

Firm Capabilities in the Finnish Forest Cluster: Comparisons Based on Self-Organizing Map

Joonas Järvinen and Jaakko Linnakangas

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This paper examines the capability portfolios of Finnish forest cluster firms in 1998–2008. In particular, the focus is on what kind of capabilities the firms in the cluster have developed, whether the firms have developed such capabilities consistently, and whether they have developed similar capability portfolios. Further, a particular focus is on the links between innovativeness and other identified capabilities. We approach the topic with an exploratory quantitative analysis of the annual reports of 11 large firms in the cluster by using computerized content analysis and a self-organizing map as the main research methods. Based on the content analysis and earlier literature, we first identify fifteen capabilities, and then build capability portfolios for the firms on the basis of the results of the self-organizing map. At the firm level, the results reveal both similarities and differences in the capability portfolios of the forest cluster firms. Similarly, we identify both continuity and change in the development of the portfolios. At the cluster level, the focus is on innovativeness capability and its relationship with other capabilities. The results suggest that especially being strategic, market-oriented, and monitoring the external environment are positively related with innovativeness; in contrast, a focus on finance and change seems to suppress innovativeness.

Keywords forest cluster, capability, content analysis, self-organizing map

Addresses Department of Industrial Engineering and Management, Aalto University, P.O.Box 15500, FI-00076 Aalto, Finland **E-mail** joonas.jarvinen@aalto.fi

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1 Introduction

1.1 Empirical Background

An essential question for organizations is how to create and sustain competitive advantage in the long term. Over time, researchers have tried to answer this question with a number of theories. In recent decades the dominant theories have proposed that an organization's resources and capabilities are behind superior performance. Competition forces firms to continuously create and reconfigure their resources and capabilities to fit the changing competitive environment (e.g. Augier and Teece 2009).

The same applies to clusters. In the globalized world, the activities of firms have crossed national borders, and such issues as comparative advantage have become less important in competition than they used to be. The performance of a cluster has become very dependent on how it can develop its capabilities (Porter 1998) and on the knowledge the cluster possesses (Tallman et al. 2004). Its innovativeness depends on its ability to recombine technological and organizational capabilities (Heidenreich 2005). The knowledge and capabilities of a cluster are receiving more and more attention, even in traditional mature industries, which can also be knowledge intensive (Porter 1998).

The forest industry has traditionally been one of the main drivers of the Finnish economy (e.g. Lamberg 2005, Lamberg and Laurila 2005, Kuisma 2008, Järvinen et al. 2009). Today, the Finnish forest industry is undergoing an era of change, perhaps the most prominent in its history (Hetemäki et al. 2006, Häyrynen et al. 2007). As a result, firms have experienced a decline in their performance. Changes for example in technology, competition, and demand are reshaping the setting where firms are operating. Global competition, the growth of developing countries, changes in energy costs and so forth are all challenges for Finnish forest firms (Lamberg et al. 2006, Häyrynen et al. 2007, Lähtinen 2007, Stendahl and Roos 2008). Thus, the capabilities that have been developed in the Finnish forest cluster in the past do not guarantee a high level of performance and competitive advantage. In order to retain its competitiveness and vitality, the Finnish forest

cluster must either capitalize its current capabilities in new ways or develop new capabilities. However, since capabilities emerge slowly as a product of history (they are often highly path-dependent) (Teece et al. 1997, Helfat and Peteraf 2003), developing totally new capabilities is not a plausible option for solving the performance problems of the cluster at least in the short run. Thus, the renewal and competitive advantage of the cluster must be mainly based on developing existing capabilities: applying them in new ways and in new types of configurations.

Developing capabilities is not possible, however, without having a clear picture of them. Thus, in order to offer the first steps for the Finnish forest cluster and firms in their quest to identify and renew their capability portfolio, we aim in this article at offering new tentative information on the capabilities of the cluster and its firms. We do this by exploring and examining the capability portfolios of the cluster and its largest firms during 1999–2008, and by employing a novel methodology in the form of a computerized content analysis of annual reports and a self-organizing map. In particular, the focus of this article is on what kind of capabilities the firms in the cluster have developed, whether they have developed capabilities these consistently, and whether the firms have developed similar capability portfolios. Further, at a cluster level, the focus is on the links between innovativeness and other identified capabilities, since innovativeness is often considered an important determinant behind both firm and cluster level competitive advantage and performance (Lin et al. 2006, Stendahl and Roos 2008, Menzel and Fornahl 2010).

In general, the results of the article offer new information on the capabilities of the Finnish forest cluster and firms. The article contributes to earlier research also by introducing a novel methodology and theoretical framework to study capabilities and their development processes. In this sense, the article also responds to recent calls for longitudinal research on capability creation and evolution, including in the context of more traditional industries (Easterby-Smith et al. 2009).

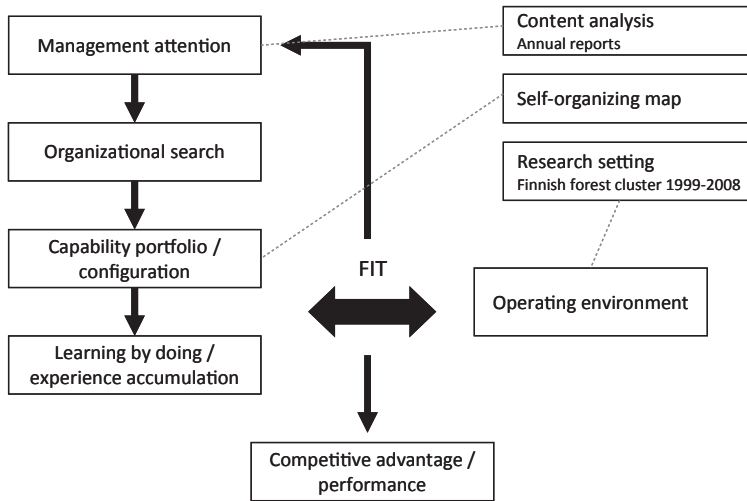


Fig. 1. The theoretical framework and its link to research methodology.

1.2 Theoretical Framework

Organizational capabilities are often defined through so-called routines (e.g. Nelson and Winter 1982, Grant 1996, Eisenhardt and Martin 2000). At their simplest, routines mean how things are done in an organization (Nelson and Winter 1982). More accurately, routines are all the regular and predictable behavioral patterns of an organization (ibid.). Winter (2000) defines organizational capabilities as a collection of routines which, when combined with other resources, give options for different types of outputs. Thus, a firm’s capabilities define what types of outputs it can achieve with its inputs (Winter 2000). At present, firm capabilities are seen as those firm resources that best provide sustainable competitive advantage (Grant 1996).

Fig. 1 presents the theoretical framework through which the paper approaches the capabilities of the Finnish forest cluster firms, constructed on the basis of earlier research, as well as the links of the framework to the empirical part of the paper. The framework sees management’s attention to capabilities and routines as the main driver of organizational search, a process by which firms adapt their portfolio of capabilities to changes in the environment (Levinthal 2000, Lavie 2006). That is, firms look for better fit-

ness with their environment by changing their configuration of capabilities. In the framework, it is thus management that affects which capabilities the firm prioritizes at different points of time and which it develops less. Due to firms’ (usually) scarce resources, the prioritization of which capabilities to develop and which not is a necessity.

The management continuously receives feedback from its operating environment and redresses the development of capabilities accordingly. The more a firm puts effort into some capabilities, the more it accumulates experience and thus ‘becomes better’ in them. It is also important to note that since capabilities are path-dependent by nature (Helfat and Peteraf 2003), they cannot be developed overnight. Thus, to build strong capabilities, they must be accumulated through experience over time (Zollo and Winter 2002). In other words, they must be learned by doing (Pisano 2000). While capabilities are learned and remembered by doing (Nelson and Winter 1982), firms can also forget them. Therefore, their consistent development is in a central role.

The last building block in the framework is the link from the firm’s capability portfolio to performance. Only by devoting consistent attention to those capabilities (i.e. accumulating experience about them) and building a capability portfolio

that best fits the demands of the environment will the firm be able to achieve (sustained) competitive advantage (Grant 1996, Teece et al. 1997). It is, however, important to note that the operating environment is rarely stable. Changes in the environment may quickly make the firm's capability portfolio outdated and result in declining performance. Thus, especially significant and sudden changes in the environment may require a firm to considerably modify its capability portfolio and develop totally new capabilities (which, however, is a long process due to the nature of capabilities).

2 Data and Methods

2.1 Research Sample, Data, and Data Collection

The research context of the paper is the Finnish forest cluster. By following the definition of a cluster as "geographic concentrations of interconnected companies and institutions in a particular field" (Porter 1998:78), the cluster can be seen to comprise all the firms operating in the forest industry value chain – in addition to the producers of pulp, paper, board, and different types of wood products also suppliers, customers, and service providers related to the industry (cf. Tykkyläinen et al. 1997).

Based on the definition of the cluster, the following eleven large firms with a central role in the Finnish forest cluster were chosen as the research sample of the article: Andritz Group (offering customized plants, process technologies, and services for hydropower stations for the pulp and paper industry), Ciba (chemicals producer), Kemira (chemicals producer), Metso (machine producer), Metsä-Botnia (chemical pulp producer), Metsäliitto (forest product producer), M-Real (paper, board, and pulp producer), Ponsse (producer of forest harvesters, control systems, and services), Stora Enso (paper, board, and pulp producer), Tamfelt (producer of paper and board machine clothing and filter fabrics), and UPM (paper, board, and pulp producer). The included firms are the shareholders of the Finnish firm Forestcluster Ltd (responsible for the operation of

the cluster's strategic center for science, technology and innovation).

The data that we used in measuring the attention of the managers of these firms for the capabilities of interest was extracted from corporate annual reports. The annual reports were downloaded from the firms' websites. If a firm released separate business and environmental reports, they were merged into one. The total number of annual reports equaled 101, meaning that nine reports were not available for the observation period¹.

Annual reports have been used as material in a number of previous business studies (for a review, see Stanton and Stanton 2002), and also widely in studying managerial cognition and attention (Osborne et al. 2001, Kaplan et al. 2003, Eggers and Kaplan 2009). Despite their wide use, when it comes to studying managerial attention, several caveats should be discussed. First, although annual reports are highly important documents for firms' management, the text in them is not necessarily fully 'from their pen'. Considering that a written text has meaning (Janasik et al. 2009), thus who has written the text must also have a meaning. Annual reports are usually written by the public relations department and accepted by the management. They can also be written by the same people year after year, and they can be based on the previous years' annual reports. These factors can have an effect on the language and can position the annual reports systematically closely to each other year after year. Second, managers may use annual reports for signaling purposes (Salancik and Meindl 1984, O'Donovan 2002, Stanton and Stanton 2002). For example, when it comes to the important stakeholders of the firms, like shareholders or financial markets, managers may try to emphasize those issues in the reports that they think the stakeholders want to read. Thus, it is possible that annual reports are just outcomes of symbolic management rather than being representative of the managers' real actions (Westphal and Zajac 1998). Due to the possibility that especially the last issue might affect the results of our analysis, we will further discuss the problem in the discussion section of the article.

2.2 Research Methods

The article employs two research methods. First, content analysis is used to 1) identify the relevant capabilities of the forest cluster firms (along with earlier literature on capabilities) and 2) measure the level of attention that the firms devote to the identified capabilities. Second a self-organizing map is used to illustrate and analyze the quantitative content analysis data as regards the capabilities. The methods are briefly introduced in the following.

In general, content analysis can be defined as a systematic and objective way of analyzing different kinds of data, usually textual data (Kyngäs and Vanhanen 1999) (see also Krippendorff 2004). Recently, using computers for automated content analysis has increased in popularity (Riffe et al. 1998). At the simplest, computer-aided content analysis is done by counting the frequencies of words in the data (Riffe et al. 1998); this is what we will also do in the current study. Perhaps the greatest advantage of computer-aided analysis is the speed at which computers can go through large amounts of data. If used properly, computers are reliable, always yielding the same information out of the data.

A recent addition to content analysis methodology is computer-aided mixed-methods research (Janasik et al. 2009). Already fifteen years ago, artificial intelligence software was used to analyze content analysis data in psychological studies (Gottschalk 1994). Janasik et al. (2009) propose that a technique called a 'self-organizing map' is a useful tool for analyzing and categorizing textual data, by improving the quality of the inferences of the researcher and also by providing a relatively objective approach.

The self-organizing map (SOM), also called the Kohonen map, is one of the most popular neural network methods (Kohonen 2001). This is an algorithm originating in artificial neural network research, which studies algorithms that have analogies with the functioning of the brain (ibid.). What makes the SOM special compared to other neural network methods is that it performs unsupervised learning (Kiang and Fisher 2008) (the process of "teaching" the map is described elaborately in Kohonen (2001) and Janasik et al. (2009)).

The self-organizing map uses high dimensional input data to produce an ordered non-linear, most often two-dimensional, projection (map) of the data as an output. The input data consists of samples with n numerical attributes². The samples can therefore be thought of as vectors in n -dimensional space, and the attributes as the lengths of component vectors. The output map consists of so-called nodes, also referred to as neurons (see Fig. 3). The shape of the node is usually a hexagon. Each node on the map has an associated prototype vector (also called a reference vector), m_i , so that the vectors resembling each other are placed on the nodes near each other and vice versa. The nodes which are near each other are called neighbors. The shape of the map is pre-defined, so that every node on the map has a unique static place and equal size (Vesanto 2002).

The self-organizing map can be visualized in many different ways (Vesanto 2002). In this article, we use a U-matrix (Ultsch and Siemon 1990) and component planes. This is because they are suitable for making inferences about the similarity of the samples, their properties, and the relationships between the variables. The component planes illustrate the values of different variables in different parts of the map. The U-matrix illustrates the distances between the nodes, and that is why the U-matrix includes extra nodes between neighboring nodes. There is only one U-matrix for one SOM. If the data is such that it includes similar enough samples that can be grouped into clusters, the clusters can be found in the U-matrix. This is because in the areas where values in the U-matrix are relatively low, the nodes are closer to each other (resemble each other), whereas high values differentiate areas from each other.

There have been a vast number of studies in different fields using self-organizing maps as a visualization method, varying from gene research (Chen et al. 2001) to face recognition (Lawrence et al. 1997). Self-organizing maps have been used also to study the contents of annual reports (Back et al. 2001). Considering the focus of this article on the changes in forest cluster firms' capability portfolios, we use the SOM to illustrate the capability portfolios and changes in them. Thus, in the first place, we are not interested in using the SOM for clustering purposes.

In comparison to many other clustering meth-

ods (e.g. hierarchical, iterative partitioning or two-step cluster analysis) or data visualization methods (e.g. multi-dimensional scaling), the SOM has several advantages (see e.g. Budayan et al. 2009, Janasik et al. 2009, Stavrou et al. 2010). First, the SOM can be used at the same time both to reduce multidimensional data by clustering them and to project them nonlinearly on a two-dimensional display (Vesanto, 1999, Kaski, 1997), which is important for the current study. Second, the SOM has visualization abilities that make it a very powerful tool for exploratory analysis (e.g. it accomplishes vector quantization and projection interactively, the low-dimensional map can be visualized to reflect spatial properties of data, and the SOM has a regularly shaped projection grid that makes it easy to compare different visualizations). Third, the SOM needs no priority assumption about the distribution of data: by using the SOM, it is possible to overcome problems associated with finding the appropriate underlying distribution and the functional form of the underlying data in the structuring task that is often encountered, for example, when using traditional cluster analysis. Fourth, according to many studies, the SOM is able to outperform the traditional data reduction and clustering techniques in both efficiency in running the algorithm and extracting results as well as the quality of the solution (e.g. Budayan et al. 2009).

3 Data Analysis

3.1 Content Analysis Process

The data analysis, from content analysis of the annual reports to data preparation and the creation of the self-organizing map, is described in the following two sections.

The downloaded annual reports were first opened in the Atlas.ti-software. The word cruncher function of Atlas.ti was used to count the word occurrences in the annual reports. The stoplist of the word cruncher was enabled in order to avoid miscalculations, because some special characters were counted as words without the stoplist.

After the word frequencies for all the words in the annual reports were listed, they were catego-

rized to represent organizational routines, which form capabilities. Initially the number of different words in the annual reports was 35, 190. The words that occurred most often were left out first. These included the most common words, such as “the, that, it, and of”. Also those words which occurred a hundred times or less were left out, which means that the total number of occurrences for the included words was more than the number of the annual reports. These steps were taken because the most and least common terms are typically not good candidates for terms (Janasik et al. 2009). Next, the remaining 2, 016 words were gone through manually; words that were considered meaningless regarding the capabilities (e.g. ‘during’ and ‘January’) were left out. Eventually 359 keywords and their derivatives were used to describe the capabilities. These words were then categorized into groups according to what capabilities they may represent. A list of capabilities identified on the basis of earlier literature was used as a guideline to categorize the words and identify the relevant capabilities. In order to ensure the validity of the categorization, the process was first accomplished by two researchers independently. The results were then compared (the categorization and the list of capabilities were generally in line with each other) and all the discrepancies were elaborately discussed. The categorization resulted in 15 groups of keywords identifying the capabilities (see Table 1)³. The frequency for each capability was counted as the sum of occurrences of its keywords.

3.2 Preparing the Data and Building Self-Organizing Maps

The process of using self-organizing maps for text mining followed the one presented by Janasik et al. (2009). After the last phase of the content analysis, where the frequencies for the capabilities in the annual reports (used as dimensions/sample attributes for initiating the SOM) were calculated, we transformed the absolute numbers of capabilities in the annual reports to relative ones. Thus, total attention (100 %) was divided to capabilities according to keyword occurrences (see e.g. Janasik et al. 2009, Laamanen and Wallin 2009). This was done in order to make sure that

the different lengths of the annual reports would not distort the maps, and because the interest was in the relative attention given to the chosen capabilities.

Next, we built the self-organizing map as follows. The data was first gathered into a table format following Vesanto (2002). The SOM toolbox for MATLAB (<http://www.cis.hut.fi/projects/somtoolbox/>) was then used to find the best-matching units for the samples, to teach the map, and the graphical representation (in addition, basic photo editor software was used for the black and white maps, which represent the positions of the annual reports). The quality of the results was evaluated by three measures: quantization error, topographic error, and average distortion

measure, offered by the toolbox. The analysis that follows is conducted on the basis of the most optimal SOM.

4 Results

4.1 Results of Content Analysis

Starting from the results of the content analysis, the identified capabilities are presented in Table 1. In addition to the capabilities, Table 1 presents the links of the keywords to earlier literature in the topical area. The lists of the words and their frequencies as well as elaborate definitions of

Table 1. Identified capabilities based on content analysis, and their links to earlier literature.

Identified capabilities	Links of capabilities to earlier literature
Financial capability	Cost control* (Day 1994), Financial management* (Day 1994), Financial management capability (Kochhar 1997)
Being responsible	Corporate social responsiveness capability (Black 2006), Environmental health and safety* (Day 1994), Social and ethical response capabilities (Litz 1996), Stakeholder integration capability (Sharma and Vredenburg 1998)
Being strategic	Strategy development* (Day 1994), Strategic planning capability (Yam et al. 2004)
Monitoring competitive environment	Market-linking capability (Song et al. 2007), Market sensing* (Day 1994), Competitive scanning capabilities (McEvily and Zaheer 1999)
Internal development	HR capability (Park et al. 2004), Human resources management* (Day 1994)
Managerial capabilities	Dynamic managerial capability (Adner and Helfat 2003), Leadership capability (Conger 2004), Managerial capability (Van den Bosch and Van Wijk 2001, Boeker and Wiltbank 2005)
External sourcing	Alliance capability (Kale et al. 2002, Draulans et al. 2003), Alliance management capability (Rothaermel and Deeds 2006), Integration capability (Zollo and Singh 2004), Relational capability (Lorenzoni and Lipparini 1999, Helfat et al. 2007)
Marketing capability	Channel bonding* (Day 1994), Customer linking* (Day 1994), Customer order fulfillment* (Day 1994), Marketing capability (Grant 1991, Dutta et al. 1999, Yam et al. 2004, Vorhies and Morgan 2005, Song et al. 2007), Pricing* (Day 1994)
Procurement/logistics capability	Distribution capability (Grant 1991), Integrated logistics* (Day 1994), Logistics service capabilities (Lai 2004), Purchasing* (Day 1994), Supply chain management capabilities (Tracey et al. 2005)
Structuring	Resource divestment capability (Moliterno and Wiersema 2007)
Operational capabilities	Manufacturing capabilities (Schroeder et al. 2002, Yam et al. 2004), Manufacturing processes* (Day 1994), Quality management capabilities (McEvily and Zaheer 1999)
Service capability	Customer service delivery* (Day 1994), Service capability (Grant 1991, Athreye 2005)
Change	Dynamic capability (Teece et al. 1997)
Innovative capabilities	Innovation capability (Cavusgil et al. 2003, Panayides 2006), New product/service development* (Day 1994), R&D capability (Yam et al. 2004), Technology development* (Day 1994), Technological innovation capabilities (Yam et al. 2004)
Internationalization capability	Internationalization capability (Chetty and Patterson 2002, Contractor 2007)

* From the figure "classifying capabilities" (Day 1994:41)

the capabilities are available from the authors on request.

4.2 Self-Organizing Map

With regard to the self-organizing map, Fig. 2 first presents a label map indicating the positions of the annual reports in the self-organizing map during the time period studied. Fig. 3 then presents the component planes for the attributes (capabilities) and the U-matrix of the SOM. Basically, the component planes show the values of the variables in different nodes of the SOM: red indicates higher values (relatively more attention), whereas blue represents lower values. The U-matrix indicates distances between the nodes. Thus, for example, when interpreting the capabilities that Ciba has paid attention to during the period of analysis, the label map (Fig. 2) first tells the location of the firm’s annual reports in the SOM and the component planes (Fig. 3) then indicate the level of attention the firm has paid to the identified capabilities year by year.

4.2.1 Firm-Level Interpretations of the Maps

This section presents the firm-level inferences of the maps on the basis of the SOM. The main interest of the analysis is in capabilities which have received relatively much attention consistently, as earlier literature suggests that a firm is able to achieve a high level of capability accumulation only with consistent development (Nelson and Winter 1982). If a firm has retained its position in the map, the focus of its capability portfolio has been consistent. However, movement does not, as such, mean that the development of individual capabilities could not be consistent – as long as the firm moves to an area representing high attention. For simplification, the levels of attention are from now on classified as low, moderate, or high.

As Table 2 indicates, every firm in the sample has its own portfolio of capabilities. When considering the paper and pulp firms, they generally stand out as being the most financially-oriented: despite Metsä-Botnia, all of them pay at least moderate attention to finance during the period of

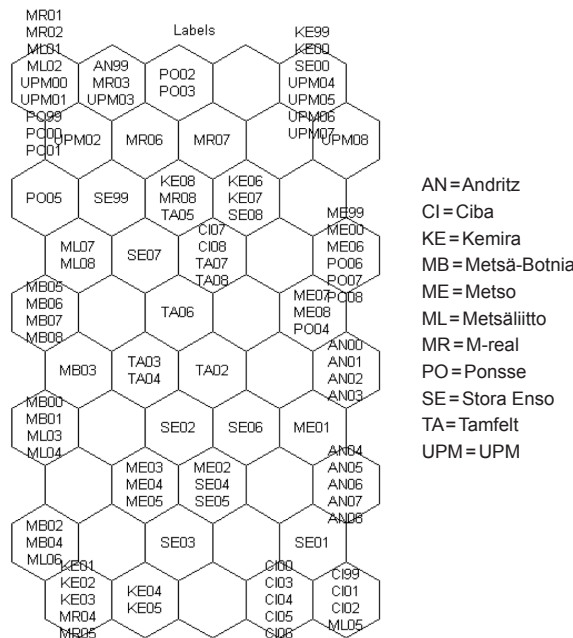


Fig. 2. Self-organizing map showing labels. In the map, the numbers after the firm abbreviations indicate the year of the annual report.

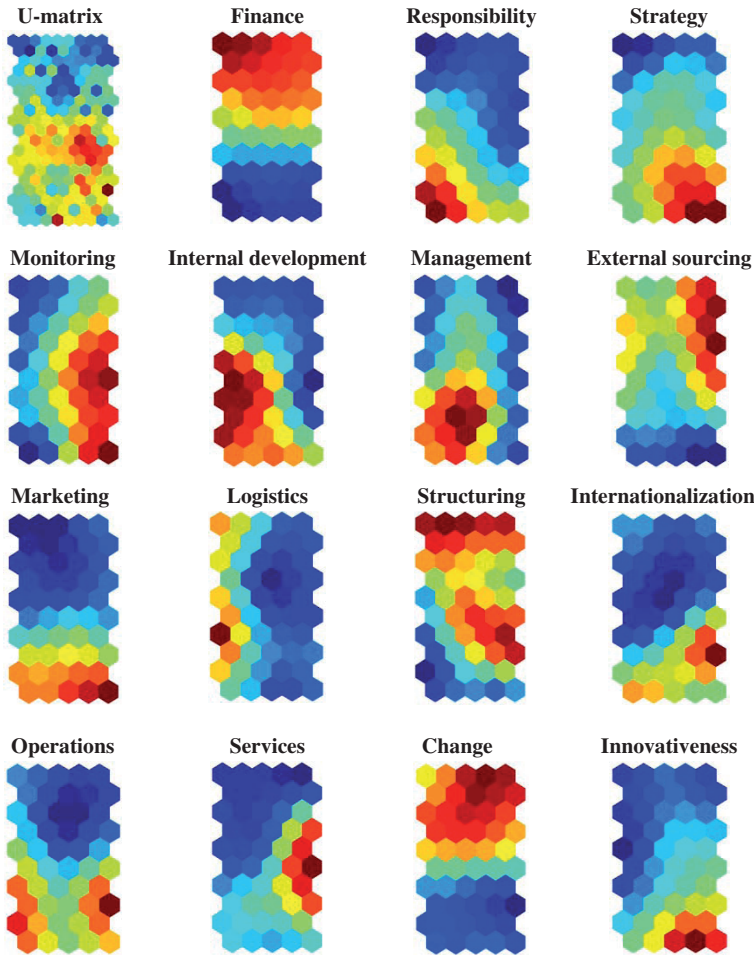


Fig. 3. U-matrix and component planes for the variables.

study. All of them also devote a fairly high level of attention towards logistics capability. Surprisingly, they do not distinguish themselves with attention towards operations. What also connects the firms is that they have neither innovation nor services in their capability portfolios. In particular, Stora Enso stands out from the other pulp and paper firms by having a strong capability portfolio when it comes to the identified capabilities: for example, what differentiates the firm from other pulp and paper manufacturers is its particular attention to being strategic and monitoring (a high level of attention), but also to marketing and sales and innovativeness (moderate level of attention).

What connects the chemical producers (Kemira and Ciba) is that they devote fairly much attention to responsibility, which is natural, as they are probably the ones who are the most confronted by environmental issues. However, neither pays attention to finance or logistics. Ciba differs probably the most from the other firms: it distinguishes itself consistently with its strong market-orientation, and its attention to being strategic and innovativeness (Kemira also pays moderate attention to these capabilities).

The four forest industry machine or equipment manufacturers (Andritz, Metso, Ponsse, and Tamfelt) differ in some respects from each other when it comes to their capability portfolios. This

Table 2. Summary of the level of attention (H=high level of attention; M=moderate level of attention) the sample firms have devoted to the considered capabilities. The table has been constructed on the basis of Fig. 2 and Fig. 3.

Capability / Firm		Finance	Responsibility	Being strategic	Monitoring	Internal development	Management	External sourcing	Marketing & sales	Logistics	Structuring	Internationalization	Operations	Services	Change	Innovativeness
Machine / equipment manufacturers for forest industry	Andritz			M	H			M	M		H	H	H	H		H
	Metso		M	H	H	M	H	H	M			M	M	H		H
	Ponsse	H			M			H		M	H			M	H	
	Tamfelt	H		M	M	M	H				H				H	
Chemicals manufacturers	Kemira		H	M	M	H	H	M	M		M	M	M		M	M
	Ciba		H	H	H	M			H			M	M	M		H
Pulp, paper, and forest products manufacturers	Metsä-Botnia		H			H	M			H			H			
	Metsäliitto	M	M			H	M	M		H			M		M	
	M-Real	H	M				M			M		M			H	
	Stora Enso	M		H	H	M	M		M	M	H	M	M		M	M
	UPM	H						H		M	H				H	

is, however, rather natural when taking into consideration the different market and product sectors they operate in. The only capability the four firms devote at least moderate attention to during the period is monitoring. In addition, all but Metso devote a high level of attention to structuring. Furthermore, what differentiates the firms from the pulp and paper manufacturers, in particular, is that three of them devote at least moderate attention to services.

Next, when it comes to how consistently the firms develop their capabilities, the results indicate differences between the firms. Regarding the whole portfolio, particularly Andritz, Ciba, M-Real, and UPM are the most consistent ones (i.e. the locations of their annual reports in the label map [Fig. 2], remain close to each other year after year or move to a direction in which the attention towards capabilities remains at the same level). Also Metsä-Botnia and Tamfelt seem to be relatively consistent. Kemira can be described as semi-consistent, as it operates in two consistent ‘modes’ of very different portfolios of capabilities.

However, being inconsistent regarding the portfolio does not mean that individual capabilities would not receive consistent attention. For

example, Metsäliitto is one of the least consistent regarding the whole portfolio, but logistics receives regularly more attention than in the other firms. Out of all capabilities, particularly finance (Ponsse, Tamfelt, M-Real, and UPM), change (the same firms as for finance), and structuring (Andritz, Ponsse, Stora Enso, and UPM) are under regular attention in a number of the firms, whereas responsibility is in most cases under attention only for shorter periods of time. Overall, the forest cluster firms seem to have rather stable resource positions relative to others during the analysis period.

4.2.2 Cluster-Level Inferences

This section presents the cluster-level inferences of the self-organizing map. First, Table 3 presents the average level of (relative) attention the firms in the sample devote to the identified capabilities at three time points. What is evident is that finance receives the most attention during the analysis period of the study, although its average share of the total average attention varies considerably during the period. The other capabilities may then be divided to three groups on the basis of

Table 3. The average level of (relative) attention in percentages the firms in the sample devote to the capabilities 1999–2000, 2003–2004, and 2007–2008. The figures are based on the results of the content analysis.

Capability / Average relative attention (%)	Finance	Responsibility	Being strategic	Monitoring	Internal development	Management	External sourcing	Marketing & sales	Logistics	Structuring	Internationalization	Operations	Services	Change	Innovativeness
1999–2000	26.9	7.4	8.3	9.0	5.2	2.6	3.9	8.8	3.2	3.8	7.1	7.7	1.0	1.8	3.3
2003–2004	17.0	10.5	9.2	9.0	7.4	3.9	3.8	8.6	4.3	3.2	8.4	8.1	1.4	1.5	3.8
2007–2008	26.3	8.2	9.1	9.4	6.0	3.1	4.4	6.6	3.4	3.0	6.8	7.6	1.3	2.2	2.6

their average attention during the study period: 1) responsibility, being strategic, monitoring, internationalization, marketing, operations, and internal development; 2) external development, logistics, management, and structuring; and 3) change and services.

Second, as earlier research considers innovativeness to be a highly important capability when it comes to competitive advantage and renewal of clusters (Porter 1998, Lin et al. 2006, Menzel and Fornahl 2010), and as it has not been among the most important capabilities in the capability portfolio of the Finnish forest cluster, in the following we will explore the relationship between innovativeness and other identified capabilities. Our particular focus is on the relationship between innovativeness and finance, being strategic, marketing and sales, monitoring, internationalization, and change, since the SOM indicates that the development of these capabilities may correlate (i.e. attention to these capabilities might either boost or hinder the attention devoted to innovativeness).

Fig. 4 shows the firms’ orientation towards innovation in relation to other selected capabilities. First, as can be seen in the top-left matrix, strategically-oriented firms seem to be more innovation-oriented. Second, the top-right matrix shows how financially-oriented firms tend to be less innovation-oriented. Especially paper producers are financially-oriented instead of being innovative; this is in line with the industry’s typical focus on cost competition and large investments. When cost-competition eats resources, the firms’ mind-set might turn away from innovation. For

example, UPM had hardly any major innovations during the period studied. Some new materials made from surplus materials were invented, but innovations were mostly incremental and related to the processes – for example the use of pine for mechanical pulping, a river transportation system, and technical innovations to reduce costs in cutting fiber. At the other end, Ciba shows the largest thrive for product innovation. It has introduced a variety of new products, ranging from sun screen products to flame retardants and radically new types of textile dyes.

Third, Fig. 4 also shows that marketing-oriented firms tend to seek innovation. As paper has remained practically the same for decades, with innovations having been mainly related to the manufacturing process (Laurila 1998, Ketunen 2002), and as the customer-relationships with printing houses and publishers have been fairly stable (Järvinen 2011), paper firms tend to be the least market-oriented. The pulp and paper industry might be described as being in a state where customers do not expect any new innovations from the paper producers; on the other hand, the producers do not therefore feel a great need to put effort into market-orientation.

Fourth, those firms that put effort into monitoring their environment also seek to be more innovative. Sensing changes in the market and following competitors may motivate firms towards innovativeness. Additionally, firms that seek innovations may also feel the largest need to sense their environment. Again, on average, paper and pulp firms monitor their environment least actively. Fifth, when it comes to the relationship between

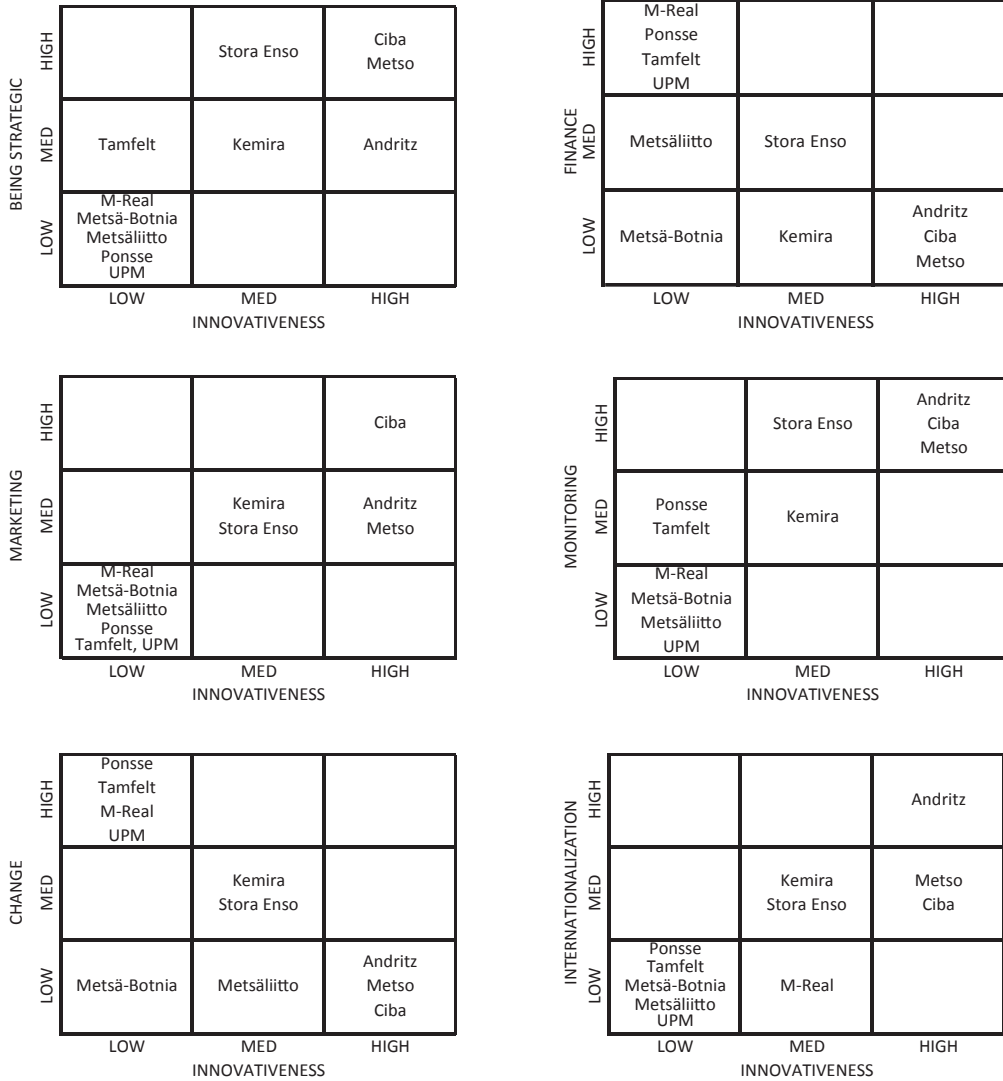


Fig. 4. Attention towards innovativeness in relation to other capabilities. The matrices have been constructed on the basis of Table 2.

innovativeness and change, the SOM suggests that the firms that devote high attention to innovativeness do not devote that much attention to change. In a sense, this may be simply because those firms that actively innovate do not necessarily feel a great need for major changes. Sixth, the results suggest that innovativeness may be also related to internationalization: those firms that devote more attention to internationalization also devote more attention to innovativeness. This may be because

internationalization requires firms to come up with new innovations more frequently in order to fulfill the differing customer expectations.

Fig. 5 and Fig. 6 show how the firms' attention devoted to finance, monitoring, and innovativeness capabilities seems to follow the financial performance of the pulp and paper industry during the analysis period. First, as can be seen, after the year 2001, which was most profitable for the Finnish forest industry, the firms' attention

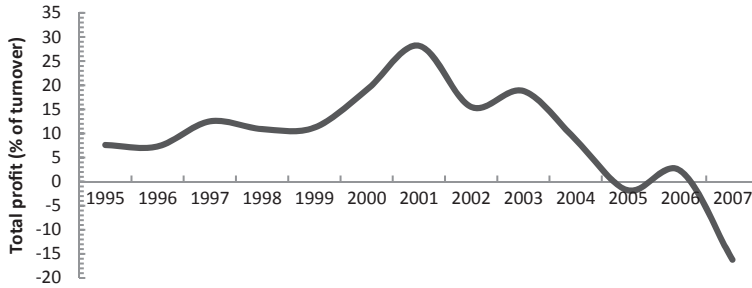


Fig. 5. Profitability of Finnish pulp and paper industry (Source: Metsäntutkimuslaitos 2008)⁴.

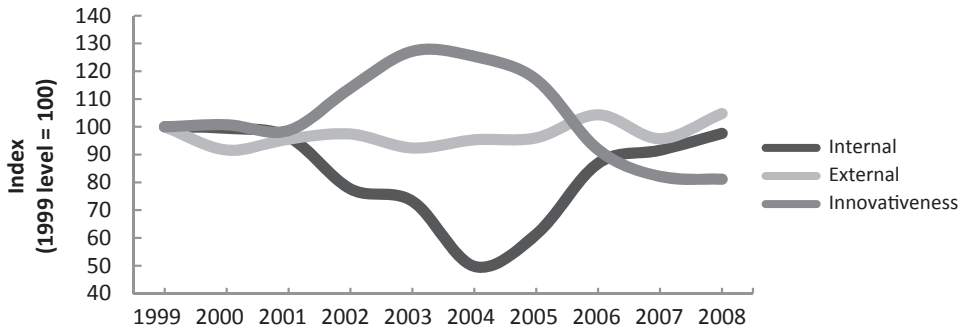


Fig. 6. The attention of the cluster to finance, innovativeness, and monitoring. The figure is based on indexing the average relative attention the cluster devotes to the capabilities in question (see Table 3).

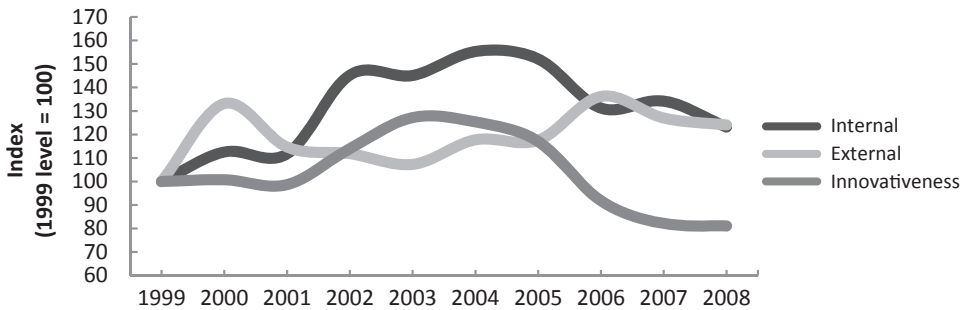


Fig. 7. The attention of the cluster to internal development, external sourcing and innovativeness. See Fig. 6 for data source.

shifted away from finance and turned to innovation, whereas attention to monitoring remained unchanged. When the financial performance declined, especially innovativeness was left aside. Attention to finance and innovativeness seems to have followed performance with a delay

during the research period. After the increase in profitability had been realized, that is, when the profitability was at its highest level, the attention devoted to finance started to decrease, whereas the attention towards innovation started to increase. When profitability started to decrease, it took a

while until attention to finance was triggered (and attention to innovation decreased). It makes sense that firms are worried about finance when they are performing less well, which leaves less 'room' for innovation. At these times, internal development also receives less attention (Fig. 7), whereas in better times firms rely on their own personnel.

5 Discussion and Conclusion

This article set out to study the capability portfolios of the Finnish forest cluster and firms. In particular, the focus of the paper was on what kind of capabilities the firms in the cluster had developed during the last 10 years, whether the firms had developed them consistently, and whether they had developed similar capability portfolios. Further, our focus on the cluster level was on the links between innovativeness and other identified capabilities.

The measurement adopted from the literature for assessing the level of capabilities was the attention devoted to them, and the data used for the measurement were corporate annual reports. It was assumed in the framework that high attention in annual reports represents high development of the respective capability. Because having a capability should be understood as relative to the capabilities of others (Winter 2000, Dutta et al. 2005), other firms' attention can be used for benchmarking. This should be kept in mind when interpreting the results. What the results tell us is which firms have paid relatively *more* attention than others. The best firms set a level that was interpreted as high.

Based on the content analysis and earlier literature, we identified fifteen capabilities. Next, we mapped these at the firm level for the eleven firms in the sample to be either high, moderate, or low, according to how much distinctive accumulation they showed in comparison to the others (D'Este 2002). First, at firm level, we noticed both similarity and differences in the capability portfolios of the firms, and both continuity and change in how the firms devoted attention to the identified capabilities during the analysis period. In general, the pulp and paper firms devoted considerable attention to finance, logistics, change, and man-

agement; and no or only little attention towards, innovation, services, marketing and sales, and monitoring the external environment. Taking into consideration the operating environment of the industry, in which reaching economies of scale and cost competition has been important, the nature of paper as a bulk product with little possibility for innovation, and the fairly stable customer relations with printing houses and publishers, the results are not highly surprising. In contrast to the pulp and paper manufacturers, we found that chemicals manufacturers and also machine and equipment manufacturers devoted much more attention to innovation, services, monitoring the external environment, and marketing and sales. Again, the operating environment in which these firms operate in (e.g. related to customers) and the necessity of frequently introducing new products to market may at least partially explain why these firms seem to devote more attention to markets and innovativeness in comparison to pulp and paper manufacturers.

The theoretical framework of the study also offers an explanation for the identified differences and similarities with regard to capability portfolios. As the firms in the forest cluster operate in different operating environments, it is evident that the firms have developed different types of capability portfolios which should maximize their fit with the environment. Further, as even the operating environment in which, for example, the pulp and paper firms operate in differ (e.g. due to the differences in their product portfolios and product markets), these differences are naturally reflected in the capability portfolios. But even a similar operating environment would not ensure similar capability portfolios, due to the equifinality of capability configurations: firms may achieve the same level of fit (and thus, performance) by combining (different) capabilities in their portfolios in different ways (cf. Siggelkow 2001). The causal ambiguity and path-dependent nature of the capabilities (Helfat and Peteraf 2003) may also result in the equifinality of the portfolios.

When it comes to consistency in capability development, the analyses suggested that Andritz, Ciba, M-Real, and UPM were the most consistent. Of these firms, Andritz and Ciba had rather similar capability portfolios, as did also M-Real and UPM. Metsä-Botnia and Tamfelt also seemed

to develop their portfolios rather consistently. One of the most inconsistent firms was Metsäliitto. Being inconsistent as a whole does not, however, mean that a firm could not develop individual capabilities consistently. For example, although inconsistent as a whole, Metsäliitto did devote a high level of attention to logistics for the whole period of the study.

Next, at a cluster level, we similarly found both consistency and inconsistency in the level of attention devoted to the capabilities and their development. Finance was clearly the most important capability for the firms in the cluster for the whole period, although the average level of attention devoted to it changes considerably during the period. Since we were interested in relative attention to capabilities, the average relative attention devoted to many other capabilities followed inversely the changes devoted to finance. What may partially explain the shift away from finance during the middle of the study period (the beginning of the 21st century) is that this period was the most profitable for the pulp and paper industry. A few years later, however, as profitability increasingly declined, the firms started to move back to the state they were in the beginning, with finance receiving most of the attention from the cluster.

Due to the important nature of innovativeness for cluster performance and renewal, we also analyzed the links of cluster level capabilities to innovativeness at a cluster level, and four characteristics promoting orientation towards innovation were identified: being strategic, monitoring the external environment, being market-oriented, and internationalization. These results are also supported by earlier research, according to which especially being strategic, monitoring the external environment, and being market-oriented boost innovation (Day 1994, Teece et al. 1997, Özsomer et al. 1997, Dutta et al. 1999). Two characteristics suppressing innovativeness were also identified: finance and change. Those firms that were relatively more concerned about financial issues were less oriented towards innovation, and at the times when finance was dominating, firms were constraining their innovation. One reason behind this might lie in 'efficiency-thinking'. Many of the sample firms operate in fields where competition has so far been driven by costs and ever-

increasing investments in new equipment rather than by innovative new products. When it comes to change, those firms that innovate frequently may not feel that much need for change.

What do the results of the study then offer for the Finnish forest cluster and firms in their quest of renewing the capabilities? First, although the cluster has entered the final phase of its evolution, decline (cf. Menzel and Fornahl 2010), during which the heterogeneity of knowledge in the cluster usually decreases, there still seems to be heterogeneity in the capability portfolios of the firms. However, the heterogeneity seems to be much related to the different industries or markets in which the firms in the cluster operate (i.e. different capabilities are needed in different markets). What the renewal of the cluster and its capabilities would require is more heterogeneity; on the basis of evolutionary theories of organizations (e.g. Aldrich and Ruef 2006), this may be achieved by new variation either by allowing more exploration-oriented research and development processes or by the founding of new firms. Thus, especially for the pulp and paper firms, which devote very little attention to innovativeness and market orientation, it would be crucial to start to devote more attention to these capabilities, since this would probably foster new variations and a higher level of technological heterogeneity.

However, a mere focus on innovativeness, for example, may not be enough, since the capabilities are often highly interlinked. Some capabilities may, for example, be mutually exclusive and cannot be developed simultaneously, whereas others may be mutually reinforcing. As the results of the article show, it may be, for example, that in order to boost innovativeness, a firm has to simultaneously develop capabilities related to marketing and sales, being strategic, and monitoring the external environment (Day 1994). In contrast, a focus on finance, internal processes, and cost-control may make it impossible (or at least difficult) to develop capabilities related to innovativeness and market-orientation.

Further, due to the identified heterogeneity of the capability portfolios of the firms, the firms may use the results as an aid in the process of benchmarking the best practices in the industry. In particular, by studying firms with a high level of consistent attention (interpreted to indicate best

practices among the firms in the sample) with regard to the capability a firm wants to develop further, it may be possible to gain insights into how to best develop that capability. For example, pulp and paper firms might learn from more innovative and market-oriented equipment and machine and chemicals manufacturers how to develop capabilities related to these. It is, however, important to note that since capabilities are, by definition, causally ambiguous, copying them directly from other firms is difficult.

As a final implication, it is possible to argue based on the theoretical framework that firms should be aware that they are not able to develop and devote attention to every possible capability. Rather, the managers have to divide their attention to an “optimal” set of capabilities, considering the firm’s situation.

The article also has several limitations, although these also result in further research opportunities. First, the use of annual reports to study managerial and firm attention to capabilities may have resulted in biases in the results, as already discussed. In particular, as managers may use annual reports for different types of signaling purposes for the firm’s stakeholders, it is possible that the capabilities we find firms devoted attention to are not necessarily those to which actual attention has been devoted in the firms. This is despite the fact that annual reports have been often used in studying managerial cognition and attention. For example, when it comes to the differences in the capability portfolios of the firms in the different sectors of the cluster, the reason why we find pulp and paper firms emphasize finance or logistics is that the shareholders or other important stakeholders consider it important to emphasize these issues. Similarly, signaling may also be the reason why chemicals and machine and equipment manufacturers devote more attention to innovativeness and market orientation. Unfortunately, the current research approach of the article did not enable us to take this potential bias more specifically into consideration. Further research, with a different research approach (either a large sample quantitative study or an elaborate qualitative study that would compare the actual behavior of organizations and capabilities identified on the basis of the annual reports) could, however, try to identify whether capabilities and attention devoted to them

on the basis of the annual reports resembles the actual attention that the firm devotes to them.

Second, the relationships that we identify between innovativeness and other capabilities do not necessarily indicate that there exists a causal relationship between them (although earlier research has also identified some of the relationships) or that the relationships would be the same in different research contexts. Thus, it would be important to further study the identified relationships and find more convincing empirical support for them.

Despite these limitations, we feel that the methodology we used to study capabilities offers one potential option to study them, their interrelationships, their evolution, and their effect on firm performance, among others. Since studying capabilities empirically is often considered to be difficult (Robins and Wiersema 1995, Saaty et al. 2003, Dutta et al. 2005, Laamanen and Wallin 2009), new methodologies to approach and analyze them are needed. In addition, the self-organizing map offers an alternative to the traditional clustering and visualization methods currently used especially in management literature. For example, the SOM might be an ideal method to find and study strategic groups among industries (e.g. Cool and Schendel 1988, Reger and Huff 1993, Osborne et al. 2001, D’Este 2002).

Notes

- 1 The missing annual reports include the report of Metsä-Botnia for 1999, the reports of Metsäliitto for 1999 and 2000, the reports for M-Real for 1999 and 2000, the reports of Tamfelt for 1999–2001, and the report of UPM for 1999.
- 2 In our case, the samples are the annual reports and the attributes the levels of attention devoted to the capabilities in focus.
- 3 All country names were included as keywords for the internationalization capability, although some of them appeared less than 100 times. The occurrences of country names were counted from the initial list of words (with 35, 190 words). The list of world countries was downloaded from the website of Gapminder (Gapminder 2010).
- 4 Note that only pulp and paper industry firms are covered in the figure. Thus, the figure may not rep-

resent the profitability of the whole Finnish forest cluster firms. However, finding information on the changes in the profitability of the whole cluster was impossible.

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