics of the process through which rivals may try to replicate the resource or accumulate something similar (Dierickx and Cool, 1989; Lockett et al., 2009). Finally, *non-substitutability* implies that one resource cannot be easily replaced by another strategically equivalent valuable resource that is itself neither rare nor inimitable (Barney, 1991; Lockett et al., 2009).

These attributes could be considered indicators of how much potential a firm's resources hold in creating sustainable competitive advantage (Barney, 1991). According to Amit and Schoemaker (1993), this form of identification of key resources is a challenging task for managers, but more useful than, for instance, *ex post* studies that point to some resources that (partly) explain the firm's past performance. Further requirements include the development, protection and deployment of superior resources and capabilities in order to preserve rent-generating resources and thus sustainable competitive advantage. In other words, there must be both *ex ante* and *ex post* limits to competition. In terms of the latter, authors often refer to *isolating mechanisms*[7] (Amit and Schoemaker, 1993; Peteraf, 1993), which include property rights (e.g., patents, copyrights and secrets), quasi-rights (e.g., lags), information asymmetries, frictions, buyer-switching and search costs, and reputation (Peteraf, 1993; Teece, 1986).

The notion of *causal ambiguity* in particular has attracted a lot of interest in the literature (Barney, 1991; Peteraf, 1993). According to Barney (1991), it is one of the key reasons why a firm's resources can be imperfectly imitable. Causal ambiguity exists if the link between the firm's resources and sustainable competitive advantage are unclear, thus making it difficult for rivals to duplicate its successful strategies through imitation (Barney, 1991). It is also possible that strong ambiguity even prevents managers from understanding the linkages between actions and outcomes (see e.g., Reed and DeFillippi, 1990). Inimitability may also be attributable to unique historical conditions and/or social complexity (Barney, 1991).

[7] The firm-level concept of isolating mechanisms has similarities with Caves and Porter's (1977) notion of *mobility barriers* on the industry level. The latter is a generalization of the concept of *entry barriers* devised by Bain in 1956 (see Conner, 1991; Peteraf, 1993). Barriers to entry or mobility exist if current and potential rivals are heterogeneous in terms of their resources, and if these resources are imperfectly mobile (Barney, 1991).

The first one of these, *unique historical conditions*, refers to the firm's history throughout which it has accumulated its unique and heterogeneous set of resources. This historical position may have enabled it to acquire a certain location, for example, which in time has unexpectedly turned into a valuable physical capital resource. The fact that "history matters" deters competitive imitation, and thus resource differences among firms tend to persist over time. Differences especially in intangible organizational assets are considered important. In other words, firms are path-dependent in the sense that their future strategies are dependent upon the current bundle of resources (Barney, 1991; Collis, 1991). *Social complexity* as a source of inimitability means that a firm's informal social relations, such as culture and tradition, which cannot be systematically managed, affect its value-generating resources and thus its competitive advantage. In other words, firms are seen as social organizations that are hard to replicate (Barney, 1991; Wills-Johnson, 2008). According to Barney (1991), the link between socially complex resources and competitive advantage is often identifiable, but because these resources are so complex rivals cannot systematically imitate them.

The literature offers many other categorizations of factors that may impede the imitation of rent-generating resources (see e.g., Collis and Montgomery, 1995; Peteraf, 1993; Wills-Johnson, 2008). For instance, Teece (1986) suggested that the most important dimensions that govern a firm's ability to protect its intellectual property, i.e. its appropriability regime, include the nature of the technology (e.g., tacit, codified) and the efficacy of its legal instruments. Dierickx and Cool (1989) also analyzed the mechanisms that may make superior resources and capabilities costly to copy. These include time compression diseconomies, asset mass efficiencies, interconnectedness of asset stocks, asset erosion, and causal ambiguity. All in all, it is not unusual that intangible resources – which are surrounded by causal ambiguity, historical conditions and social complexity – have the potential to create sustainable competitive advantage (Bonsi et al., 2008).

Despite the significance of the RBV within the strategy literature, the approach has faced criticism mainly due to its methodological and practical limitations (Eisenhardt and Martin, 2000; Lockett et al., 2009). First, it has been accused of being tautological because of its circular reasoning, which posits that competitive advantage is attributable to the firm's unique resources, and its resources are unique because they are utilized by

the firm, which thereby gains competitive advantage (Eisenhardt and Martin, 2000; Lockett et al., 2009; Wills-Johnson, 2008). Second, criticism has been directed towards its conceptual vagueness (Eisenhardt and Martin, 2000; Wills-Johnson, 2008). Third, scholars claim that it does not properly address the question of how and through what mechanisms strategic resources contribute to competitive advantage and firm growth (Eisenhardt and Martin, 2000; Wills-Johnson, 2008). Moreover, resources that are of key concern are often related to organizational learning and knowledge, and on account of their intangible and unobservable nature researchers are often compelled to focus on those that are more easily identifiable and measurable, but less important and interesting (Lockett et al., 2009). Fourth, the RBV may overlook resource interaction because the focus is on some intrinsic properties of individual resources (Wills-Johnson, 2008). Fifth, the basic notion that firms are unique in their resource bundles makes it difficult to draw meaningful conclusions about the impact of resources on competitive advantage across a sample of firms (Lockett et al., 2009). Sixth, scholars need to equate a firm's performance with the unobservable concept of competitive advantage in empirical tests (Lockett et al., 2009). Seventh, the RBV has not focused on how firms can change their valuable resources over time to respond to shifts in the competitive landscape (Ambrosini and Bowman, 2009; Eisenhardt and Martin, 2000), and sustainable competitive advantage has therefore been considered likely only in stable environments (Eisenhardt and Martin, 2000).

2.2.3 Managing the resource base with dynamic capabilities

The standard resource-based view has thus emphasized that the *possession* of resources with VRIN attributes creates and sustains competitive advantage. However, increasing emphasis has been given to the *exploitation* of such resources, thus superseding the static view according to which some firms are able to generate superior performance in a state of equilibrium (Ambrosini and Bowman, 2009; Newbert, Gopalakrishnan and Kirchhoff, 2008). This has led to the development of the dynamic-capabilities approach, which concerns how strategic resources can be created and reconfigured in order to achieve congruence with the changing business environment. In essence, this is an

extension to the RBV[8] in that it shares similar basic assumptions. It acknowledges that firms are collections of historically determined, heterogeneous resources (Ambrosini and Bowman, 2009; Augier and Teece, 2007; Eisenhardt and Martin, 2000; Winter, 2003), but contrary to the RBV it stresses learning and the firm's ability to build, integrate and reconfigure internal and external organizational skills, resources, and competences.[9] It thus facilitates understanding of the sources and methods of value creation, especially in environments of rapid (technological) change (Teece et al., 1997).

The dynamic-capabilities approach builds on the premise that a resource-based strategy, although protected by isolating mechanisms, is often not enough to sustain superior competitive advantage: what is further required is the exploitation of existing capabilities and the development of new ones in response to changes in the business environment (Eisenhardt and Martin, 2000; Teece et al., 1997; Winter, 2003). In other words, the resource base must be purposefully created, extended and/or modified, and this capacity is referred to as a dynamic capability (Helfat et al., 2007). Following Leonard-Barton (1992), Teece et al. (1997, p. 516), who coined the notion in the 1990s, define dynamic capabilities as *"the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments"*. There are many other explications of dynamic capabilities in the literature complementing Teece et al.'s (1997) original definition (see e.g., Eisenhardt and Martin, 2000; Helfat and Peteraf, 2003; Zollo and Winter, 2002). Despite the variation, however, authors generally view the concept similarly. Other typical characteristics of dynamic capabilities are that they are path-dependent, built instead of bought, and embedded in the firm (Ambrosini and Bowman, 2009).

[8] The RBV has branched out into several fields in addition to the dynamic-capability approach since its advent. The most significant of these include the core-competency approach, the knowledge-based theory of the firm, and strategic leadership (Ambrosini and Bowman, 2009; Hoskisson et al., 1999; Wills-Johnson, 2008).

[9] See Bowman and Ambrosini (2003) for a detailed description of the processes comprising dynamic capabilities. They categorize assets and resource-creation possibilities as reconfiguration, leveraging, learning, and integration.

The literature also recognizes different levels of capability, which allows the differentiation of dynamic capabilities from ordinary or operating capabilities (see Ambrosini and Bowman, 2009; Collis, 1994; Winter, 2003). Collis' (1994) first category and Winter's (2003) zero-level or ordinary capabilities refer to the existing resource base that enables the firm to operate in the present. On the next level are future-oriented dynamic capabilities, which are used to modify existing capabilities. Finally, higher-order or meta-capabilities include learning-to-learn capabilities, which allow renewal of the dynamic capabilities on the lower levels (Ambrosini and Bowman, 2009; Collis, 1994; Winter, 2003).

Unlike resources, effective dynamic capabilities may have commonalities across firms in terms of key features. This 'best practice' implies that companies may start the development of some particular capabilities from different points and follow different paths, and still end up with a rather homogeneous set. This does not stop each dynamic capability from being path-dependent and having its specifics, but it does imply that they are not in themselves a source of long-term superior performance. Within this framework the creation of valuable resource configurations assumes importance, and this, for one thing, requires the responsive, rapid and effective use of dynamic capabilities in order to alter the resource base. In other words, dynamic capabilities create value through the deployment and manipulation of the resource base in developing new value-creating strategies (Amit and Schoemaker, 1993; Eisenhardt and Martin, 2000). Mahoney (1995) also stresses the importance of managing resources and skills in rent generation. This value-creation process is presented in Figure 6 (Ambrosini and Bowman, 2009; Eisenhardt and Martin, 2000).

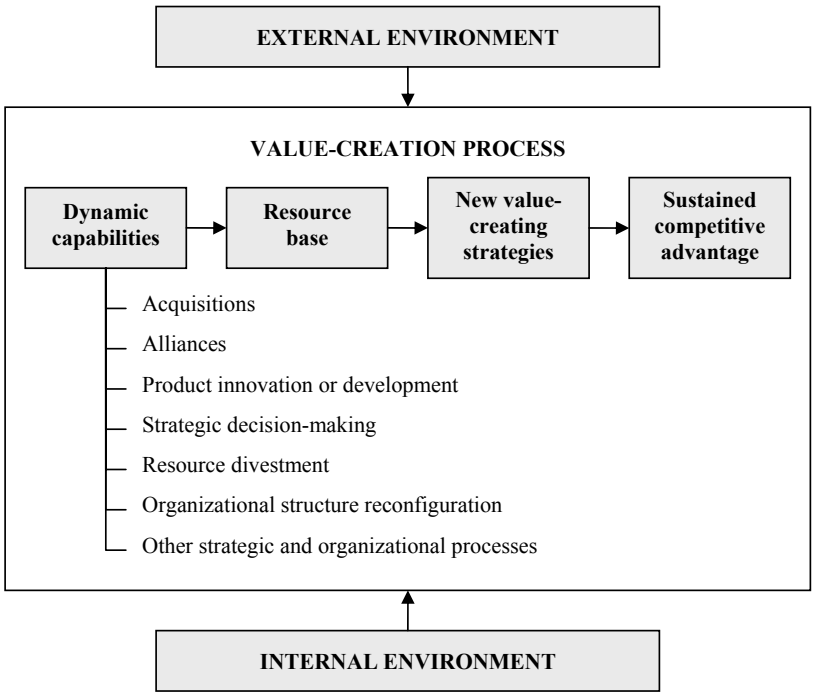

Figure 6: Creating value with VRIN resources altered by dynamic capabilities (adapted from Ambrosini and Bowman, 2009; Eisenhardt and Martin, 2000)

Dynamic capabilities could thus be defined as the organizational processes that are used to alter the resource base in particular in situations of rapid and unpredictable change (Amit and Schoemaker, 1993; Eisenhardt and Martin, 2000). In other words, resource management is a dynamic capability (Finney, Lueg and Campbell, 2008). Other examples include acquisitions, alliance formation, product innovation and development, research and development (R&D), absorptive capacity, organizational restructuring, resource divestment and other types of strategic and organizational management (Ambrosini and Bowman, 2009; Eisenhardt and Martin, 2000). In terms of using dynamic capabilities in resource creation and altering the resource base there are two main options. First, a company may enhance its existing resource base by developing new competences internally, and second, it may reach out to the external business environment in order to gain access to existing resources (Capron et al., 1998). According to Capron et al. (1998), there are many constraints on internal development, such as bounded rationality, which may prevent businesses from developing new resources internally quickly enough to meet competitive demands. Nevertheless, RBV

scholars have traditionally focused on resources within the firm, and empirical work within the field has emphasized the possession of VRIN resources.

However, scholars have increasingly begun to emphasize the need to understand firm-specific resources more broadly than only as resources that exist or that can be developed within the firm (Ahuja, 2000; Dyer and Singh, 1998; Newbert et al., 2008; Yasuda and Iijima, 2005). Dyer and Singh (1998) also stress that the firm's ability to generate competitive advantage should not be determined by the resource endowments within it. On the contrary, its critical resources may span traditional firm or industry boundaries, and opportunities should be pursued without regard to what is currently owned or controlled (Dyer and Singh, 1998; Newbert et al., 2008; Stevenson and Jarillo, 1990). This notion of exploiting and acquiring resources in unique ways is particularly applicable to small and/or new firms whose resource base is not extensive, as well as to companies that are aspiring to enter new markets or to tap new emerging business opportunities (see e.g., Newbert et al., 2008).

As explained earlier, the developments within the external competitive environment, and especially the structural changes within industries, may have a great influence on the value-creation process because often the most promising opportunities exist outside of the company (see e.g., Bate and Johnston, 2005). Therefore the external environment needs to be monitored actively in order to sense the changes and strategic opportunities opening up. There is also a need for effective dynamic capabilities allowing a rapid response to these changes and thereby facilitating prosperity in the new competitive landscape. Moreover, internal factors affect the value-creation process, and especially the development of dynamic capabilities. According to Teece et al. (1997), these paths and positions shape the organizational and managerial processes on which competitive advantage lies. In other words, within the dynamic-capabilities framework the competitive advantage of a firm is considered to rest on its managerial and organizational *processes* (i.e. its routines, patterns and learning), which are shaped by its specific asset *positions* (i.e. intellectual property, complementary assets, customer base) and the evolution *paths* (i.e. strategic alternatives) available to it.

2.3 Summary

The theoretical premises of this study on value creation at the intersections of industries shed light on industry transformation and new sources of value creation, and on how to exploit these emerging opportunities. The research topic is therefore explored on different levels of analysis. The discussion on the developments within the external environment relates to the industry-level analysis, which is important in order to understand the changes occurring in the competitive landscapes. The discussion on how to capitalize on the new value-creating opportunities focuses on company-level strategies, among other things. Within this framework a company must develop and manage its competences and knowledge base, and match them with the changes and opportunities in the competitive landscape (see Figure 7).

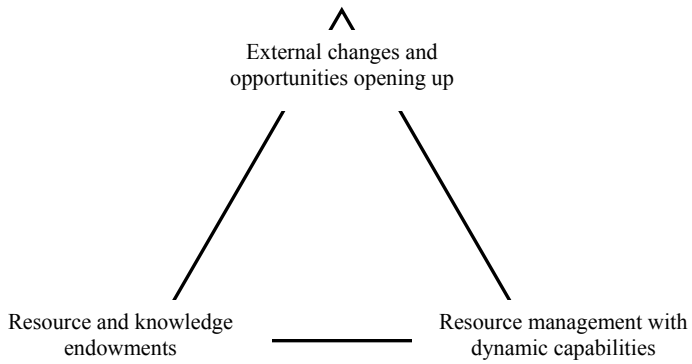

Figure 7: Congruence between external developments and strategic resources

The static aspect within the RBV emphasizes the possession of VRIN resources in the creation of sustainable competitive advantage. Scholars are increasingly departing from this traditional view, however, and are focusing instead on the exploitation of strategic resources. This study also adopts this 'dynamized' extension of the resource-based approach as its underlying theoretical view. Moreover, it departs from the classic focus on resources within the firm and posits a broader understanding of critical resources in that they may span traditional firm or industry boundaries. In other words, opportunities should be pursued without regard to the currently owned or controlled resources. The overall theoretical context of this thesis is summarized in Figure 8.

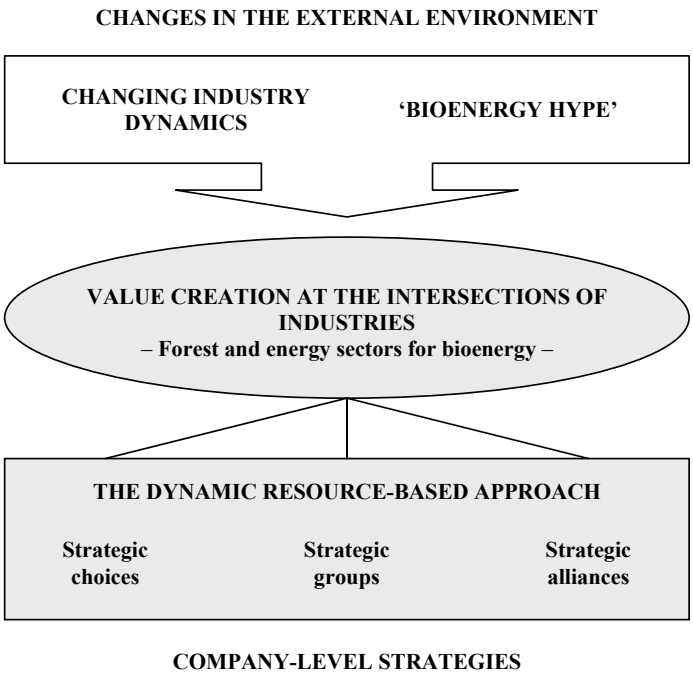

Figure 8: A theoretical framework for value creation at the intersections of industries

As Figure 8 illustrates, value creation is influenced both by the changes within the external environment and by company-level strategic choices. In terms of the former, ongoing globalization, the emergence of new markets and accelerating competition are forcing companies to seek new sources of sustained competitive advantage. The demand shift and the increasing global competition from low-cost producers are among the key challenges facing the PPI within its competitive landscape. On the other hand, these external changes could also act as a catalyst for new value-creating business opportunities: the general 'hype' around bioenergy is a major driver whereupon the strategic importance of renewable energy sources has increased and diverse sets of actors have become interested in producing bioenergy and biofuels from forest-based biomass in particular.

The impact of company-level strategies on value creation is illustrated through the strategic choices of firms, the existing and potential actors in the bioenergy business, and the collaboration activities of forest, energy and bioenergy companies. The strategic

choices cover a wide range of issues ranging from identifying the resources that will be needed in the future and filling the possible gap between existing and required resources to the organization of bioenergy production. Nevertheless, all these issues shed light on the many factors that need to be taken into account on the firm level in order to profit from the opportunity. The strategic choices are closely related to the resource endowments and their management within the firm, and therefore the dynamic resource-based perspective from the field of strategy research is adopted as the main theoretical approach. The research on strategic groups is utilized in investigating the existing and potential actors that could profit from the opportunity, and in examining the companies' potential roles within the emerging bioenergy value chain. Moreover, as explained earlier, strategic-alliance formation is considered one of the mechanisms by which companies are able to reconfigure their resource base and potentially create sustainable competitive advantage. Strategic alliances and joint ventures therefore comprise one of the perspectives through which value creation between the forest and energy industries is examined.

3 RESEARCH DESIGN

3.1 Research strategy

The overall research design of this study is described in this chapter. The objective is to provide a basis for Chapter 4, which introduces the four complementary research papers and summarizes their key findings. As explained earlier, the objective of this thesis is to examine sources of sustainable competitive advantage and determinants of value creation at the interface of the forest and energy industries. In order to achieve this the topic is examined from four different yet closely related perspectives in the complementary research papers. In other words, each paper addresses a specific research question, all of which are designed to form a coherent whole.

The key research methods and data-generation techniques used in this explorative study include, first, a Delphi study that is complemented with themed interviews with experts; second, strategic group analysis; and third, an examination of cooperation activity within and between the industries under scrutiny (i.e., bioenergy, forest, energy). Thus the study combines both quantitative and qualitative research methods, and draws on both primary and secondary data. This kind of approach that combines quantitative and qualitative methods has been defined as mixed-methods research, convergent methodology, multi-method/multi-trait, convergent validation and triangulation, for instance (see e.g., Creswell, 2009; Decrop, 1999; Jick, 1979; Rudd and Johnson, 2009). Characteristic of all these is the viewing of quantitative and qualitative methods as complementary and not as 'rival camps'[10] (Decrop, 1999; Jick, 1979). The tradition of considering the same research question or questions from a combination of strategically selected perspectives has its origins in areas such as military and navigation sciences, and several disciplines, including management, have since adopted the approach (Decrop, 1999; Rudd and Johnson, 2009).

Triangulation in general means combing several research methodologies, data sources, investigators or theories to examine the same phenomenon, and it may feature

[10] There has been a lot of debate on qualitative vs. quantitative research (see e.g., Rudd and Johnson, 2009).

throughout the research or only at the analysis phase (Ammenwerth, Iller and Mansmann, 2003; Jack and Raturi, 2006; Jonsen and Jehn, 2009). According to the classic view on triangulation, the fundamental principle of combining approaches is to produce more objective and valid results, i.e. a data set that has complementary strengths and non-overlapping weaknesses (see e.g., Jonsen and Jehn, 2009; Rudd and Johnson, 2009). In other words, the initial objective was the *confirmation* of findings in order to increase validity and objectivity. Triangulation has also been used for other purposes more recently. For instance, it is assumed to increase the *completeness* of the data and the comprehensiveness of the study, and thereby to provide a richer and more complete and detailed understanding of the studied phenomenon (Ammenwerth et al., 2003; Begley, 1996; Jack and Raturi, 2006; Jonsen and Jehn, 2009).

These above-mentioned key objectives of combining research methods also apply as the main strengths of mixed-method research. First, the phenomenon being studied is looked at from different perspectives, and the rich data set is used to verify, elaborate or illuminate the research problem. Second, triangulation enhances generalizability and limits personal and methodological bias. Third, combining research methods is desirable in order to overcome the weaknesses and to complement the strengths of single-method designs (Decrop, 1999; Jick, 1979; Rudd and Johnson, 2009). Triangulation is not limited to combining different data sources or different research methods, however: several different researchers could interpret the same data set, and a single data set could be considered from different theoretical perspectives (Decrop, 1999).

Accordingly, there are four basic types of triangulation. *Method triangulation*, which is the most popular type, involves the use of several different research methods in combination to study a single problem. *Data triangulation* means using a variety of data sources, i.e. the method or investigator usually stays the same but the empirical unit varies in that data is gathered at different times and situations and from different subjects. *Investigator triangulation* means that the data set is collected and analyzed by several different researchers, who may work as a team or may try to replicate each other's work. Sometimes an independent investigator will check part of the data or comment on a summary of the analysis, or review the gathering and analysis processes. Finally, *theoretical triangulation* involves the use of more than one theoretical perspective in interpreting the data (Decrop, 1999; Downward and Mearman, 2007;

Jick, 1979; Sim and Sharp, 1998). All in all, whether it is a matter of data, method, investigator or theoretical triangulation, it potentially offers richer and more valid interpretations (Decrop, 1999).

This thesis primarily utilizes data triangulation in that a variety of data sources were used. There are also features of method triangulation, however, as more than one method (i.e., the Delphi study and themed interviews) was used to examine the same dimension of the research problem (Decrop, 1999; Jick, 1979). All in all, triangulation was applied in order to gain a rich and comprehensive understanding of the research topic. The qualitative Delphi study and themed expert interviews addressed the first two sub-objectives, the first aim being to increase understanding of the bioenergy business that is arising at the interface of the forest and energy industries, with a specific focus on identifying the potential opportunities for value creation as well as the greatest challenges and threats that influence them. Second, the Delphi study and the themed interviews with experts were used to investigate the key industry- and company-level factors that affect the bioenergy business and its lucrativeness. The themed interviews with experts were conducted after the first web-based Delphi round in order to complement the data and to assist in the formation of statements for the subsequent rounds.

The overall Delphi procedure produced a rich set of data, which included both numerical responses and written comments on the statements as well as the interview data. Emphasis was given in the data analysis to the comments made by the Delphi panelists, and the numerical responses were used to complement them. This produced a more comprehensive view of the emergent phenomenon than merely looking at the mean values. After continuous reading of and careful familiarization with the data the statements were re-grouped along different dimensions that considered the research topic from distinct perspectives. The findings of the Delphi study and the themed expert interviews were reported in the first and second research papers comprising this thesis. As explained earlier, the aim of the first paper was to enhance understanding of the overall phenomenon from the perspective of the forest and energy industries, whereas the second one took a more detailed approach and examined the key factors affecting it. After the Delphi study – which focused primarily on the industry level – the idea was to shed light on the diverse set of actors currently or potentially operating in the bioenergy

field, and thus to move on to firm-level analysis. In order to accomplish this, samples of firms were gathered from the traditional forest and energy industries and from the emerging bioenergy field. Cluster and ANOVA analyses were applied to each industrial sector, and the companies were categorized according to three factors that reflected their strategic posture. The natures of the strategic groups were further analyzed with reference to three more variables and through cross-tabulation and Chi-square testing. Finally, seven variables depicting firm performance from different perspectives were used to test whether the distinct clusters were associated with any performance differentials, and whether there were any statistically significant differences in performance on the industry level. A Kruskal-Wallis nonparametric ANOVA test was therefore carried out. The results of the cluster analyses and the additional tests are reported in the third research paper comprising this thesis.

Examination of the alliance activity of the three interconnected industrial sectors (forest, energy and bioenergy) complemented the above-mentioned study of strategic groups. Thus the underlying premise of this strategic-alliance analysis was to explore the cooperation activities of firms with promising potential for collaboration given their complementary resources. An investigation was therefore undertaken to explore whether there had been any cross-industry alliances among the forest, energy and bioenergy fields. Several other aspects of the cooperation taking place in these sectors were also covered, including (1) the development in the number of alliances during the research period of 1988-2007, (2) the main types of inter-firm relations (strategic alliances and joint ventures), (3) their average size, and (4) the primary motivations for forming cooperative agreements. An additional objective was to identify the number of intra-industry alliances within the forest and energy sectors.

Overall, this study is rather explorative in nature although some analyses (e.g., the cluster analysis) include statistical and empirical testing. Such a setting, which combines both qualitative and quantitative research methods and thus looks at the research topic from different angles, could be considered suitable for studying a phenomenon that is just emerging and lacks, or at least has a scarcity of, comprehensive historical and financial data. For instance, Veryzer (2005) also used a mixed-method, multiple-sample design and found it applicable in studying an under-researched topic and laying the foundation for further investigation. A further typical characteristic of the

research design of the current thesis is that it combines industry- and firm-level analysis: it begins with a wider examination of the overall topic covering the changes within the external operational environments and then moves on to a more detailed analysis of the actors and their strategic resources.

The different data-collection methods and secondary sources used to derive the empirical data are described next. The focus is on the techniques in general and on how they were used in gathering the data for the study.

3.2 Data collection

3.2.1 The Delphi method

According to Schwarz (2008), futures studies could be considered an activity that aims at supporting strategic future-oriented action. It plays a significant role in management because the daily planning situations with which managers are confronted imply some assumptions about the future. As regards policy making in the areas of science and technology, expert opinion is often taken into consideration to give new added knowledge on complex issues. There is demand for information on the supply of and demand for new technologies, for example. Formerly it was common to gather expert opinions in meetings or in-depth interviews. Nowadays, information-technology (IT) assisted methods are more often used because they allow the sampling of the opinions of fairly large numbers of experts, and they also avoid potential dominance by particularly persuasive individuals. The Delphi method is an example of this kind of technique (Scapolo and Miles, 2006). Other methods used in futures studies include growth curves, scenario writing, and simulation and gaming (Cheng, Chen and Chen, 2008; Schwarz, 2008). They generally fall into two broad categories: exploratory forecasting and normative forecasting (Cheng et al., 2008). The main difference between them is that the former forecasts the future based on past data and current conditions, whereas the latter structures the future based on certain possible future events and assumptions (Cheng et al., 2008).

The Delphi method was originally developed in the 1950s at the RAND Corporation in Santa Monica, California, where researchers started to study the use of expert opinion in science. Military aims were strongly behind these first applications of the technique, but the RAND Corporation was also the first to propose its adoption for non-military purposes. Its use spread rapidly in the 1960s, particularly in technological forecasting and the evaluation of social problems. In Europe, however, Delphi studies did not assume importance as a national forecasting method in science and technology before the 1990s (Blind, Cuhls and Grupp, 2001; Gupta and Clarke, 1996; Landeta, 2006; Linstone and Turoff, 1975; Ronde, 2003). Nowadays the method, which is named after the ancient Greek oracle at *Delphi*, is probably the best-known forecasting mechanism to carry its own name. It is a qualitative research method that is applied widely to a variety of problems in different domains (e.g., academia, agriculture, banking, economics, education, management, strategic planning, and transportation). It typically entails two or more survey rounds in which the participating experts are provided with the results of previous rounds from the second round on. The panel of experts is used as the source of information, and the questionnaires act as the medium of interaction.

The key characteristics of a traditional Delphi study are iteration, participant and response anonymity, controlled feedback, and group statistical response (Chang et al., 2002; Landeta, 2006; Rowe and Wright, 1999). The first aspect, *iteration*, means that the experts are consulted at least twice on the same question. Thus the process is repetitive and the individuals on the expert panel are given the opportunity to change their opinions and judgments. Moreover, as this happens *anonymously* there is no fear of losing face. On account of the anonymity the personality and status of the participating experts do not influence the responses, and undue social pressures can be avoided. The third feature, *controlled feedback*, means that the panelists are given feedback between each questionnaire round informing them of their anonymous colleagues' opinions. A study group coordinator controls this exchange of information. Fourthly, the Delphi answers may be processed quantitatively and statistically in a *group statistical response*, and all the opinions form part of the final outcome. These four key features are often considered necessary for defining something as a 'Delphi' procedure (Chang et al., 2002; Landeta, 2006; Rowe and Wright, 1999).

According to Rowe and Wright (1999), Delphi cannot be paralleled with statistical or model-based procedures. However, it is especially suitable in judgment and long-range forecasting (20-30 years) situations, when expert opinions are often the only source of information available due to the lack of appropriate historical, economic or technical data (Blind et al., 2001; Gallego, Luna and Bueno, 2008; Gupta and Clarke, 1996; Landeta, 2006; Levary and Han, 1995; McLeod and Childs, 2007). Hanafin (2004) summarized the following situations in which the Delphi technique is particularly useful:

1. The problem does not permit the application of precise analytical techniques, but can benefit from subjective judgments on a collective basis.
2. The relevant specialists are in different fields and occupations and not in direct communication.
3. The number of specialists is too large to effectively interact in face-to-face exchange and too little time and/or funds are available to organize group meetings.
4. Ethical or social dilemmas dominate economic or technical ones.

Traditionally the main objective of the technique was to obtain the most reliable *consensus* of opinion from the panel of experts by conducting a series of questionnaires with controlled opinion feedback (Landeta, 2006). Many later Delphi applications have discarded this search for consensus, however, and rather emphasize the range of quality ideas the process generates. In other words, finding reasons for *dissensus* has replaced the common search for consensus (Landeta, 2006; Nielsen and Thangadurai, 2007). A variant called Policy Delphi, which is based on dissensus, represented a significant departure from the understanding and application of the traditional technique when Turoff introduced it in 1969 (Steinert, 2009; Turoff, 1975). According to Turoff (1975, p. 80), the aim is not to reach stability in the responses but to *"generate the strongest possible opposing views on the potential resolutions of a major policy issue."* In other words, Policy Delphi aims at persuading the experts to come up with all possible options, and the supporting or rejecting evidence. Another of its main premises is that the informed group should present all the options and the supporting evidence for the decision maker's consideration. Thus, it is not a quantitative mechanism for generating

a decision (Kuusi, 1999; Turoff, 1975), but could rather be defined as *"an analytical tool of an explorative nature"*, as Steinert (2009, p. 293) put it.

Since then many other researchers have adapted the dissensus-based Delphi design, including Kuusi (1999) with his Argument Delphi and Tapio's (2002) Disaggregative Policy Delphi. The Delphi study utilized in two of the research papers comprising this thesis draws mainly from the Classical and Argument variations, and could be classified as a dissensus-based online Delphi study. The Delphi process was conducted in the latter half of 2006 in the context of a research project entitled 'Creation of new business concepts in the intersection of industries: Electricity networks and generation, ICT and forest industries (in short Talikko)', coordinated by the Technology Business Research Center (TBRC) at LUT.

This Delphi study consisted of three rounds of online inquiries and four themed expert interviews (see Figure 9). The time scale extended to 2015, and the perspective was primarily that of Finland, although global trends were also acknowledged. The key objective was to elicit expert opinions on the value-creation opportunities in the bioenergy business that is emerging at the interface between the forest and energy industries. The analysis focused especially on identifying the most focal and divergent issues that invoked differences of opinion the most and that would have the strongest influence on the future development of this business opportunity. The study participants were encouraged to give arguments supporting their views and opinions. Thus the panelists' comments were valued over the mean values of the responses, and therefore the study could be classified as qualitative.

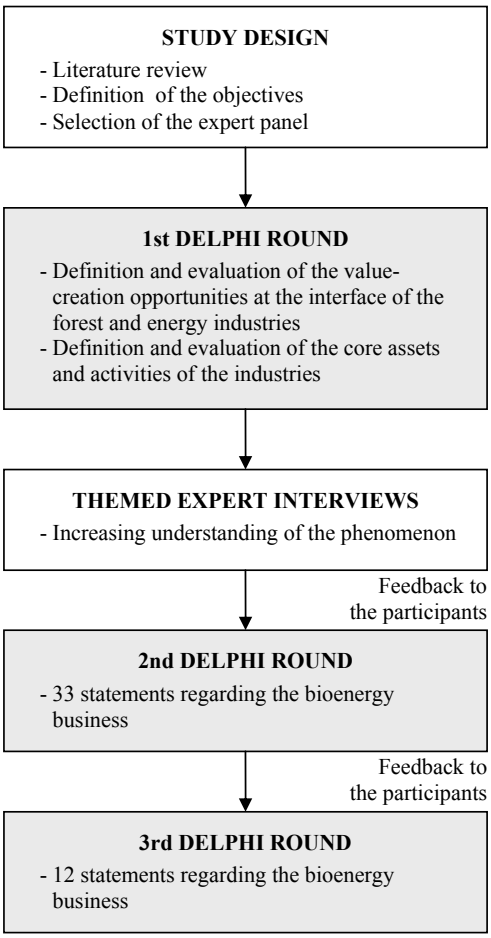

Figure 9: The key steps in the Delphi study

The first Delphi inquiry was open-ended in format (see e.g., Chu and Hwang, 2008), and the panelists could relatively freely comment on the value-creation opportunities that were arising at the interface between the forest and energy sectors, one of which was bioenergy production from forest-based biomass. On a more structured level, the panelists were also asked to assess the core assets and activities of the two industries on a scale from one (less important asset/activity) to five (critical asset/activity), the aim being to build an understanding of the changing operational environments. In other words, the first Delphi round served as a basis for the following rounds, which then covered the various aspects of the emergent bioenergy business more thoroughly. Before this, however, four themed expert interviews were carried out in order to shed

light on the phenomenon, which had previously been researched mainly from a technological perspective. Kuusi (1999) also used personal interviews in order to identify the arguments to be presented in the next Delphi rounds. The second and third rounds incorporated more tailored questions regarding bioenergy business opportunities. In all, the second-round questionnaire consisted of 33 statements. Those that invoked the most opinions and comments from the panelists formed the basis of the third round, which included 12 statements[11]. In the second round the panelists evaluated the statements on a scale from one (totally agree) to four (totally disagree), and in the third round the scale ranged from one (prone to agree) to two (prone to disagree). All the questionnaires were pre-tested, and the panelists were given feedback after each round.

The main elements that were covered in the Delphi study fell into three wide categories, including external changes within the operational environments of the forest and energy industries, and company- and industry-level factors affecting the bioenergy business. The first category was mainly addressed in the first round, and the company- and industry-level factors were examined in the second and third rounds. The industry-level factors included the drivers, challenges and policy interventions that influenced the emergent bioenergy business. On the company level we focused on the conversion of forest resources into paper or energy, the raw-material bases, the resources required in the bioenergy business, the organization of production, and the collaboration potential between the forest and energy industries, as well as the challenges.

We followed the guidelines suggested by Hatcher and Colton (2007) and Scheele (1975) in forming our panel of experts, selecting the participants for their expertise on the subject matter. They represented three groups: (1) business managers and executives, (2) university employees, and (3) representatives of the joint organizations of the industries under scrutiny. The business managers and executives represented either a forest company or an energy company, and the specialists in the other two groups were closely involved with these industries. Thus, our objective was to bring the industry specialists together. Thirty-six experts responded to the first Delphi inquiry, of which 17

[11] The third Delphi inquiry also included five future scenarios but their results are not reported in this thesis.

were business managers and executives, eight represented universities, and 11 were from joint industrial organizations. The panelists in the second and third rounds, which focused more closely on bioenergy production from forest-based biomass, numbered 11 and 10, respectively. The responses were anonymous, although the experts were aware of the composition of the panel.

The Delphi method in general has both advantages and weaknesses. Table 1 summarizes some of these, taking into account the fact that some advantages may also be disadvantages, and vice versa (Gupta and Clarke, 1996; Hung, Altschuld and Lee, 2008; Landeta, 2006; see also Linstone, 1975).

Table 1: The key advantages and weaknesses of the Delphi method

Advantages	Disadvantages
Quick and simple, flexible methodology	Potential for poor implementation
Anonymity facilitates honest opinion and encourages taking up a personal viewpoint without group pressure	May lead to quick, hasty replies and the promotion of desired outcomes by the panelists
Selective feedback of relevant information	May lead to conformity
Adaptable and relatively inexpensive to organize and administer	Conceptual and methodological inadequacies
Brings geographically dispersed experts together	Lack of general guidelines for sample size or sampling techniques
Limited time required to complete surveys	Requires participant commitment due to the many survey rounds

In this study the Delphi method proved valuable for analyzing the forest energy business for several reasons. First of all, the subject lacks historical and financial data, and thus it was necessary to collect expert opinions. Secondly, it made it possible to obtain a comprehensive view of the bioenergy sector from experts with a background in different industries, thereby avoiding potential time and place constraints. Thirdly, due to the anonymity criterion, the panelists could express their opinions freely without being aware of any company or industry connections, and without fear of losing face. Fourthly, the various iterative rounds enabled us to refine the statements and to look more thoroughly at certain interesting subject areas that provoked the most discussion

and the sharpest differences of opinion among the participants. Fifthly, giving feedback to the panelists enabled them to refine their responses and to further justify their opinions. All in all, the Delphi process was fruitful in terms of focusing discussion on this complex and emergent phenomenon on which it would not have been sensible to seek consensus.

Despite the many advantages of the Delphi method it has been criticized and evaluated a lot throughout the years (Gupta and Clarke, 1996; Hung et al., 2008; Landeta, 2006; Rowe and Wright, 1999). Scholars have questioned its reliability, validity and credibility. Other methodological and conceptual issues arising in the Delphi context include the choice of experts, the number of rounds, questionnaire development, analysis of the results, feedback, and the achievement of consensus (Gupta and Clarke, 1996; Hanafin, 2004). A number of methodological issues remain unresolved even today (Gupta and Clarke 1996; Hung et al., 2008; Rowe and Wright, 1999), although it has been considered an advanced model compared to other group-judgment techniques (such as brainstorming, focus groups and the analytic hierarchy process (AHP) technique), the main disadvantage of which is the risk of taking into account only the perceptions of the most outspoken or opinionated persons[12] (Gallego et al., 2008; Hanafin, 2004; Landeta, 2006).

In this bioenergy context, one could, for instance, question whether the panel of experts chosen for the Delphi study was representative, and whether the number of experts was adequate in the later rounds. However, we considered it important for each panelist to have solid relevant expertise, and therefore it seemed advisable to keep it relatively small. Another limitation was that the panelists were all of Finnish extraction, which may affect the generalization of the findings. Data and method triangulation were applied in order to overcome these weaknesses and to increase the validity and objectivity of the study: data from secondary sources complemented the information gathered from the Delphi study and the themed interviews.

[12] Note that in the AHP technique the risk of taking into account only the opinions of the most outspoken persons can be avoided if the method is implemented through online questionnaires for instance, or applied to interview data (see e.g., Dwivedi and Alavalapati, 2009; Lähtinen et al., 2008).

3.2.2 Themed interviews

The interview data for this study was gathered in themed semi-structured interviews. Various types of interviews are among the most significant data-gathering tools in qualitative research (Myers and Newman, 2007). Hirsjärvi and Hurme (1995) distinguish between unstructured, semi-structured/themed and structured interviews, whereas other researchers (see e.g., Myers and Newman, 2007) separate group from structured and unstructured or semi-structured interviews. According to Hirsjärvi, Remes and Sajavaara (2003), themed interviews focus on some specific themes that are determined in advance, but the precise form and order of the questions are not known. Thus, the script of the interview is incomplete and there is room for improvisation (Myers and Newman, 2007).

According to Appleton (1995), there are many advantages in collecting interview data. For instance, the interviewer has the opportunity to clarify unclear and ambiguous questions that different interviewees may misinterpret. Furthermore, high response rates are typical. Hirsjärvi et al. (2003) suggest that interviews are often selected as a research method when the research topic is an unknown and little-researched phenomenon. Other reasons for conducting them include being able to clarify responses by asking additional questions or seeking justification of the answers. On the other hand, it is rather costly and time-consuming, and themed interviews in particular require a great amount of work in both the planning and analysis phases. Other challenges include the artificial nature of situations in which the interviewer and interviewee are typically strangers to each other, and there might be a tendency to give socially acceptable responses to the questions. They are also often conducted within strict time limits (see e.g., Appleton, 1995; Hirsjärvi and Hurme, 1995; Hirsjärvi et al., 2003; Myers and Newman, 2007).

The interviews were conducted after the first Delphi round. The objective was to shed more light on the emergent phenomenon and further delimit the research topic in order to focus on the most important and interesting issues in the ensuing rounds. Thus, the themed interviews served as a basis for the second and third rounds. Given that the key objective of the interviews was to enhance the researchers' understanding of the phenomenon under investigation and to help in forming the statements for the subsequent Delphi rounds, in other words to complement the Delphi study, the number

could be considered adequate. If they had constituted one of the main data-collection methods in themselves there should have been more of them.

As in the Delphi study, the interviewees represented three groups: (1) business managers and executives (one interviewee), (2) university employees (two interviewees), and (3) representatives of the joint organizations of the industries under scrutiny (one interviewee). All four interviews were conducted face-to-face, audio-taped and transcribed. They covered four themes ranging from outlining the current state of the bioenergy business to the future of the business sector. The semi-structured interview form (see Appendix 1) was revised in part as the interviews progressed and the interviewer's knowledge of the research topic increased.

3.2.3 Secondary databases

Quantitative data was collected from three secondary databases in order to complement the qualitative data collected in the course of the Delphi inquiries.

Amadeus. Amadeus (https://amadeus.bvdep.com/) is a pan-European database containing financial information on over 11 million public and private companies in 41 European countries. The information is taken from over 30 specialist regional information providers, and it is exclusive to Bureau van Dijk Electronic Publishing (BvDEP) and its information providers. A standard company report provides information on 25 balance-sheet items, 26 profit-and-loss-account items, and 26 financial ratios, descriptive information including trade descriptions and activity codes, as well as ownership information. The database also provides complementary news, and market-research and supplementary financial data. The data is available for up 10 years.

Thomson One Banker. The Thomson One Banker (http://banker.thomsonib.com/) – available from Thomson Reuters Financial – is a comprehensive web-based research and analytics tool containing global company information. It combines a full range of financial data and source documents, and it provides access to quotes, earnings data, financial fundamentals, market moving news, transaction data, corporate filings, ownership profiles and research. The Thomson Reuters Worldscope Fundamentals – which is available through Thomson One products – includes up to 20 years of

historical data on more than 50,000 firms in more than 70 countries and over 30 developed and emerging markets. In total the Worldscope covers more than 95 per cent of the world's market value and provides, for instance, detailed financial statement content, per-share data, calculated ratios such as growth rates and profitability, as well as pricing and textual information (Thomson Reuters Financial, 2009b).

The Thomson One Banker and Amadeus databases were utilized to collect firm-level data on a total of 187 European companies representing the bioenergy, forest or energy sectors. The objective was to include firms that seemed to have the most potential for engaging in the bioenergy business in the future as well as those that were already operating in this emergent field. Samples of the biggest companies in the energy and PPI industries were identified and collected with the help of four-digit Standard Industrial Classification (SIC) codes. The forest-industry companies were restricted to organizations that were engaged in the production of pulp, or of both pulp and paper, and the sample of energy firms included companies with their own energy production. An explorative approach had to be used in collecting the sample of bioenergy firms because of the lack of SIC codes. In short, the first step was to identify a couple of firms and the second was to narrow down the potential number of codes that included bioenergy firms. The final sample was defined from the listings provided by the two databases with the help of the given business descriptions and the companies' websites. In order to increase the reliability of the data, the two databases were cross-checked and another researcher independently collated the information. In sum, the final sample comprised 77 firms representing the bioenergy business, 40 from the forest industry and 70 from the energy industry.

SDC Platinum. SDC Platinum – also available from Thomson Reuters Financial – provides information on global issues, mergers, acquisitions and alliances, syndicated loans, private equity, project finance, corporate restructuring, corporate governance, and more. The database covers more than 1.9 million transactions and 7,500 data items. The subset database of worldwide mergers, acquisitions and alliances includes over 53,000 strategic alliances and joint ventures from 1988 to the present. Over 200 data elements comprise, for instance, the participant profile, the joint-venture name, terms and conditions, current status, purpose, and description of the business and products (Thomson Reuters Financial, 2009a).

Information about collaboration activity within and between the forest, energy and bioenergy companies was drawn from the SDC Platinum database. The aim was to shed light on bioenergy-related business by examining the cooperation activities of firms with promising potential for collaboration given their complementary resources. The search covered strategic alliances and joint ventures established during 1988-2007 and involving at least one European firm. SIC codes were utilized to draw samples from the forest and energy industries. The method generated 150 strategic alliances and joint ventures ordered by PPI companies, and 921 strategic alliances and joint ventures ordered by energy firms. As in the previous collection of firm-level data, an explorative approach had to be taken in gathering information on bioenergy-related inter-firm relationships. Eight frequently occurring key words referring to bioenergy or biofuels production were identified and then typed into the SDC Platinum database. This yielded a total of 59 strategic alliances and joint ventures, from which one entry was removed from the final sample following collation of the data for accuracy.

3.2.4 Summary

Figure 10 summarizes the overall research design of this study. It depicts the research objectives within each paper and points out the method that was utilized in conducting the research.

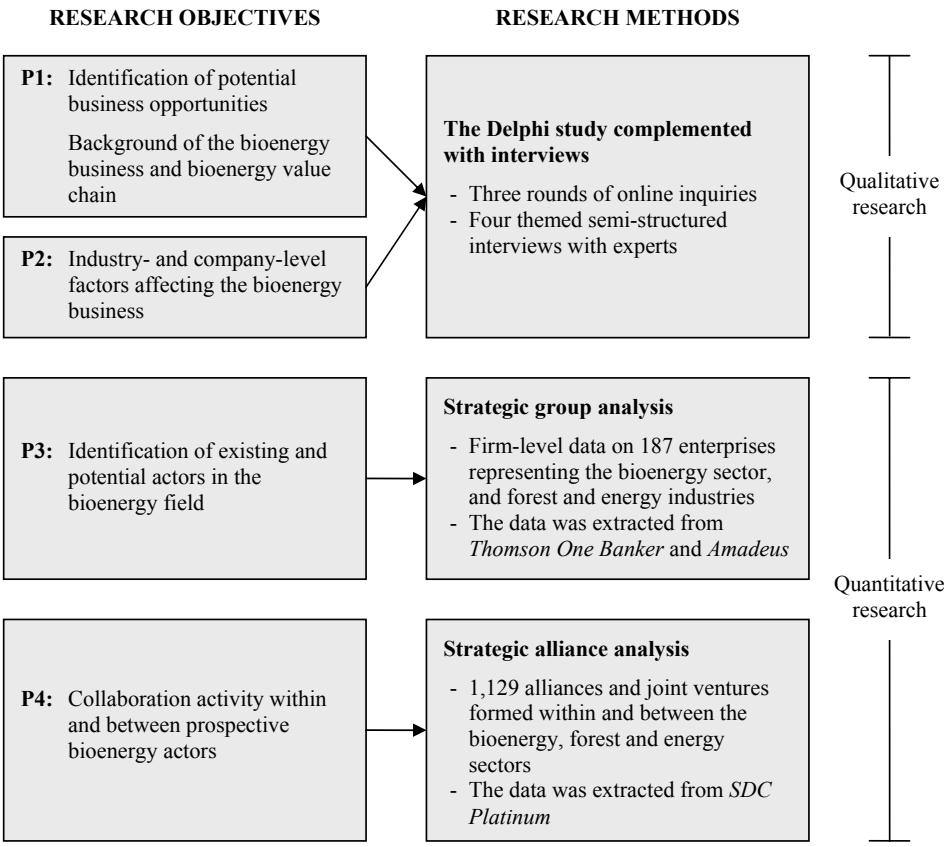

Figure 10: Research design

As Figure 10 shows, the empirical data for this study was taken from different sources, including the three Delphi inquiries complemented with four themed expert interviews; a strategic-group study; and a strategic-alliance analysis. An explorative research design combining qualitative and quantitative research methods was adopted, which – given the nature of the research topic – is appropriate for this thesis. In short, the key objectives of the Delphi study and interviews were to identify the emergent novel business opportunities at the interface of the forest and energy industries, and to gain a better understanding of the given research topic and its pros and cons. Complementing this background information, the Delphi study also shed light on the evolving bioenergy value chain, and analyzed the key company- and industry-level factors affecting this novel business sector. Secondly, the aim of the firm-level strategic-group analysis was to identify existing and potential actors in the bioenergy field. A total of nine clusters emerged from three closely interconnected industrial sectors, and the nature of the firms

within them was determined with the help of several financial and non-financial variables. Finally, the strategic-alliance analysis focused on the collaboration activities within and between the three sectors, the aim being to find out how active the alliance formation had been and whether the firms had utilized the potential to collaborate with one another in terms of complementary resources.

All in all, there is unique value in the explorative nature of this research, which comprises unique data sets. The Delphi study provided rich and detailed information on a complex issue and combined the perspectives of multiple experts. To the author's knowledge, this study represents the first application of the strategic-group and strategic-alliance perspectives to the bioenergy sector as tools for enhancing understanding of this emerging phenomenon.

4 A REVIEW OF THE PUBLICATIONS

4.1 Introduction

This chapter introduces the research papers that constitute the second part of the dissertation. The four different papers illustrate the phenomenon under study from different perspectives in order to provide a comprehensive view of it. In general, the first publication gives a more general view, and the others focus more on the detail. Each paper addresses a specific research question, all of which are presented in Table 2.

Table 2: The research questions and their links with the publications

Research questions	Publications
What kinds of business opportunities are arising at the interface of the forest and energy sectors?	1
What are the industry- and company-level factors that affect the bioenergy business?	2
Who are the actors that operate in the bioenergy field, and which ones hold the potential to operate there in the future?	3
How active is the alliance formation among the forest, energy and bioenergy actors?	4

The papers form a continuum in that successive publications focus on more specific themes within the overall research context described in the one. **Publication no. 1** examines the emerging interface between the PPI and the energy sector, with a specific focus on the new business opportunities that are arising in response to the growing global interest in renewable energy options. It could be classified as an explorative study, and draws mainly on the qualitative Delphi study and the themed interviews.

Continuing on from this, the main objective of **Publication no. 2** is to examine the phenomenon more deeply by identifying both the company- and industry-level factors that are affecting the emerging bioenergy business. The Delphi study and the themed interviews serve as the primary data.

Publication no. 3 also focuses on the firm level, investigating the nature of the existing actors and the potential new entrants in this upcoming area of business. The objectives of the study were to identify and recognize the existing actors in the energy, forest and bioenergy fields, and to categorize them on the grounds of their distinctive strategic features. These were met through a strategic group analysis of European firms that currently operated either in the forest or energy sectors or in the emerging bioenergy industry.

Publication no. 4 continues the work by examining the inter-firm relations, namely the strategic alliances and joint ventures, in these three industries under scrutiny. In addition to analyzing alliance activity the study also explored the knowledge that firms seek from each other when they enter into bioenergy-related alliances.

An overview of the publications is presented in Table 3 which summarizes the objectives, the theoretical perspectives, the methodologies and the main findings of each paper.

Table 3: A summary of the research papers comprising this thesis

	Publication 1	Publication 2	Publication 3	Publication 4
Title	Creating value with forest-based biomass – traditional industries seeking new business opportunities	Industry- and company-level factors influencing the development of the forest energy business – insights from a Delphi study	The interface of the energy and forest sectors – potential players in the bioenergy business	Profiting from inter-firm relations – a study in the evolving bioenergy industry
Objective	Examines the value-creation opportunities at the interface between the forest and energy industries. Gives an overview of the emerging bioenergy sector and the overall research context.	Identifies the key company- and industry-level factors affecting the bioenergy business.	Analyses actors from three industrial sectors and their potential to tap into the bioenergy business. Illustrates their strategic posture and performance.	Analyses the alliance activity of and between the bioenergy, forest and energy sectors, and examines the types of knowledge acquired through the alliance formation.
Theoretical perspective	Explorative study. Structural industry change and resource / asset complementarity.	Dynamics of basic mature industries, IO economics, resource-based view, dynamic capabilities.	Manufacturing strategy, strategic groups.	Strategic alliances from the perspective of resource-based theory.
Methodology	Qualitative. Delphi study and themed interviews.	Qualitative. Delphi study and themed interviews.	Quantitative. Samples of firms from three industries.	Quantitative. Analysis of 1,129 alliances.
Main findings	Provides an overview of the bioenergy value chain and discusses its future value-creation possibilities.	Complementary resources held by forest and energy firms are the key success factors in the forest energy business. The efficient procurement and logistics of forest-based biomass yield the most synergetic gains between the industries.	The study identifies firms from the bioenergy sector, and applies the strategic-group perspective. It illustrates the business environments of three industrial sectors.	This study proposes a method for finding and classifying alliances that are related to the bioenergy business. The paper shows that the existing bioenergy-focused alliances have been formed outside the forest and the energy industries.

4.2 Creating value with forest-based biomass – traditional industries seeking new business opportunities

Main objective. This paper reports an explorative study of the interface between the forest and energy sectors, the overall aim being to improve understanding of the emerging bioenergy sector and thus to build a basis for the subsequent papers. The first objective was to discuss the business opportunities that are related to producing bioenergy from forest-based biomass in forest biorefineries, and the second was to examine the biggest challenges and threats influencing the success of collaboration between the forest and energy sectors. The paper draws on the qualitative Delphi study and the themed interviews. It begins with a discussion on the current dynamics in the PPI and gives an overview of the evolving bioenergy business, the emphasis being on forest-based biomass. It then gives an outline of the evolving bioenergy value chain and discusses the business opportunities, challenges and threats from the perspective of the forest and energy industries.

Main contribution. This paper gives an overview of the bioenergy sector, which is emerging at the interface between the forest and energy industries. More specifically, the findings of the study indicate that the growing global interest in and arguments in favor of biomass largely concern the external benefits (e.g., employment generation, decrease in greenhouse gases) that are related to renewable energy, and gloss over any real estimates of its financial viability. Collaboration between the forest and energy sectors is nevertheless seen as promising, and would direct the complementary resources and knowledge of the two industries more efficiently. In other words, co-production of traditional pulp and paper products together with bioenergy would seem to outweigh their separate production. In the short term, however, many Delphi panelists thought that processing biomass in rather small local units from where it originated was a sensible and profitable solution. In the long run the forest biorefinery was identified as a potential source of value creation, especially when the necessary technological and marketing skills have developed further.

4.3 Industry- and company-level factors influencing the development of the forest energy business – insights from a Delphi study

Main objective. This paper was written in order to enhance understanding of the strategic challenges that mature, basic industries (forest, energy) in particular are confronted with today. These industries have a long tradition of following pure cost-based strategies that no longer yield enough additional value. The paper discusses how they could incorporate customer-oriented aspects into their overall strategies. Hence, the key objective of the study was to explore how these industries could take advantage of new potential sources of sustainable competitive advantage related to the bioenergy business. The new value-creation opportunities stem from the internal knowledge that the industries possess on the one hand, and from the external factors that are changing their structures on the other. The paper thus identifies the main company- and industry-level factors that are most likely to influence the forest energy sector, its value-creation potential, and forest and energy firms' future roles in it. It also draws on data from the Delphi study and the themed interviews.

Main contribution. By way of an outcome this study identified the key company- and industry-level factors that should to be taken into account in redefining conventional pulp mills as forest biorefineries. In general, the majority of the Delphi representatives stated that the ongoing external changes, such as climate change, the depletion of fossil-fuel reserves and increasing raw-material prices, were opening up novel opportunities for the forest and energy industries, of which regeneration was of current interest due to profitability problems. The value-creation potential of bioenergy was strengthened by the complementary knowledge that the industries possessed. Hence, taking advantage of the external impacts and risks requires internal knowledge and resources from both industries: the expertise of the forest industry was seen to be more in the upstream actions of the energy value chain, whereas the energy sector was thought to have a better command of the downstream operations. Moreover, the most critical factors yielding synergetic gains between these industries were identified as the efficient procurement and logistics of forest-based biomass.

4.4 The interface of the energy and forest sectors – potential players in the bioenergy business

Main objective. This aim in this paper was to foster further familiarization with the actors that are currently operating in the bioenergy field and with those with the potential to engage in the business in the future. The focus in the study was therefore on the most focal, existing bioenergy actors as well as the traditional forest and energy companies, identified by means of strategic-group analysis. The explanatory comparison between these three groups of firms is made on the grounds of their distinctive features, including company size, strategic focus, geographical scope, fuel source, ownership structure, and specific performance variables. The cluster analysis gives a better understanding of the actors and the patterns of competition within each industrial sector. Moreover, the paper investigates whether the specific strategic groups are associated with any performance differentials. The results of the study are further elaborated in a discussion of the potential roles that the identified strategic groups could assume within the emerging bioenergy value chain.

Main contribution. This paper contributes to the literature on strategic groups by applying cluster analysis to the emerging bioenergy sector: to the authors' current knowledge this has not previously been done elsewhere. The technique is also used to compare firms that represent three distinct industrial sectors, of which one is still lacking SIC codes. The paper identifies three strategic groups from each sector. The names of the clusters illustrate their size and resource commitment, geographical scope and number of diversification areas, which were also the factors used in forming the strategic groups. The clusters of the bioenergy sector include intermediate globals, small locals and multiform giants; those of the energy industry include international specialists, diversified locals, and global, multiform giants; and in the forest industry they comprise small locals, intermediate internationals, and global, multiform giants. The ownership structure, vertical integration and fuel source of the firms are also analyzed, which enhances understanding of the nature of each group.

The general outcome of the tests was that performance varies more on the industry than on the strategic-group level, bioenergy being the fastest growing industry and the forest

industry exhibiting the lowest values in terms of growth. The paper also identifies the following three clusters on the strategic-group level – the global, multiform giants of the forest and energy sectors and the multiform giants of the bioenergy sector – as the most stable, whereas the other strategic groups consist of faster-growing and more flexible firms. On the industry level the results demonstrate that bioenergy firms are growing the fastest, and that PPI firms are among the slowest. However, performance is better in the forest and energy industries due to the extensive depreciations in the bioenergy sector. In sum the results of the study indicate that the relatively smaller bioenergy firms are at the beginning of their life-cycle, and in recent years have been growing more aggressively than the energy and forest firms. In the future, however, the larger volumes of raw material may produce procurement and logistics difficulties for these existing bioenergy actors, of which nearly half use biomass as their fuel source. It is therefore suggested that value could be created through adopting different strategies within the bioenergy sector: small bioenergy firms already have the resource base on which to create value from small-scale bioenergy production, whereas the larger forest and energy organizations seem to have the potential to create value on a large scale. It appears that energy firms in particular are in a focal position in the later stages of the value chain due their extensive distribution systems.

4.5 Profiting from inter-firm relations – a study in the evolving bioenergy industry

Main objective. The key objective in this paper was to study how active the cooperation has been between two sectors (i.e., forestry and energy) that hold fruitful promise for joint efforts in the bioenergy field. It also identifies the inter-organizational relations that are related to bioenergy but are formed outside the forest and energy industries. This makes it possible to identify the nature of the firms that have entered into bioenergy-driven alliances. The premise of the study was that their complementary assets related to producing bioenergy from forest-based biomass makes collaboration between the forest and energy sectors desirable, and the paper explores whether the firms have already taken advantage of this possibility. Furthermore, the strategic-alliance and joint-venture analysis enhances understanding of the knowledge that actors seek from each other when forging alliances within the forest, energy, and especially,

bioenergy sectors. The data comprised 1,129 European strategic alliances and joint ventures that were either (1) formed by forest or energy firms or (2) related to bioenergy production from renewable energy sources. Alliances formed by the forest and energy companies were included in the analysis because these firms have knowledge that is relevant in the bioenergy sector. Analysis of the second group, which includes bioenergy-driven alliances, reveals the nature of the existing alliances in this field. The nature of all the alliances was studied in terms of the following factors: alliance activity in 1988-2007, main types of alliance, average size, primary motivation behind its formation, number of cross-industry alliances, and number of intra-industry alliances.

Main contribution. The paper describes the alliance activity within and between three closely related industries (forest, energy, bioenergy). It was possible to define bioenergy-driven alliances even though there are no SIC codes that define bioenergy firms: eight key words were used instead. The analysis reveals, first, that the bioenergy-driven alliances formed in the research period did not involve forest and energy firms: only 11 inter-firm relations from the bioenergy sector included a forest or an energy firm. Second, alliance activity between the forest and energy firms was rare. In general, the number of alliances differed greatly between industries, and the trend was even downward in the forest industry whereas bioenergy alliances showed a clear upward trend, especially since 2004. The most common identifiable motive for alliance formation in each industry was manufacturing. In sum, cross-industry alliances between forest, energy, and bioenergy firms are rather rare, which indicates that these firms have not made optimal use of their collaboration potential.

4.6 A summary of the publications and the study findings

The research objectives and focuses of each publication in the thesis are summarized in Figure 11. As the figure indicates, the first ones consider the research phenomenon from a broader perspective, and then the unit of analysis gradually shifts to the company level and to more detailed issues, such as the prospective actors operating in the field and the collaboration activities taking place among them. This research approach of considering the research topic from several different perspectives proved to be valuable in that the findings reported in the research papers complement each other and provide a

comprehensive view of the subject. In terms of theoretical perspective, the study combines insights from the literature on manufacturing strategy, strategic groups and strategic alliances. The fact that the RBV has been used to explain the rationale behind these approaches draws the perspectives together to form a coherent whole.

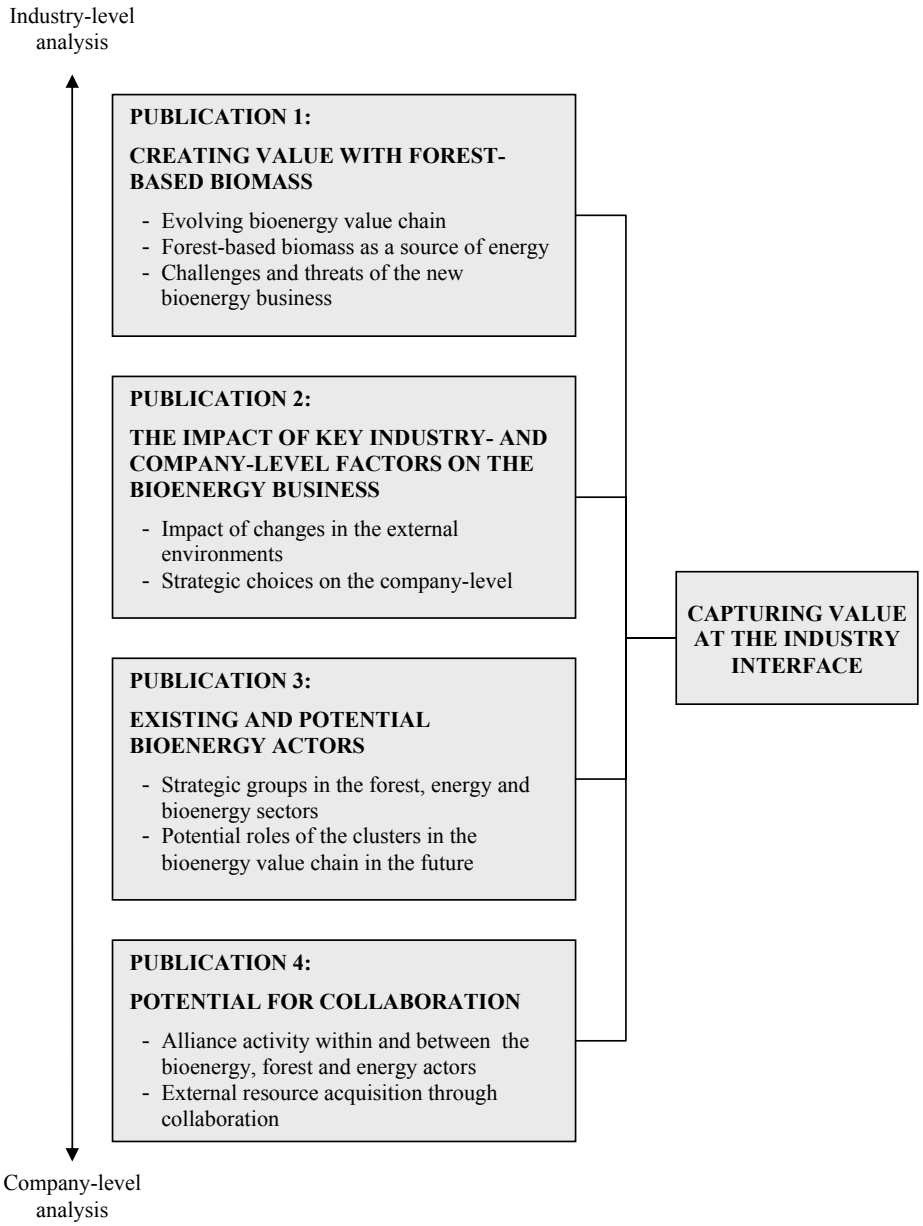

Figure 11: Research focuses within the publications

The key objective in the first research paper was to increase overall understanding of the forest-based biomass-for-energy business. The prospective analysis focused on the possible challenges, opportunities and threats that face the energy and forest sectors should they engage in novel bioenergy production. The discussion also focused on the role of forest-based biomass as a source of energy, and outlined the evolving bioenergy value chain. This explorative study, which was aimed at providing a holistic overview of a phenomenon that is just emerging, proved to be a valuable and necessary starting point for the subsequent, more detailed studies.

The second paper then identified the main industry- and company-level determinants that are influencing the bioenergy field. The study addressed questions such as what drives both the forest and energy industries to enter the field, what is the impact of policy interventions, how suitable and sufficient are the different raw-material bases for bioenergy production, how should its production be organized, should forest resources be converted into paper or energy, or both, and what are the advantages and disadvantages of collaboration between the forest and energy industries.

The third publication focused on the existing bioenergy actors and also the players with the necessary resources and knowledge in this emergent field. The underlying objective was to shed light on who could profit from forest energy in the future. The identified strategic groups structured the forest, energy and bioenergy industries and the strategic postures adopted by the companies. The cluster analyses also served as a basis for discussing the potential roles of these strategic groups within the emerging bioenergy value chain.

The key motive for the fourth paper, i.e. to shed light on the alliance activity within and between the forest, energy and bioenergy sectors, stemmed from the complementary resources possessed by the forest and energy industries: firms in the PPI exercise control over forest-based biomass resources and they also have a wealth of experience related to global large-scale industrial processes. In terms of the energy industry they possess knowledge and experience in the downstream operations of the energy value chain. This puts forest and energy companies in a unique position from which to capitalize on the emerging bioenergy business opportunities through collaboration. The study thus investigated whether these firms had used alliance formation as a strategy in

order to gain access to critical necessary resources. It also pinpointed inter-organizational relationships that were merely related to bioenergy but were formed by firms with a background in sectors other than forestry and energy. Including them in the analysis facilitated identification of firms that had already forged such relationships.

5 DISCUSSION AND CONCLUSIONS

5.1 Theoretical and methodological contributions

The contribution of this study lies mainly in the area of strategic management, and particularly the RBV of the firm. The RBV and the extended version, namely the dynamic capabilities approach, were utilized in analyzing a new field that is emerging at the intersection of two closely connected industries, i.e. forestry and energy. The research topic was also viewed through other theoretical lenses, including the literature on strategic groups and strategic alliances, and IO economics. Nevertheless, RBV logic was applied throughout. The primary focus was on resources, given the complementary resources and capabilities of forest and energy firms with respect to the bioenergy business. The RBV logic behind the studies on strategic groups (Publication no. 3) and strategic alliances (Publication no. 4) was as follows: the similarities in resource endowments were taken as one basis for identifying the clusters in the study on strategic groups, and the formation of strategic alliances was seen as a valuable external mechanism through which to obtain otherwise unattainable valuable resources and thus fill the resource gap. Furthermore, the RBV was behind the analysis of the business opportunities that are arising at the industrial intersection (Publication no. 1), and the investigation of the key company- and industry-level factors (Publication no. 2) in that knowledge, capabilities, and resources and their interplay with the changing business environment were considered critical sources of competitive advantage.

Gaining and sustaining competitive advantage – i.e. value creation – was seen in this study as interplay between the organizations' knowledge and capabilities and the environmental changes and opportunities. The forest industry in particular is undergoing structural changes that are affecting the sources of sustainable competitive advantage, but at the same time new business opportunities are arising in the external environment. Thus, the IO economics tradition was considered relevant in that it facilitates inclusion of external industry-level factors in the analysis. Thereafter the dynamic resource-based view was adopted as the main approach in analyzing the capitalization of the novel value-creating opportunities.

In some respects this study departs from the traditional RBV. *First*, emphasis was given to the exploitation and management of resources with VRIN attributes rather than to resource possession. In other words, the RBV of the firm was complemented with the dynamic-capabilities approach. *Second*, it was assumed that critical resources also exist beyond firm and industry boundaries. In other words, the study focus is not limited to resources that are currently owned or controlled by a firm but also considers the need to exploit arising opportunities by acquiring the resources that are lacking in unique ways. In terms of altering the resource base, this study focused on creating new competences through collaboration, i.e. pooling resources with the complementary resources of another firm. *Third*, it extends beyond traditional firm and industry boundaries and the typical research focus on one group of firms or one industrial sector. In other words, potential future competitors were identified based on their resource endowments, and the competitive landscape was extended beyond firms that were currently operating in the same field. It was thus understood that companies with different industrial backgrounds – but similar resource endowments – have the potential to operate in the same field in the future. In sum, the findings of the study offer some insights:

- Firm success requires congruence between its knowledge and capabilities and its environmental opportunities
- The creation of value-adding strategies in order to gain and sustain competitive advantage requires dynamic capabilities in terms of developing and managing the resource base
- Valuable and critical resources may span traditional firm and industry boundaries, and one should not focus solely on those that are currently owned or controlled by the firm
- Value creation through collaboration has become increasingly important as a means of filling the resource gap
- The competitive landscape extends beyond traditional industry boundaries, and competitors should be analyzed based on their resource endowments.

The current literature emphasizes that new sources of competitive advantage are increasingly to be found in knowledge and intellectual capital, intangible resources, and the ability to learn and adapt at a fast rate. However, the importance of intangible assets

in gaining competitive advantage was not emphasized in the overall findings of this study. One reason for this may be that the bioenergy field is in its infancy and not all the knowledge required in this novel business is recognized or understood. Currently the emphasis is mainly on developing technologies and processes. Of course, the existing experience and knowledge held by the forest and energy industries in terms of bioenergy production is considered favorable, but in the future the role of intangible skills and capabilities is expected to increase in significance.

The methodological contributions of this study relate to the unique data set used: many barriers had to be overcome in order to gather data on this novel, emerging phenomenon. *First*, the industry lacks historical and financial data, and therefore explorative methods of information collection were required. Both primary and secondary data sources were used, and qualitative and quantitative research methods were combined. This triangulation of data and methods was considered necessary, and it made it possible to shed light on how the industry has developed, what its current state is, and what it might be like in the future. In addition, data triangulation made it possible to explore the research topic from different, complementary perspectives. *Second*, on account of its topicality the subject matter is quite sensitive and open to conflicting opinions and interests. This was one reason why the Delphi technique, due to its anonymity criteria, proved to be valuable in shedding light on the research topic and generating insights into the key elements influencing this new value-creating business opportunity. Moreover the Delphi method facilitated the collection of opinions from experts with a background in different industries.

Third, the bioenergy industry lacks SIC codes, and there are no widely accepted definitions of a bioenergy firm. Consequently, it was impossible to take samples of bioenergy companies or bioenergy-driven strategic alliances as such from the databases. The companies were therefore identified from their websites and business descriptions, and by means of key-word searches. This explorative data gathering facilitated the application of the strategic-group perspective to the bioenergy sector, and the identification of strategic alliances related to this field. To the author's best knowledge, this thesis reports the first attempts to enhance understanding of the bioenergy field through the study of strategic alliance and strategic groups. In sum, there is novelty value in the explorative nature of this research.

5.2 Managerial implications

This section discusses the managerial implications of the study, especially with regard to how it may benefit managers in forest and energy companies. Overall, it enhances understanding of how value can be captured in the new forest-based bioenergy business, and of the determinants affecting the value creation. More specifically, it sheds light on the value-creating opportunities that are just starting to take shape, and which have mainly remained in the research province of engineers. In general, value creation with forest-based biomass is identified as one of the most fruitful options available for adding value in the forest and energy industries in the future. The reasons for this include price and availability problems with non-renewable energy sources, changing energy policies and taxation, as well as the development of novel energy technologies. The forest industry has experience in the procurement and use of forest fuel and in the related technology, whereas energy companies have knowledge specifically on delivering products to end-users. These complementary resources are thus seen as a catalyst for creating value through collaboration in the upcoming bioenergy business.

In other words, complementary resources with regard to process knowledge, infrastructure, and industrial and technological processes are considered to favor collaboration between forest and energy companies. Value creation by this means has not so far been common, however, at least involving these two sectors, and it seems that PPI firms in general have not adopted alliance formation among their strategies. Energy companies do appear to have reshaped their strategies through alliances, especially in recent years in accordance with the deregulation in the industry. This implies that forest and energy companies have not yet entered into bioenergy-driven inter-firm relationships to a large extent. Naturally it is possible that collaboration potential has been utilized in other ways than by forming strategic alliances. Nevertheless, it is suggested that they ought to consider their formation as a potential strategy for acquiring and complementing skills and resources.

The potential for collaboration appears to be particularly strong in the integrated forest biorefinery, which would co-produce pulp and bio-based products (energy and fuels). Given the synergy benefits associated with this construct, it would seem to outweigh the sole production of transportation fuels, for example, and moreover the potential for

increasing value seems to be remote within the traditional business models of pulp and paper production. On the strategic level it is considered important for the biorefinery to maximize its value added from the economic resources available to the mill, and for the novel products to meet customer needs. Moreover, it is suggested that the key factors in the bioenergy business include efficient procurement and logistics systems for handling large volumes of forest raw material. Potential sources of competitive advantage in addition to large-scale bioenergy production in the integrated forest biorefinery included small-scale bioenergy generation. This refers to bioenergy production from versatile fuel sources by smaller firms operating in a distributed manner near the raw material and point of use.

The process of transforming traditional pulp mills into biorefineries will nevertheless take time. A practical step in the short run might be to develop the small-scale utilization of biomass close to its origin. Environmental concerns also appear to favor the more simple use of wood. Nevertheless, greater value-creating potential is expected from large-scale bioenergy production. Co-producing traditional pulp and paper products together with bioenergy and biofuels would entail adopting more strategies based on economies of scope instead of merely focusing on traditional economies of scale as the only source of competitive advantage.

There are many factors affecting the success of collaboration between forest and energy companies. It is suggested that technology, new skill sets and financing are among the main targets for development. In addition, biomass transportability and investment costs should also be considered carefully. Currently one of the major challenges is the poor financial viability of wood-fuel energy compared to other fuels. In the future, however, the costs of energy from renewable sources and of fossil-fuel-based energy are expected to head in opposite directions, which would improve the competitiveness of the former. Quite surprisingly, however, the commercialization of bioproducts does not seem to be held up by the lack of a logistics chain from the mill to the customers. There are also many uncertainties about the future development of the bioenergy markets. In particular, there are concerns about potential changes in policy interventions and regulative decisions. These matters are generally beyond the companies' control, and adjustments to taxation and subsidy policy may change the prospects of the bioenergy business relatively quickly, and influence the roles the actors could play in the market.

The acceptability of future bioenergy products among customers also remains a question mark. For instance, there has been discussion about Neste Oil's palm-oil-based NExBTL biodiesel concerning competition with food production and its negative environmental consequences. In their recent study Dwivedi and Alavalapati (2009) analyzed four stakeholders' (non-governmental organizations, government, industry, and academia) perceptions of forest-biomass-based bioenergy development in the southern US and found that all the groups were generally in favor. However, neither customers nor the general public were included in the study. Nevertheless, bioenergy production from forest-based biomass (e.g., sticks, stumps and by-products of wood processing) is likely to have less negative impacts on the environment and to compete less fiercely with the food chain.

With regard to the existing and prospective actors in the bioenergy field, this study identifies nine strategic groups from the forest, energy and bioenergy sectors, and examines their potential roles in the evolving value chain. The value chain is considered all the way from the sources of the raw material to the delivery of bioenergy to the end customers, and key sources of competitive advantage and the necessary capabilities within each part of the chain are identified. The characteristics of the firms currently operating in the forest, energy and emergent bioenergy sectors are then reflected against the capabilities required to create added value at different stages of the value chain.

It is thus suggested that different strategies can be applied in order to create value within the bioenergy sector. First, a company could position itself to exploit forest-based raw material, and efficiently provide it to various end uses. Second, a company could create value through small-scale heat and electricity generation, the key sources of competitive advantage lying in the versatile and flexible use of fuel sources near the raw material and the point of use. Third, the firm could engage in large-scale biofuel production that could potentially be integrated into pulp and paper production. Finally, it could specialize in downstream actions in the bioenergy value chain, i.e. delivering the bioproducts to the end users.

It is suggested that small bioenergy firms have the existing resource base to create value in small-scale bioenergy production, whereas the larger forest and energy organizations seem to have the potential to create value on a large scale. Energy firms in particular are

considered to be in a focal position in the later stages of the value chain on account of their extensive distribution systems. In general, existing bioenergy companies – although they are growing fast – are small players in the field, and it may be that collaboration with larger firms will pay off.

In sum, bioenergy is currently a sector in which firms are continually looking to redefine their roles and positions. It is to be expected that competition will intensify in the future as more and more players express their interest in the phenomenon. Given the existing knowledge and resource base in the forest and energy industries, it is likely that these firms are in particularly promising positions to create added value through collaboration. They can develop the required skills and resources more quickly than companies with different industrial backgrounds, or entirely new entrants starting their operations from scratch. It must nevertheless be borne in mind that there will be other companies capitalizing on this emerging phenomenon if the forest and energy industries do not exploit the opportunity.

5.3 Limitations

This section discusses the limitations of this study. The overall research setting was rather explorative both theoretically and methodologically, not least because the phenomenon under scrutiny is just emerging and has not been the subject of extensive research, not at least from the strategic-management and business perspectives. The study started from the premise that there was a need to increase general understanding of this new emerging industrial sector, and therefore the investigation covered different angles and applied multiple research methods.

In terms of *theoretical limitations*, one could question whether the elements of the research context that were chosen to illustrate the phenomenon were all necessary, and whether they gave a coherent view. In short, the thesis considered strategic choices in terms of the resources available to firms, and identified prospective bioenergy actors and their strategic posture. To this end it analyzes the key company- and industry-level factors affecting the business, as well as the strategic groups and the strategic alliances within the industries. The fact that the phenomenon had to be viewed through multiple

lenses decreased the possibility of a more in-depth analysis of all the approaches. At the same time, however, linkages are shown and the various approaches are connected in novel ways. The aim of the study, i.e. to explore the phenomenon from many viewpoints and thus to lay the foundation for further research, also limited the testing of the theories and hypotheses. It does not provide any statistical evidence on whether collaboration between the forest and energy industries will pay off in the future. On the evidence produced, however, one could make suggestions concerning future strategic choices and the many factors that decision makers need to consider carefully.

There are also *methodological limitations* that need to be addressed. Because of the lack, or at least the scarcity of, comprehensive historical and financial data on the subject the data set had to be collected in novel ways and by utilizing various research methods. Consequently, replicability may be difficult. One could also question issues such as whether the panel of experts chosen for the Delphi study was representative, and whether the samples of bioenergy companies and bioenergy-driven alliances in the strategic-group and strategic-alliance studies were representative in that they had to be identified through the websites and deal texts of the companies and through key-word searches.

Another possible limitation is that the generalizability of the findings outside Europe and over different countries and cultures may be limited because the quantitative analyses included European firms (Publications no. 3 and 4), and the panelists in the qualitative Delphi study were all of Finnish extraction (Publications no. 1 and 2). Thus, the perspective in this study was primarily that of Finland and Europe, although the questions, issues and also the actors involved are concerned at least to some extent with the global bioenergy business. Major global trends and changes within the forest, energy and bioenergy fields were acknowledged in an attempt to allay this limitation.

In the data gathering it turned out to be difficult to differentiate forest-based biomass from other fuels used for bioenergy production, although it is the most interesting renewable energy source from the perspective of the forest and energy industries. Furthermore, due to the fact that the bioenergy industry is just emerging, the available financial information on the companies covered a rather short period of time. It must also be kept in mind that, given the novelty of the forest energy business in general, the

terms and phrases related to it could be understood differently given the lack of fixed definitions. However, many measures were taken to ensure the reliability and validity of the research data. For example, multiple databases were cross-checked, and the information gathered was collated by another researcher. In sum, all the research methods could be criticized on some basis, on account of which data and method triangulation were used in order to obtain a more complete view of the subject under investigation.

5.4 Suggestions for future research

As one of the first non-technological studies on bioenergy this thesis opens up many avenues for future research. *First*, the study could be replicated in another context, such as among American firms, in order to further increase understanding of the global developments within the bioenergy field. This would also facilitate comparison between the different geographical and cultural areas. *Second*, the research design used in this study could also be applied to other industrial contexts in which similar convergent developments and the blurring of industry boundaries are taking place (e.g., the interface between the PPI and information technology). *Third*, it would be interesting to study in more detail other actors that might have potential in the bioenergy sector in the future. For instance, what is the role of firms that are entering the sector with completely different industrial backgrounds, and what is their influence on the forest and energy companies' role in the field? *Fourth*, as the bioenergy sector develops further studies could focus on the organization of bioenergy production and the make-or-buy decisions between the companies involved, and on whether any other actors are closely involved in the business operations. *Fifth*, in the future longitudinal studies are needed that examine the effects of this business opportunity on the overall performance of the firms. This research objective would also shed light on the overall role of the bioenergy business in the forest and energy industries, which at the moment is difficult to predict. *Sixth*, there is also a need for studies that would document in detail both successful and unsuccessful cases within the bioenergy field in order to increase understanding of why some firms succeed and some do not.

Seventh, research exploring general public opinion regarding the acceptability of various bioenergy products might be valuable. This would shed light on whether customers in general are willing to accept novel bioenergy products, for instance, and potentially to pay a premium price for them. *Eighth*, research focusing on the required capabilities for managing collaboration projects within the bioenergy field would be useful given the variety of actors involved in the bioenergy value chain. *Ninth*, there is a need for studies focusing on managing knowledge and intangible skills and capabilities, given their expected increasing importance in gaining and sustaining competitive advantage in the future. *Tenth*, it might also be fruitful to analyze in more detail the nature of change within the forest and energy industries. McGahan (2004) introduces four industry trajectories in which the prerequisites of success differ, and thus stresses the importance of distinguishing truly important developments from more transient distractions. Therefore one could explore what is essential for success in the evolutionary environments of the forest and energy industries in order to create strategies that reflect the nature of change and long-term opportunities. Moreover, it would be interesting to find out whether these two industries are following the same trajectory, and if not whether this hampers collaboration between them. *Finally*, in terms of data-collection methodology, it would be valuable to conduct a large-scale survey emphasizing the issues addressed in this study, thereby accumulating more evidence on them and their relative importance in the bioenergy business.

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