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ECONOMIC AND COMPETITIVE ENVIRONMENT ANALYSIS IN THE FORMULATION OF STRATEGY
A Decision-Oriented Study Utilizing Self-Organizing Maps

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At Pori, October 26, 2004
Aapo Länsiluoto

TABLE OF CONTENTS

1 INTRODUCTION

Nowadays, we are living in the information rich era when the amount of new information has been growing rapidly. Lyman and Varian (2003) claim the growth rate of the information being over 30 per cent a year. This means that the information stored on media totals about 5 exabytes ($5*10^{18}$ bytes) of new information each year (Lyman & Varian 2003). This huge increase of amount of information has caused new problems. The problem is not anymore the scarcity of information but the problem is our capacity to deal with it (Simon 1997, 21-22 &226). Due to the huge information overflow and bounded rationality[1] we need assistance to survive with the information rich environment. One way to survive is to utilize different computational tools. Computers can be used, for instance, to organize data so that only the relevant message for the decision-making from the databases can be perceived (cf. Simon 1997, 22-23).

One reason for the increasing amount of information need and availability is the globalization of companies. Companies are operating more and more in the global markets (cf. Pesonen et al. 2001 and Stephens 1999) in order to enhance and improve their growth, productivity and profitability. On the one hand, globalization increases the information requirements of the new external environment. Globalization creates several questions, such as, how and into what direction foreign growth and the volume of retail sales are changing or what kind of turbulence the invested capital is expected to achieve. On the other hand, it might not be an easy task to find the relevant information and structure it in a meaningful manner.

Globalization has been an incentive and a force in trying to change the traditional management accounting toward more strategic oriented. Strategic management accounting (SMA) is a response to the presented critique against the relevance of management accounting (MA) (e.g. Johnson & Kaplan 1987). SMA enlarges the perspective of traditional MA by focusing also on competitors, marketing (e.g. pricing of products) and future (Bromwich 1990, Guilding et al. 2000 and Simmonds 1986), whereas, traditional MA focuses more on production and history.

[1] Chapter 1.3 discusses bounded rationality.

SMA studies have widened the focus of accountants from firm to industry level, but have not included the analysis of macro level[2]. Only few SMA studies have considered the importance of economic information, which is one form of macro level data[3], for managers' decision-making[4] and strategic planning. Economic information can be utilized in a number of different ways in the strategy process: to estimate environmental turbulence (Brouthers & Roozen 1999), to identify growth areas in an economy, to check the plausibility of a company's forecasts and to identify cyclical factors (Miles & Nobes 1998). Therefore, information concerning finance, economy, markets and competitors have a notable impact on companies' strategic planning (Palvia et al. 1996). The strategic management accountant has to produce the valuable analyses for strategic planning, which is not possible without using also economic data.

Several reasons give support for the producing of economic information in the formulation of strategy. First, disadvantageous economic changes may affect the success of operations and this results in companies' declining financial performance (profitability, solvency and liquidity) and competitive positions (see Ahola 1995, 114, 173, Brealey et al. 2001, 280, Ginter & Duncan 1990, Fahey & Narayanan 1986, 118, Mouritsen 1995, Pesonen et al. 2001 and Pärnänen 1993). Second, disadvantageous economic trends[5] can subsequently blur the companies' productive efforts (Mouritsen 1995). Finally, economic trend analysis provides a reality and accomplishment for a business plan (i.e. strategy) and a benchmark for company result (Green 1997). Therefore, for instance, if the companies are planning to increase revenues from customers more than the forecast of consumption indicates, then the companies have to consider the reality of their sales forecasts.

Business cycle studies are closely related to economic environment analysis at the macro level. There are a number of studies relating to business cycles and interdependencies in these cycles (Artis et al. 1997, Crucini 1997, Gregory et al. 1997, Kindleberger 1995, Lumsdaine & Prasad 1999 and Schaefer 1995). Several explanations of the causes and origins of business cycles have also been suggested (Crucini 1997, Kindleberger 1995, Lumsdaine & Prasad 1999 and Sterne & Bayorni 1993. Chapter 3.2 introduces these causes more

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2 Chapter 2.4.3 considers in more detail the different levels of environment.

3 Chapter 2.4.3.1 considers the other types of macro level data (i.e. political, social and technological).

4 Simon (1965) defines decision-making as the whole range of the problem solving, thinking, and choosing activities that are involved in productive work. Therefore, decision-making can be also thinking and evaluation for instance alternative financial sources of investments although any choice of the alternative has not been made. In the current study we understand the term of decision-making in the way of Simon (1965) and subsequently when we use the term of decision-making it refers also thinking of alternatives although any final chose of the alternatives has not be made.

5 In this study economic trend is synonym for business cycle.

specifically.). The primary techniques used in analyzing trends in earlier studies are statistical calculations (Andreou et al. 2000, Sterne & Bayoumi 1993), mathematical models (Crucini 1997) or one-variable trend analysis (Schaefer 1995). These techniques have, however, their own limitations; e.g. different cause-effect relations are not always straightforward, the selection of dependent (cf. Paci 1997) and independent variables is difficult (i.e. what are the causes for the business cycles), the visualization of results is unsatisfactory and statistical analysis of economic time series is carried out using complicated mathematical models.

However, advanced information systems, such as neural network-based systems (e.g. self-organizing map), seem to give us new possibilities to overcome the described limitations (See Chapter 1.5). Neural networks are said to improve the possibility to analyze ratios and figures in real time, which facilitates the analysis of the business environment. Neural network-based systems do not make any assumptions of data linearity or nonlinearity (cf. Andreou 2000 who found nonlinearities in financial variables especially in the USA) and the using of these systems does not require extremely sophisticated statistical (cf. Serrano-Cinca 1996) or mathematical skills. They do not require knowledge about the dependent and independent variables, which is needed in statistical analysis, i.e. regression analysis. Therefore, the method does not suffer from the difficulties of regression analysis in determining the cause and effects. This study[6] uses the technique of Self-Organizing Map[7] (SOM) whereby we can visualize large databases and find similarities in data.

Figure 1 summarizes the earlier discussion and presents the background for the research. The most important issues of the research (i.e. the technology of self-organizing map, competitive environment analysis including industry and macro levels and two practices of SMA strategic pricing and target costing) are circled in Figure 1.

[6] Some of this study was conducted as part of the GILTA research group. This group was led by three professors: Barbro Back, Hannu Vanharanta and Ari Visa.

[7] Self-Organizing Map (SOM) is a synonym for Kohonen map.

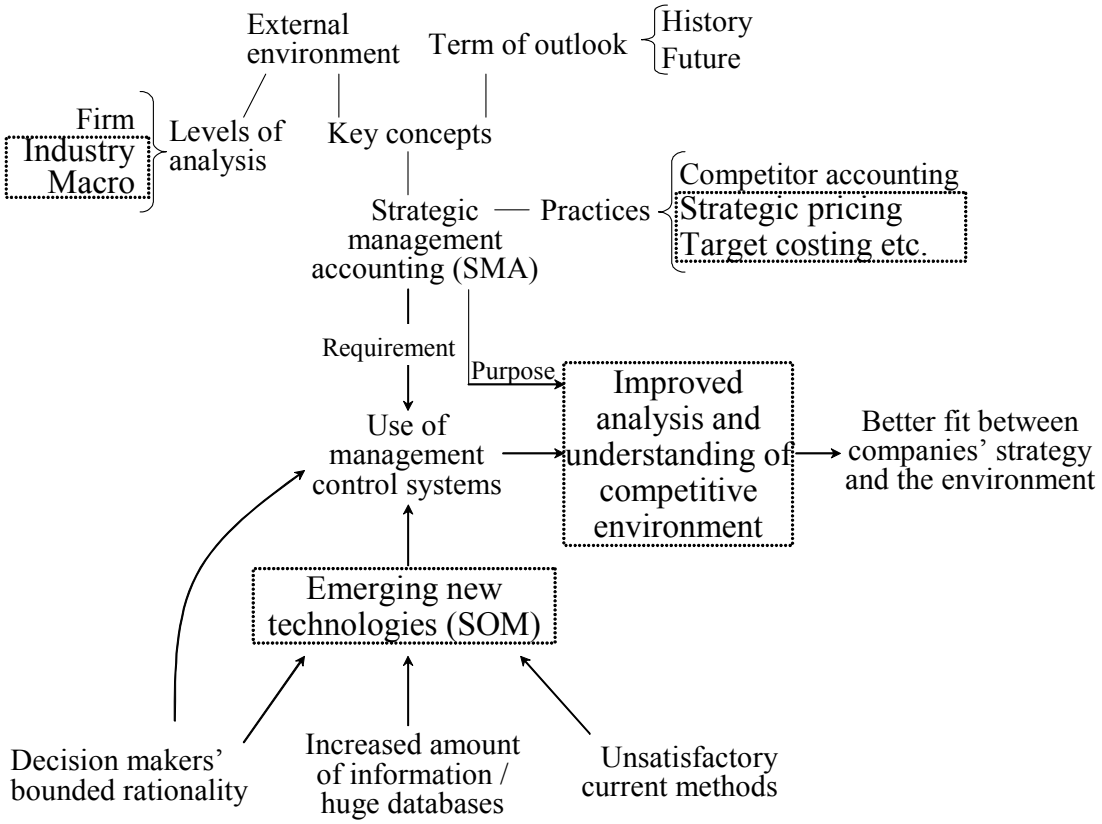

Figure 1: Background for the research

The general idea of Figure 1 is that the strategic management accountant has to use new emerging management control systems (such as SOM) due to bounded rationality, increased amount of information and unsatisfactory current methods. The purpose of the use of these systems and strategic management accounting is to improve the analysis and understanding of the competitive environment[8]. The analysis and understanding aims to improve fit between companies' strategy, operations and the environment. The importance of competitive environment analyses is supported by Daft et al. (1988 cf. Eisenhardt 1989 and Judge & Miller 1991), whose study showed that high-performing companies scan[9] the environment more frequently than low-performing companies.

[8] Competitive environment includes dimensions such as economies, industries, markets and products in this study (cf. Stoffels 1994, 34-53). Stoffels (1994, 34, 53-55) proposes that governments (i.e. legislation, central banking, taxation, education etc.) is still one dimension including competitive environment.

[9] Stoffels (1994, 1) defines environment scanning as a methodology for coping with external competitive, social, economic and technical issues that may be difficult to observe or diagnose but that cannot be ignored and will not go away. According to Stuffels (1994, 87-96) environment scanning encompasses three different stages: 1. Gathering inputs and generating information, 2. Synthesizing and evaluating emerging issues, 3. Communicating environmental insights. This study focuses on two first stages and we exclude the communicating stage.

The idea of the lower part of Figure 1 is as follows. The increased amount of information has created challenges to develop new computational technologies that would help bounded rational people to cope with information overflow. Bounded rationality causes difficulties to achieve understanding of the competitive environment due to limited human information processing capabilities. New computational technologies have been developed to overcome the problems concerning the limited processing capabilities. The emerged new technologies have enabled managers to use different management control systems - such as self-organizing maps. These kind of management control systems aim to help managers to analyze the competitive environment by improving the analysis and understanding of the environment. The improved understanding enables companies to adapt their strategies and operations to the environment.

The idea of the upper part of Figure 1 is that the discussion concerning SMA includes key concepts such as term of outlook (i.e. history and future) and external environment. External environment includes three different levels of analysis; firm, industry (or competitors) and macro environment. This study focuses on industry and macro levels. On the other hand, the practices of SMA are competitor accounting, strategic pricing and target costing. The current study focuses on the last two SMA practices. SMA requires the use of management control systems so that the accountant would have more time to analyze the external environment. Figure 1 shows that the purpose of SMA is to improve the analysis and understanding of competitive environment.

1.1 Research aim

The overall purpose of this study is to illustrate how companies can utilize the technique of self-organizing maps within the strategy formulation by analyzing the economic and competitive environment at macro and industry levels. To achieve this broad goal we formulate some specific sub-goals. Therefore, at the beginning of the study we theoretically define the concept of strategy, its formulation, the different forms of environment, the levels of environment analysis and the technique of self-organizing map.

Because the field of strategy formulation is quite wide and the technique of self-organizing map can be utilized in several different areas (e.g. competitor, customer, supplier analysis), levels (i.e. macro, industry and firm) and environments (i.e. political, economic, social and technological), we focus firstly on economic environment analysis in strategy formulation at the macro level. We focus on countries' economic trend analyses because they have often been forgotten in the discussion concerning strategic management

accounting (see Chapter 1.4) although they have been considered important in the formulation of strategy in the macro level analysis (see Chapters 2.3 and 2.4). Economic trend analyses are still important because changes in the economy (i.e. recessions and booms) affect the success of investments and the profitability of companies (and their products) although the company itself can have efficient production and products (Mouritsen 1995 and Pärnänen 1993). Therefore, we can claim that the analysis of the economic environment improves our understanding of the business environment at the macro level. The improved understanding of the business cycles can explain, for instance, the differences in the profitability of products between market areas.

The second focus of the study is on the environment analysis at the industry level. The industry level analysis is important because it can show, for instance, some nations establishing new customs or the labor unions negotiating new agreements. The justification for the industry level analysis is given in several studies which have proved industrial factors effects on companies' performance variation (Hawawini et al. 2003, Mauri & Michaels 1998 and McGahan & Porter 1997).

The first specific purpose of this study *is to show how the SOM can be used for analyses on macro level.* We construct three models[10] (self-organizing maps) that explore if different countries' economic trends deviate from each other at the macro level. We investigate if some countries have larger business cycle fluctuations than other countries. This knowledge is important, for instance, from the investment point of view, because the magnitude of business cycle fluctuation affects the country's risk profile and -sooner or later- companies' financial success. Furthermore, we investigate the starting time of fluctuations and the similarity between economic trends of countries. The similarity assessments of countries' economic trends are worthwhile. Therefore, if the trends are different between countries, we can avoid the disadvantageous situation by operating in the countries with a beneficial trend or we can diversify the risk by operating in other countries. On the contrary, if the countries' trends are similar, we cannot diversify the risk by operating in other countries. We conduct some what-if analyses (see the definition and examples from Alter 2002, 170) with the macro level model because we want to show the optimal trend and to analyze the distance between the optimal trend and countries' actual trends. This kind of study is important because

[10] Alter (2002, 44) defines model as a useful representation of a specific situation or thing. Models are useful because they describe or mimic reality without dealing with every detail of it. The models can help us to make sense of the world's complexity. (Alter 2002, 44) Therefore, we construct models to illustrate the complex economic and competitive environment so that this complexity of environment would be easier to understand. The models try to help to get knowledge about the complex relationships between the variables by using different graphs and figures, i.e. self-organizing maps (cf. Alter 2002, 172).

decision makers need models and techniques that show the development of the economic environment. Furthermore, decision makers need practical tools to evaluate the risk of countries' changing economic situations when they are planning investments, entering (or exiting) new market areas or analyzing the financial performance of competitors, suppliers, subsidiaries etc.

The incentive for creating three macro level models[11] came from earlier studies (Chapter 3.2) which have explored a great number of different causes for macro economic trends. The purpose of these three models is to examine if the use of different variables has an impact on the constructed models. The first model (Model 1) includes three financial variables[12]. These variables are exchange rate, interest rate and stock market index. The second model (Model 2) includes six production variables: industrial production, total volume of retail sales, gross domestic production (GDP), import to GDP, export to GDP and an indicator forecasting future economic trends (s.c. leading indicator). In the last model (Model 3) we combine all the above presented financial and production variables and examine once again the possible deviation of economic trends. We also investigate briefly if the results of the last model are parallel with the models with three and six variables.

The second specific purpose of the research *is to show how the SOM can be used for analyses on industry level.* We construct a model[13] (Model 4) that explores if different countries' trends deviate from each other at the industry level. The industry level model focuses on pulp and paper industry. Model 4 aims to answer quite similar questions with the first three models, i.e. is there dependence between the industrial trends in different countries or do some countries have a better or worse trend than the others. We construct what-if (i.e. simulations) analyses also at the industry level by using this industry level model. These simulations present trends if one (or two) of the variables is changed. These simulated trends and real trends are compared to achieve better understanding of the industry level environment. The only difference from the earlier three models is the focus on the industry level. The industry level model includes seventeen variables; six variables relate to costs and prices, eight variables measure production and productivity and finally three

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[11] Model 1 was presented at the conference of Tenth Annual Research Workshop on: Artificial Intelligence and Emerging Technologies (AI/ET) in Accounting, Auditing and Tax in 2001 (Länsiluoto et al. 2001). Model 2 was presented at the conference of Strategic Management Society Conference (Länsiluoto et al. 2002d). Model 3 was presented at European Conference on Accounting Information System (ECAIS) in 2002 (Länsiluoto et al. 2002a). Appendix 4 discusses my role in different Models because I was a member of the GILTA research group.

[12] Chapter 4.4 introduces the data, studied countries and variables used which have been received from the Finnish Forest Industries Federation.

[13] Model 4 can be found from the Journal of Pulp and Timber in 2002 (Länsiluoto et al. 2002b).

variables, i.e. output to input ratio, capital/labor ratio and annual blue-collar working time.

This industry specific model will be used in the comparisons[14] later. These comparisons investigate if the possible movements at the industry level can be at least partly explained by the simultaneous movements at the macro level. If these movements would be somehow congruent, this study would give further evidence about the importance of the simultaneous multilevel analysis in the strategy formulation process.

The third specific purpose of the study *is to show how the SOM can be used for target costing in the area of SMA*. We construct a model[15] (Model 5) that investigates the possible price level differences between the Finnish grocery retailers. We also investigate if the size, location or group of the retailer could explain the possible price differences. Model 5 is interesting from two points of view. First, consumers are interested to know which (and why) retailers offer the lowest prices. Second, the managers of grocery retailers are interested to benchmark their price level against that of competitors. After the benchmarking the managers can try to improve the possible price level gap. The idea of Model 5 is close to one basic practice of strategic management accounting, i.e. target costing (Chapter 1.4 discusses strategic management accounting in more detail). Model 5 uses the data of National Consumer Research Centre (Finland). The database contains 135 grocery retailers and the prices of 237 grocery products.

The fourth specific purpose of the study *is to show how the SOM can be used for simulation purposes within target costing and price sensitivity analysis in the areas of SMA*. We conduct some sensitivity (or what if) analyses by utilizing Model 5 so that the effects of changing pricing policy on some competitor retailers' pricing positions will be analyzed and illustrated. Model 6 presents the results of these analyses. These kinds of sensitivity analyses are close to two traditional strategic management accounting practices, i.e. target costing and strategic pricing. Model 6 is interesting especially from the retailers' point of view because retailers want to know first if it is possible to change their pricing position and second how this new planned pricing position would be achieved. Figure 2 summarizes the models,

[14] The results concerning the comparison between Models 1 and 4 were presented in the SOM workshop (Länsiluoto et al. 2003a). The results concerning the comparison between Models 2 and 4 were presented in the PulPaper 2004 conference (Länsiluoto et al. 2004). The results concerning the comparison between Models 3 and 4 were included in the proceedings of AI/ET 2003 workshop (Länsiluoto et al. 2003b).

[15] Model 5 was presented at the conference of eleventh Annual Research Workshop on: Artificial Intelligence and Emerging Technologies (AI/ET) in Accounting, Auditing and Tax in 2002 (Länsiluoto et al. 2002c).

their scope of the environment, and the number of the examined countries and used variables.

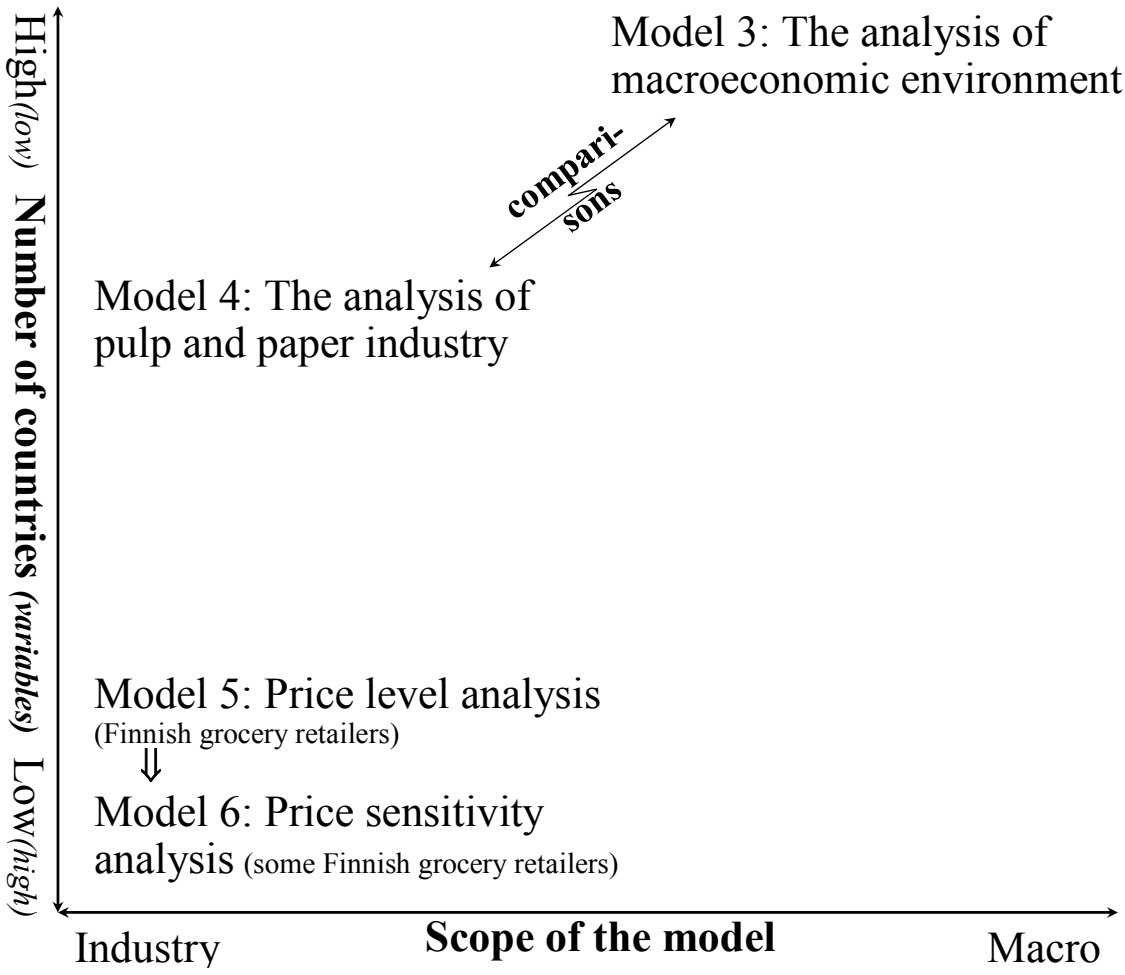

Figure 2: Scope and number of countries in different models

According to Figure 2 the scope of Model 3 is at the macro level analyses whereas the scope of Models 4, 5 and 6 are at the industry level. Figure 2 shows the number of the countries being higher in Models 3 and 4 than in Models 5 and 6. Models 5 and 6 analyze only Finland and its grocery industry. We can see the number of the used variables correlating with the number of model, i.e. Models 5 and 6 have the highest number of the used variables whereas Model 3 has the lowest number of variables. Figure 2 shows comparison between Models 3 and 4. Finally we can see that the construction of Model 5 is needed before the utilization of Model 6.

A final goal of the study *is to evaluate the suitability of self-organizing map (SOM) technique for trend analysis by testing with a survey the opinions of the persons responsible for the business intelligence tasks about the usefulness of Model 3 for strategic environment analysis in the Finnish publicly noted companies*. Therefore, we investigate the opinions and attitudes of managers

concerning the usefulness of Model 3. We have several reasons to choose Model 3 for a closer investigation. First, we want to use a macro level model due to its suitability for different industries and companies. Second, Model 3 also includes a larger number of the macroeconomic variables than Models 1 and 2. Third, due to the data confidentiality we cannot reveal specific identification of retailers and thus the industry level model, Model 5, cannot be used.

1.2 Relevance of work

The reasonability of the final goal of the study was evaluated by a survey. The purpose of the survey was *to describe the state of the art of macro environment analysis methods in the Finnish publicly noted companies*. The survey aimed at finding out *how often macro environment is analyzed, what the currently used methods are and how information is searched*.

The state of the art survey process[16] was the following. First, we[17] called all the Finnish public companies (103) that were noted at the main list of HEX. We tried to contact the manager of business intelligence or the corporate development department. Second, we sent the first e-mail to the contact person. This e-mail included one link to a web page where a brief project description and a three-part questionnaire were available. After first e-mail we received 18 answers to the macro environment part of the expert survey. Third, we sent the second e-mail to those respondents who did not reply to the first e-mail. We received four more answers to the macro environment analysis after the second e-mail. Fourth, we sent the third and final e-mail notification and it gave three more answers. Therefore, the final number of respondents in the macro environment part was 25 (24.3%). Finally, we sent the conclusions of the survey to participants who requested these conclusions.

The survey implicitly evaluated the need for new and better methods in the field of macro environment analysis. Therefore, if the companies are not satisfied with the current methods of the macro environment analysis, they need better and more sophisticated methods and subsequently our research is worthwhile. On the other hand, if respondents are satisfied with the current methods, this study may still be worthwhile because people can be satisfied with the current methods if they do not know about the availability of other, potentially better methods.

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16 The survey process is reported more detail in Chapter 6.2

17 I called to the Finnish public companies together with Lic. sc. (econ) Tomas Eklund.

In the field of macro environment analysis, we had reasons to focus specifically on macro economic variables although the analysis of the macro environment can also use other variables. Therefore, the environment can be assessed also according to culture (individualism vs. collectivism, masculinity vs. femininity), demographics (age structure, ethnic composition), political conditions (economic system, political risk) or lifestyle (attitudes, opinions, values) (Kotabe & Helsen 1998, 192-200 and Palmer & Hartley 1999, 34-38). The reasons to focus on macro economic variables were the following. First, our state of the art survey[18] showed that the economic environment has higher importance for the companies' success than political, social and technological variables (cf. Daft et al. 1988 and Elenkov 1997). Second, the respondents of our survey answered that the economic aspect possesses the greatest uncertainty and has the highest analysis frequency of the macro environment. Third, economic variables can be understood quite independent of subjective human opinions and decisions[19]. Finally, the accountants are probably more familiar with economic numbers and figures than with qualitative measures due to the traditional role of accounting.

Although we presented different theoretical methods for macro economic environment analysis in the beginning of the study, our state of the art survey showed that the more complicated and sophisticated methods (i.e. regression and correlation analysis) are used with much less frequency compared to the simpler software (i.e. Power point and Excel). The lower usage of the sophisticated methods is not itself a problematic issue. It is not valuable or necessary to use the sophisticated methods if the simple methods are sufficient enough for the purposes of decision-making. The practical problem is that the respondents of our state of the art survey were not very satisfied with the current methods. The respondents were the most dissatisfied concerning the format factor of information. This increases the demand for new techniques so that the satisfaction with the macro environment analysis methods would improve (see the lower part of Figure 1).

Table 1 presents the importance of the study as a function of business environment and the severity of competition.

[18] Länsiluoto (2004) reports the results of the survey in detail.

[19] Therefore, if we use for instance cultural variables we have to decide for instance if the culture is individual or collective, which is a subjective decision.

Table 1: Importance of study as a function of business environment scope and the severity of competition

		Business environment	
		Global	***Local***
The severity of competition	***High***	1st (Highest; Forest industry)	2nd (High; Grocery industry)
	Low	3rd (Low)	4th (Lowest)

According to Table 1, the study is the most important and interesting for global (as well as international) companies with hard-competed market (the first upper quarter). On the contrary, this study is not as important for companies which are operating in local markets[20] and possesses monopoly (the fourth quarter). This is in congruence with Brouthers and Roozen's (1999 cf. Ginter & Duncan 1990 in Chapter 2.4.3.1) proposition that the importance of different data and analysis depends on the level of environmental turbulence. Global vs. local market indicates environmental turbulence where the former is understood as more turbulent than the latter in this study. On the other hand, the severity of competition is associated with the number of competitors, i.e. larger numbers of competitors cause more sever competition. We consider three reasons why the Finnish forest industries have the biggest interests in the study. First, these companies operate globally. Second, they have established in central European and Asian countries. (Pesonen et al. 2001) Finally, we investigate the trends of pulp and paper industry in Model 4. The Finnish grocery industry has the second biggest interest because they have competed in the local markets but the severity of competition has been rather high (cf. Aalto-Setälä 2002). Furthermore, we have two models that focus on the Finnish grocery industry. Therefore, two quarters are emphasized in Table 1.

1.3 Bounded rationality

As Figure 1 shows, the current study is interesting from the perspective of people's limited information processing capabilities (Simon 1970). To overcome this incapability we need assistance in the decision-making process. The assistance is needed in particular if we have huge databases and we have

[20] The study is still important for companies who have customers in local markets and some foreign suppliers because these foreign suppliers are under their own economic conditions. The changes in these conditions affect suppliers' operation and subsequently the companies' own performance.

to achieve a quick overview of these databases. Our state of the art survey showed that the respondents were somewhat frustrated with the amount of information in practice. The theory that focuses on the limited information processing capability and its impact on decision-making is called bounded rationality theory (Simon 1972). The ancestor of the theory is the Nobel prize winner Herbert Simon. This section is based mainly on the writings and ideas of Simons. The structure of the section is the following: First, we define the theory of bounded rationality and its basic concepts. Finally, we discuss how the negative effect of bounded rationality could be decreased.

1.3.1 The definition of bounded rationality and its basic concepts

Because we are discussing the theory of bounded rationality, we have to define the concepts of bound and rationality. Simon (1997, 84) defines rationality concept as the selection of preferred behavior alternatives in terms of some system of values whereby the consequences of behavior can be evaluated. Simon (1976 see also Simon 1997, 106 about substantive and procedural planning) proposes that rationality can be either (both) substantive or (and) procedural. According to Simon (1976) behavior is substantively rational if it is appropriate to the achievement of given goals within the limits imposed by given conditions and constraints. On the contrary to the substantive, behavior is procedurally rational if it is the outcome of appropriate deliberation[21] (Simon 1976). Therefore, the difference between substantive and procedural rationality is that the former highlights final decision (or solution of problem) and the latter concept highlights the process how the decision has been made. In practice it can be difficult to dichotomize rationality as substantive or procedural because the decision can be based also on the intuition (Langley et al. 1995 and Simon 1997, 129-137). Intuition refers more to substantive rationality but intuition can be based also on the formal analyses of situation that have been made in a similar historic decision situation. Therefore, outsiders can judge the decision founding on the intuition, but actually the decision maker uses the constructs that she has formulated and constructed after a previous quite similar decision situation (Langley et al. 1995 and Nutt 1997) and subsequently the decision can be based on the procedural rather than substantive rationality.

Simon (1997, 85) adds that the concept of rationality should be defined by using different adverbs. According to Simon (1997, 85 & 324) the decision

[21] The deliberation can be based, for instance, on the utilization of strategic process descriptions (cf. Ahola 1995, 206) if the companies are planning strategies.

can be rational in six different ways: objectively, subjectively, consciously, deliberately, organizationally or personally. A decision is objectively rational if it is the correct behavior for maximizing given values in a given situation. On the other hand, a decision is subjectively rational if it maximizes attainment relative to the actual knowledge of the subject. It is consciously rational to the degree that the adjustment of means to ends is a conscious process. A decision is deliberately rational to the degree that the adjustment of means to ends has been deliberately brought about by the individual or by the organization. Decision is organizationally rational if it is oriented to the organization's goals and personally rational by orienting to the individuals goals. Therefore, we can observe that according to Simon (1997) there are a large number of different adverbs that can describe the rationality of decision and the decision can be rational although it is not, for instance, deliberately made, but in congruence with personal or (/and) organizational goals. The earlier explained substantive rationality refers at least to adverbs of organizational, personal and subjective because substantive rationality only depends on the actor's goals (Simon 1976). On the other hand, the mentioned procedural rationality refers to adverbs such as consciously and deliberately because procedural rationality depends upon the process how the decision is made (cf. Simon 1976). By using different computational techniques such as neural networks, we can possibly improve the conscious and deliberate (i.e. procedural) rationality of decision-making (cf. Simon 1978).

The second important concept in the discussion of the theory of bounded rationality is bound. Skidd (1992 see also Simon 1955) summarizes the bounds (i.e. constraints): uncertainty about alternatives' consequences (computational inability), incomplete information about alternatives, and complexity where complexity and uncertainty make rationality impossible. Augier (2001) adds that we are bounded also by objectives because there could be multiple and competing objectives (i.e. quality improvement of product and cost cutting or the central location of a super market and rent of the building) in particular if there is a group of people making decisions.

Simon developed the theory of bounded rationality because he did not accept assumptions behind the concept of economic man (cf. Simon 1955 and Holden 1986). According to Simon (1955) economic man has clear and voluminous knowledge of the relevant aspects of his environment. Economic man has also a well-organized and stable system of preferences, and a skill in computation that enables him to calculate and evaluate the alternative courses of action before the appropriate alternative is selected. Simon (1955) criticizes that human decision-making alternatives are examined sequentially in practice as a result of the bounds of human. Because alternatives are examined sequentially, we choose the first satisfactory alternative. Therefore, according

to Sent (1997 see also Simon 1976) the examination and search of alternatives halts almost always long before all alternatives have been examined and subsequently the best alternative cannot probably be achieved.

The satisfactory alternative is defined and determined by aspiration level and it can change from point to point in the sequence of trials (Simon 1955 and Simon 1972). Simon (1955 and 1972) proposes that if human finds it easy to discover satisfactory alternatives (i.e. information about operating environment), his aspiration level rises. If human finds it difficult to discover satisfactory alternatives her aspiration level falls. Because a decision maker tries to achieve a balance between the benefits of better decision-making and the effort cost (as result of trying to obtain better information about the alternatives) of decision (Smith & Walker 1993 see also Simon 1955 and Aalto-Setälä 2003), decision maker stops to search new alternatives after the satisfying alternative has been found. Problems arise if the aspiration level and the satisfactory alternatives operate too slowly to adapt aspiration to performance. Therefore, emotional behavior –such as apathy or aggression– will replace rational adaptive behavior (Simon 1959). The basic idea of the bounded rationality is presented in Figure 3.

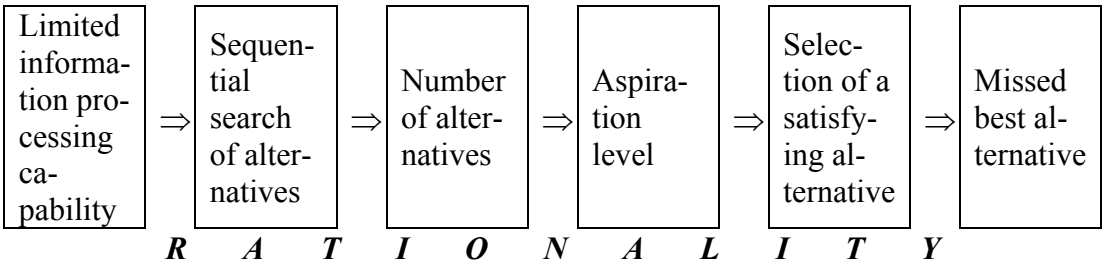

Figure 3: Basic idea of bounded rationality theory

The basic idea of Figure 3 is that humans try to be rational in decision-making (which we earlier described with six adverbs by using the definition of Simon 1997, 85) but humans have bounds concerning information processing capabilities. According to Figure 3 limited human information processing capabilities cause sequential search of alternatives. If a human cannot find different solutions easily, her aspiration level falls. The aspiration level determines the chosen alternative (Simon discusses about satisfying alternative). As a result of the sequential search and aspiration level it is possible that a human misses the best alternative because all the alternatives are not searched and evaluated.

Bromiley and Euske (1986) summarize the idea of bounded rationality as follows: individuals attempt to be rational but face severe limits on their ability to handle information. Bromiley and Euske (1986) give an example where a totally rational manager knows the total cost of producing another unit

of output at all output levels and the quantity of output saleable at all prices. Thus an optimally profitable level of output can be set. In the bounded rationality perspective we recognize that the manager knows some of the costs of output but has only the roughest estimations of the total cost including all corporate and staff costs, and at best only knows the effects of price changes on sales near the current price level (and even that is a bit weak since different marketing strategies can change the sales at a given price). Thus according to Bromiley and Euske (1986) a manager with bounded rationality thinks about management in a very different way than "economic man"- relying on feedback from the market and rules of thumb such as constant mark-up pricing. The next subchapter discusses how the negative effects of bounded rationality could be decreased.

1.3.2 Overcoming the negative effects of bounded rationality

Because people have bounded rationality we consider how its negative effects on decision-making could be minimized. According to Simon (1996, 144), the solution is not to provide more information to people, but to allocate the time they have available for receiving information so that they will get only the information that is most important and relevant to the decisions they will make. Partly contrary to Simon (1996, 144), Lovrich (1989) states that due to bounded rationality artificial means of intelligence should be used and improved in the information processing so that we can get better and more plentiful information to make decisions. Therefore, we propose and illustrate later in the current study that information systems have to identify patterns, visualize the results and cluster all available information so that managers can get a fast and correct overview of all the information. After that overview managers should be able to focus on the most relevant information that is needed to make certain decisions.

According to Skidd (1992), Simon claimed over twenty years ago that the decision maker could utilize an unprecedented collection of models and computational tools to aid him in his decision-making processes. Skidd (1992) concludes that whatever the compromises the decision maker must make with reality in order to comprehend and cope with it, these computational tools make the task of matching the decision maker's bounded capabilities with the difficulty of his problems substantially more tractable. Today different computational techniques can assist firms and individuals to achieve procedural rationality by helping them to make better decisions (cf. Simon 1976 & Simon 1996, 27-28 & 49). Different computational techniques (such as self-organizing maps) can overcome human's deficiencies concerning data

processing because these techniques can rapidly process data all over again and again (cf. Simon 1972 and Simon 1976). Therefore, we assume that these techniques help people with bounded rationality especially from the point of view of limited information processing capability.

There are different opportunities how computers can be used so that the effects of bounded rationality could be minimized or at least decreased. According to Simon (1997, 245) the most important use of the computer -and subsequently the greatest challenge- in decision-making is to model complex situations and to illustrate the consequences of alternative decisions. Therefore, the computer can be used as a simulator that calculates the alternative paths (or scenarios). We suggest later that these paths and scenarios could be used, for instance, in the formulation of strategy. On the other hand, the computer can be used as a simulator by presenting how the macroeconomic changes have affected the industrial level success of companies in different countries or how the price position of a retailer will change after we change the prices of products.

A fast information processing capability is vital for business success. This is confirmed by empirical research evidence. For example Eisenhardt (1989) proved that fast decision makers use more information than slow decision makers. According to Eisenhardt (1989), Judge and Miller (1991) the fast decision makers also developed more alternatives and these alternatives were considered simultaneously, not sequentially, as did slower decision makers. Eisenhardt (1989) proved that fast decisions led to superior performance in high-velocity microcomputer industry and subsequently fast decision-making seems to be vital for the success. Judge and Miller (1991) also found that fast strategic decision-making led to higher profitability in a high-velocity biotechnology industry but this kind of correlation was not found in the textile and hospital industry which are not considered high-velocity industries.

The purpose of the study is not to investigate whether bounded rationality exists or not since much evidence supports the concept of bounded rationality. In this study we rely especially on Skidd's (1992 see also Bromiley & Euske 1986) findings. Furthermore, Nutt (1997) verified that if decision makers develop several alternatives and do not stop the search of the alternatives when the first satisfactory alternative is found the decision is most likely successful. Nutt's (1997) result shows increasing decision success if we can avoid bounded rationality or at least increase the aspiration level. Therefore, bounded rationality is an incentive and starting point for the study to develop some models. These models try to help the bounded rational decision maker to get a correct and fast overview of the external environment in the formulation of strategies.

1.4 Strategic management accounting (SMA)

As can be seen from the upper part of Figure 1, the second motive for conducting this study is the existing critique against the relevance of management accounting. Johnson & Kaplan (1987) are the pioneers of this critique. They claim that management accounting (MA) has not developed appropriate means of measuring and reporting management critical information for the needs of today such as increased productivity or quality, reduced lead times or inventory. Johnson & Kaplan (1987) also argue that MA has been subordinated by financial accounting, which has led to short-term orientation. Consequently, they claim that the progress of MA has been stalled and as a result much of its former relevance has been lost.

Traditionally, management information system and accounting have three shortcomings. First, these systems produce mainly financial information (ignoring non-financial information). Second, the systems deal mainly with historical-oriented information (ignoring future) and finally, the systems are focusing on internal firm information (ignoring external environment or competitor information) (Bromwich 1990, Brouthers & Roozen 1999, Piercy & Morgan 1989 and Taylor & Graham 1992). The insufficient information causes a laborious, ill-informed decision-making process, missed opportunities and consequently lower profits (Taylor & Graham 1992). This study shows how the second and third shortcomings can be responded to. To respond to the second shortcoming, we construct Model 6 where the possible future pricing positions are illustrated. To respond to the third shortcoming, all the models use external data of the company.

Strategic management accounting[22] (SMA) is a response to the arisen critique (cf. Roslender & Hart 2003). SMA differs from traditional management accounting by focusing on the external environment (e.g. competitors), marketing and longer term of outlook (e.g. both history and future) (Bromwich 1990, Guilding et al. 2000, Jones 1988, Roslender & Hart 2003 and Simmonds 1986), whereas, traditional MA focus more on production and history. Competitor accounting (competitive position monitoring, competitor cost assessment and competitor performance appraisal based on published financial statements) and strategic pricing (competitor price reaction, price elasticity) are the most famous strategic management

[22] The studies of Carnaghan et al. (1997), Holland (1998), Hookana (2001), Sheridan (1998), Tufano (1998) and Waterhouse et al. (1993) propose that financial accounting has also pressures to move toward more strategic direction. Therefore, this chapter could also be titled by strategic accounting by emphasizing the strategic role of both financial and management accounting. However, Chapter 1.4 focuses only on management accounting because the strategic discussion concerning management accounting has longer history (and subsequently much more articles) than the discussion in the field of financial accounting.

accounting practices (Guilding et al. 2000 see also Grundy 1992). Guilding (et al. 2000) list also other SMA practices such as life cycle costing, quality costing, target costing, value chain costing and activity-based costing.

As Figure 1 shows, strategic pricing is the most interesting SMA issue for the purposes of this study (cf. Models 5 and 6) and furthermore it is a widely used practice in the field of SMA (Guilding et al. 2000). Strategic pricing covers many kind and type of strategic analyses such as competitor price reaction (how do competitors react to the new prices, what are their financial possibilities to react), price elasticity (how does the demand change if the prices change), projected market growth (what are the effects of growth on the industry and its profitability, do the market shares change as a result of the growth) and economies of scale and scope (do the competitors have some kind of economic advantages compared to us) (cf. Simmonds 1982). Another widely used new practice of SMA, which emphasizes the importance of pricing, is target costing. This specific SMA practice highlights the external perspective in the pricing of products and is a technique of market-driven pricing (i.e. congruence with the philosophy of SMA) rather than cost-based pricing, i.e. congruent with the traditional management accounting (cf. Guilding et al. 2000, Horngren et al. 2000, 428 and Marshall 2000). Target costing starts with the analyses of the target price, i.e. the price that the customers are willing to pay or the product price of the competitors, and possible income and after that target costs are determined (Horngren et al. 2000, 428 and Marshall 2000). If the target costs are higher than actual costs, the cost structure and processes have to be reengineered so that the actual and target costs are consistent (Marshall 2000). Target costing helps companies to prevent the launch of a low profitability product by emphasizing market conditions (Cooper & Chew 1996 cf. Horngren et al. 2000, 428-434).

However, only a few SMA studies have considered the importance of macro level data for managers' decision-making and strategic planning although the macro level analysis has been considered important in several different studies (see Ahola 1995, Brouthers & Roozen 1999, Fahey & Narayanan 1986, Ginter & Duncan 1990 and Miles & Nobes 1998). Therefore, one motive to conduct this study has been the discussion concerning SMA and the lack of consideration and utilization of macroeconomic data in these SMA studies. This has been a motive especially for the construction of Models 1-3.

Macro level data can be utilized by a number of different ways: to estimate environmental turbulence (i.e. the change pace of economy) (Brouthers & Roozen 1999), to identify growth areas in an economy, to check the plausibility of a company's forecasts and to identify cyclical factors such as inflation and interest rates (Miles & Nobes 1998). Therefore, financial (currency fluctuations, interest rates, availability of capital etc.), economic

(economic indicators, GDP, income per capita), market (e.g. information about product demand, existing products and their prices etc.) and competitor (e.g. strategies) information have an impact on companies' strategic planning (Drucker 1999, 121-2 and Palvia et al. 1996). Management information systems should also produce analyses which are based on macro information (Taylor & Graham 1992), especially, if companies are operating in global markets.

There are several reasons why accountants should conduct also macro level analysis. First, if accountants conducted macroeconomic analysis they could immediately consider how the changes in the environment would affect the financial success of companies and how the company could avoid the threats of the changes because they know and understand the organization's business (cf. Cook & Farquharson 1998, 341). Second, if accountants produce economic information to managers, all the information would be produced from a single source (cf. Coad 1996 and Jones 1988). Then managers would be able to cope with the data flow and explain what kind of data they really need in the strategy process. Finally, accountants have routine and experience of data collecting (especially internal cost and overall financial data), analyzing and reporting to managers and other stakeholders (cf. Brouthers & Roozen 1999, Fordham et al. 2002 and Sheridan 1998).

1.5 Neural networks

An increased amount of data is normal in companies nowadays. Our state of the art survey in the Finnish public companies showed that the respondents were somehow frustrated with the amount of information. Data scarcity is not the problem any more, but the key problem is to get a fast and correct view of the data[23] concerning the business environment. Therefore, the utilization of data will be a success factor for global companies in the future (Kiang & Kumar 2001). Different information systems and techniques try to help to analyze large information databases. The systems also increase problem identification speed, decision-making speed and the extent of analysis in decision-making (Leidner & Elam 1993/4). Therefore, information systems seem to be vital for all the companies which are planning their strategies.

[23] The enlarging databases have created discussion about data mining. Data mining is the process of automated discovery of interesting patterns, trends and correlations hidden in a corporate database by sifting through large amount of data (Kiang & Kumar 2001 see also Alter 2002, 207-8 and Wang & Wang 2002). On the other hand, these patterns, trends and correlations may be unsuspected before the beginning of data mining, which is an opposite starting point to the traditional statistical methods (Wang & Wang 2002). The traditional methods try rather to verify or test the human knowledge than find new unsuspected patterns (Wang & Wang 2002).

This study performs with the technique of neural networks. This technique has been utilized in many different applications such as recognition and identification (machine fault diagnosis; Ko et al. 1995), assessment (automated food inspection; Hueter 1993) and classification (e.g. credit risk management; Glorfeld & Hardgrave 1996 and countries' welfare and poverty classification; Kaski & Kohonen 1996), monitoring and control (machine failure diagnosis, Yamashina et al. 1990, bibliography in auditing see Calderon & Cheh 2002) both forecasting (financial distress forecasting; Altman et al. 1994) and prediction (bankruptcy prediction; Back et al. 1995, Davalos et al. 1999, Fletcher & Gross 1993, Kiviluoto 1998 and Serrano-Cinca 1996; stock performance prediction Kryzakowski et al. 1993; the prediction of total industrial production; Aiken et al. 1995). The neural network technique has also been used in several sensory and visualization tasks (Kaski et al. 1998b, Lampinen et al. 1997, 35 and Wong & Selvi 1998).

Neural networks have many advantageous properties compared to traditional statistical techniques (e.g. factor analysis). A large number of different studies have revealed that neural networks perform well even in conditions where data is unclear, nonlinear, missing, faulty or even incomplete (Agrawal & Schorling 1996, Haykin 1999, 2-4, Venepogul & Baets 1994 and Wong & Selvi 1998). Despite these good properties some problems are associated with neural networks. The first problem is the lack of regularities concerning the number of hidden layers, neurons in the hidden layers, learning stop time (Hung et al. 1996, Serrano-Cinca 1997 and Wang & Wang 2002) or the quick finding of causalities in the cluster properties. The second problem concerns the learning process, which can be time-consuming (Hung et al. 1996). The first two problems (i.e. number of hidden layers, neurons in the hidden layers) closely relate to the other type of (supervised) neural network, which we do not use in this research. On the contrary, the latter problems also relate to our neural network used. Our type of (unsupervised) neural network has two specific problems because it does not provide any measures of validation of the clusters (Wang 2001) and this validation is based only on the researcher's determination and evaluation.

Neural networks can be classified according to learning principles into either supervised or unsupervised learning[24] (Haykin 1999, 63-65, Hung et al. 1996 and Ultsch 1993). Supervised learning means the adaptation of a network's behavior to a given input-to-output relationship. Supervised learning is useful if we know examples (e.g. financial ratios (inputs) and

[24] Kohonen (1997, 68-69) classifies neural networks to three categories; signal-transfer networks (≈supervised learning), state-transfer networks and competitive learning or self-organizing networks (unsupervised learning)

bankruptcy companies (outputs)) but we do not know how to describe these functional relationships (i.e. relation between the level of financial ratios and bankruptcy) (Back et al. 1995, 13, Davalos et al. 1999 and Ultsch 1993). Therefore, the approximation of function is a typical task for a supervised learning network. The back-propagation algorithm is a well-known algorithm that uses supervised learning (Bigus 1996, 69-71, Berry & Linoff 2000, 120, Groth 1998, 28-9, Han & Kamber 2001, 303-311, Hung et al. 1996 and Ultsch 1993).

Neural networks can also use unsupervised learning technique. In this study we use Self-Organizing Map (SOM)[25], which is based on unsupervised learning. Unsupervised techniques are used if no classes are defined a priopri[26], or if they are but the data are to be used to confirm that these are suitable classes (Bigus 1996, 63-4 and Ripley 1996, 287). Self-organizing map projects a multidimensional input space into two-dimensional space, in a way that the similar inputs (data) are close to each other on output layer (map) (Kohonen 1982, Kiang & Kumar 2001 and Ripley 1996, 287 & 323). The SOM is useful especially for data visualization, clustering and classification purposes (Kiang & Kumar 2001 and Ripley 1996, 287 see also Kohonen 1997, 69 and 219)[27]. The visualization is an especially important capability for the current study because our state of the art survey showed the lowest satisfaction level of format concerning the current macro economic environment methods. We explore the unsupervised learning technique more specifically in Chapter 4.3.

1.6 Research methodology

In this subsection we examine the philosophical assumptions of the study. The first subsection is based on the work of Burrell and Morgan (2000, 1-9) and their assumptions about the nature of social science. The second subsection concerning the used methodology is primarily based on the studies of Neilimo and Näsi (1980) and Kasanen et al. (1993).

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[25] Chapter 4.1 shows also what kind of other techniques we could use and why we chose the self-organizing map.

[26] This is the difference between supervised and unsupervised learning. When we are using supervised learning, we have to classify a priori e.g. the solvent and bankruptcy companies but by using unsupervised learning we do not have to classify companies before training.

[27] Chapter 4.2 presents the most interesting applications of SOM from the point of our study.

1.6.1 Philosophical assumptions

Burrell and Morgan (2000, 1) state that researchers approach their subject via explicit or implicit assumptions about the nature of the social world and the way in which it may be investigated. These assumptions are related to ontology, epistemology, human nature and the used methodology (Burrell & Morgan 2000, 1-7). The assumptions can be approached by a subjectivist or objectivist approach. Burrell and Morgan (2000, 7-8 see also Lukka 1990) state that "German idealism" is behind the subjectivist approach. Figure 4 shows the current study, as we can notice from the next discussion, being a rather objectivist approach to social science. Figure 4 illustrates two extremes to approach social sciences and the approaches can be seen also as a continuum (cf. Morgan & Smircich 1980). However, if we interpret Morgan's and Smircich's (1980) continuum we believe that this study is closer to the objectivist approach than subjectivist.

Figure 4: A scheme for analyzing assumptions about the nature of social science (Burrell & Morgan 2000, 3 the circulation added)

According to Burrell and Morgan (2000, 1 see also Lukka 1990) ontological assumptions concern the very essence of the phenomena under investigation. They propose that ontological assumptions can be based on either nominalism (subjectivist approach) or realism (objectivist approach). By the subjectivist approach ontology is nominal[28] and the reality is the product of individual consciousness and cognition. Names, concepts and labels create individual consciousness that is needed for describing, making sense of and negotiating the external world between individuals. Contrary to the subjectivist approach, the objectivist postulates that the social world is real and

[28] Ryan et al. (2002) use idealism term as synonym for the nominal term.

it is as hard and concrete as the natural world. The objectivist also sees that the reality is external to the individual and subsequently reality is given out there in the world (Burrell & Morgan 2000, 1 & 4). In this study, ontological assumptions are based more on the objectivist approach because we consider companies' competitive and economic environment to be real and out of individuals' mind. Therefore, we consider that the world exists objectively independently of individual perception (cf. Lukka 1990).

After ontological assumptions the researcher considers assumptions concerning epistemology. According to Burrell and Morgan (2000, 1 see also Lukka 1990 and Lukka 1991) epistemological assumptions relate to the grounds of knowledge and how this knowledge can be obtained. The authors propose that the epistemological assumption can be based on anti-positivism (subjectivist approach) or positivism (objectivist)[29]. Anti-positivism assumes knowledge being more subjective, i.e. based on experience and insight of a unique and essentially personal nature. Therefore, the anti-positivist thinks that knowledge can be understood only from the point of view of the individuals who are directly involved in the activities. Contrary to anti-positivism, positivism thinks that the growth of knowledge is a cumulative process and can be achieved by observing. Knowledge is hard, real and capable of being transmitted in tangible form. Positivism seeks to explain and predict happenings in the social world by searching regularities and causal relationships. (Burrell & Morgan 2000, 1,5) The epistemology of the study is rather positivist because we think that knowledge is quantitative and objective and it can be obtained by observing to achieve the purposes of the study. Furthermore, the used methodology (i.e. decision-oriented as well as nomothetic) is associated to positivist epistemology (Kasanen et al. 1993, Lukka 1991, Lukka et al. 1984 and Neilimo & Näsi 1980, 33).

The third assumption concerning the social world relates to human nature and, in particular, the relationship between human beings and their environment. According to Burrell and Morgan (2000, 2) human nature can be either deterministic or voluntary. The former type relates to the objectivist approach because human beings and their activities and experiences are regarded as products of their environment. This means that the activities of humans are conditioned by the environment in which they are located. Therefore, the deterministic form of human being assumes that people are like marionettes. If human nature is voluntary, individuals are regarded as creators of their environment because they are free-willed and autonomous. The voluntary form relates to the subjectivist approach to social science. (Burrell & Morgan 2000, 2 & 6) Our study is based on determinism because we assume

[29] Neilimo and Näsi (1980, 11-25) consider more specifically positivism.

that individuals try to behave so that their behavior is in congruence with their environment. Therefore, individuals can optimize their future welfare by monitoring and scanning the environment. People can subsequently avoid or minimize the impacts of negative happenings by understanding the development of the competitive environment.

The examined assumptions relating to ontology, epistemology and human nature have direct influence on methodology. Burrell and Morgan (2000, 2-3, 6-7 see also Riahi-Belkaoui 2000, 246-250) state that methodology can be based either on an ideographic or nomothetic form. Ideographic methodology is typical for the subjectivist approach to social sciences. It emphasizes the viewpoint that the researcher can only understand the social world by obtaining first hand knowledge of the investigated subject[30]. The understanding of the social world is based on getting inside a situation and involving in the everyday flow of life. On the other hand, nomothetic methodology is generally used in natural sciences where hypotheses are tested by using different scientific tests and quantitative techniques[31]. Therefore, the data of a nomothetic study can be based on surveys and questionnaires. (Burrell & Morgan 2000, 2-3, 6-7) The positive issues concerning nomothetic research relate to methodological precision, rigor and credibility (Riahi-Belkaoui 2000, 247). Our study is rather based on the nomothetic approach because we do not deeply involve any case organization although the evaluation of Model 3 and state of the art survey are performed. Furthermore, we collect our data by two different questionnaires. The first questionnaire is used for evaluating the state of the art of environment analysis methods and the second questionnaire is used for the usability evaluation of Model 3 for economic environment analysis. We consider the methodology used in more detail in the next subchapter.

1.6.2 Methodology selection

The Finnish methodological discussion on accounting has been based on the study of Neilimo and Näsi (1980). They identified four methodological approaches: conceptual, nomothetical (natural scientific), decision-oriented (management science oriented) and action-oriented (hermeneutic). Kasanen et al. (1993) added a constructive research approach to the group of traditional research approaches. The location of constructive approach against other

[30] This view is close to action-oriented research methodology which is presented by Neilimo and Näsi (1980, 34-35 see also Kasanen et al. 1993).

[31] More about the relationship between positivism and nomothetic approach see from Neilimo and Näsi (1980, 11-25 and 63-65).

traditional approaches is presented in Figure 5. In the current study we use decision-oriented approach and subsequently it is circled in Figure 5.

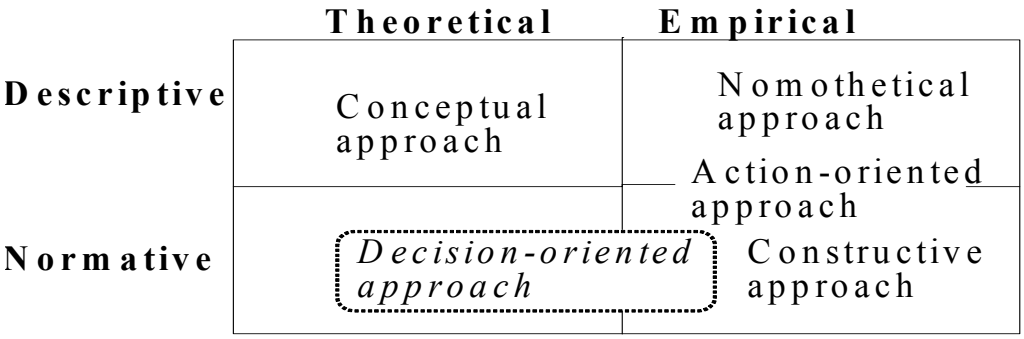

Figure 5: Decision-oriented versus other research approaches (adapted from Kasanen et al. 1993)

In Figure 5, Kasanen et al. (1993) use two dimensions, theoretical-empirical and descriptive-normative to explain and classify different approaches. According to Lukka (1991), descriptive study tries to answer the questions such as what or why something (i.e. explain the reasons) happens whereas normative study tries to answer the question how we should act (i.e. normative study proposes an action plan) to achieve a desired situation. The contribution of theoretical study is based on thinking whereas the contribution of empirical study lays on empiric data (Lukka 1991). The decision-oriented approach locates in the third quarter by emphasizing normative and theoretical characteristics. We have used the decision-oriented approach in this study and it is circled in Figure 5. The decision-oriented approach enables the researcher to construct different models that try to help decision-making in running the firm (Kasanen et al. 1993 and Neilimo & Näsi 1980, 33-34). Therefore, the decision-oriented approach is the closest to the purpose of the current research. The study has also features of nomothetical approach because we use the results of two questionnaires (i.e. state of the art and the evaluation of Model 3) although the primary research approach is decision-oriented.

The decision-oriented approach has similarities with the constructive approach. The main difference is that the constructive approach always entails an attempt to explicitly demonstrate the practical usability of the constructed solution. (Kasanen et al. 1993) Therefore, Kasanen et al. (1993 see also Lukka 1991) concluded that a decision-oriented study, which encompasses a successful implementation, may correspond to a constructive study. Also Järvinen (1999, 59) emphasizes the building[32] of a new artifact if the study is

[32] March and Smith (1995) divide the building of an artifact and its evaluation as different research activities although the research effort may cover both these activities. Building is the process of

based on the constructive research. Järvinen introduces the importance of existing (research) knowledge and/or new technical, organizational etc. advancements on artifact building process. Contrary to Kasanen et al. (1993), Järvinen (1999, 59) does not emphasize practical usability so much if the study is based on the constructive approach because the utility of the new artifact can be sooner or later evaluated. Therefore, Järvinen's (1999, 59) definition of the constructive approach is quite close to the decision-oriented which is presented by Neilimo and Näsi (1980, 33-34)

Normative is a typical feature of the decision-oriented and constructive research approaches (Kasanen et al. 1993). Järvinen (1999, 59) investigates the concept of normative concerning model and method. The normative model describes what kind an artifact ought to be. Some utility aspects are behind the normative models. On the contrary, the normative method describes how to construct, i.e. in which steps to proceed in construction of, a certain artifact. (Järvinen 1999, 59) In this study the normative approach appears in two ways; first, on the selection of the appropriate technique for analyzing competitive environment and second, on the construction of models (i.e. self-organizing maps).

Riahi-Belkaoui (2000, 248) introduces Evered' s and Louis classification of the basic differences between research methods. The classification emphasizes the differences between the modes of the research approach to the object. The approach can be based either on an inside (ideographic) or outside (nomothetic) approach, which is similar to the methodological dichotomization of Burrell and Morgan (2000, 6-7). Figure 6 shows that the methods of action and case research are ideographic if the researcher has an active role in the organization. If the researcher uses an outside mode of inquiry she uses the nomothetic methodology that is based on positivism. The user of the positivistic approach has rather the role of an analyst or model builder than the role of an active organizational actor. We introduce Evered's and Louis classification because it reveals more explicitly the differences of the researcher's role between action research and positivistic sciences (i.e. nomothetic research) than Kasanen's et al. (1993) classification. Our research has a positivist nature because we have an outside focus on the research area (even though the usability of Model 3 is evaluated in the Finnish public companies by survey) and we are building an environment analysis model for the purposes of strategy formulation. Therefore, we have circled the area concerning our research in Figure 6.

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constructing an artifact (e.g. SOM) for a specific purpose whereas evaluation is the process of determining how well the artifact performs. The building process of SOM is introduced in Chapter 4.5 and the evaluation is considered in Chapter 6.

Mode	***Primary purpose of knowledge-yielding activity***		***Role of researcher***
	Organizational action	Organizational inquiry	
From the inside (ideographic)	Coping Action taking Managing Surviving	Situational learning Action research Clinical practice Case research	Organizational actor Participant observer
			Unobtrusive observer Empiricist
From the outside (nomothetic)	Organization. design and engineering Controlled experimentation Social technology	Traditional positivistic science	Data analyst Model builder

Figure 6: Two different modes to approach a research object (adapted from Riahi-Belkaoui 2000, 248)

However, our research has also descriptive (as well as normative) and theoretical characteristics. These characteristics can be seen in the examination of the formulation of strategy and in analyzing the similarities of economic trends in the chapters concerning theory and result. Therefore, this research, as usual, has chapters in the beginning that have been conducted by using the conceptual approach although the primary approach used has been decision-oriented (cf. Lukka 1991).

1.7 Outline of thesis

Figure 7 presents the outline of the rest of the chapters in the thesis.

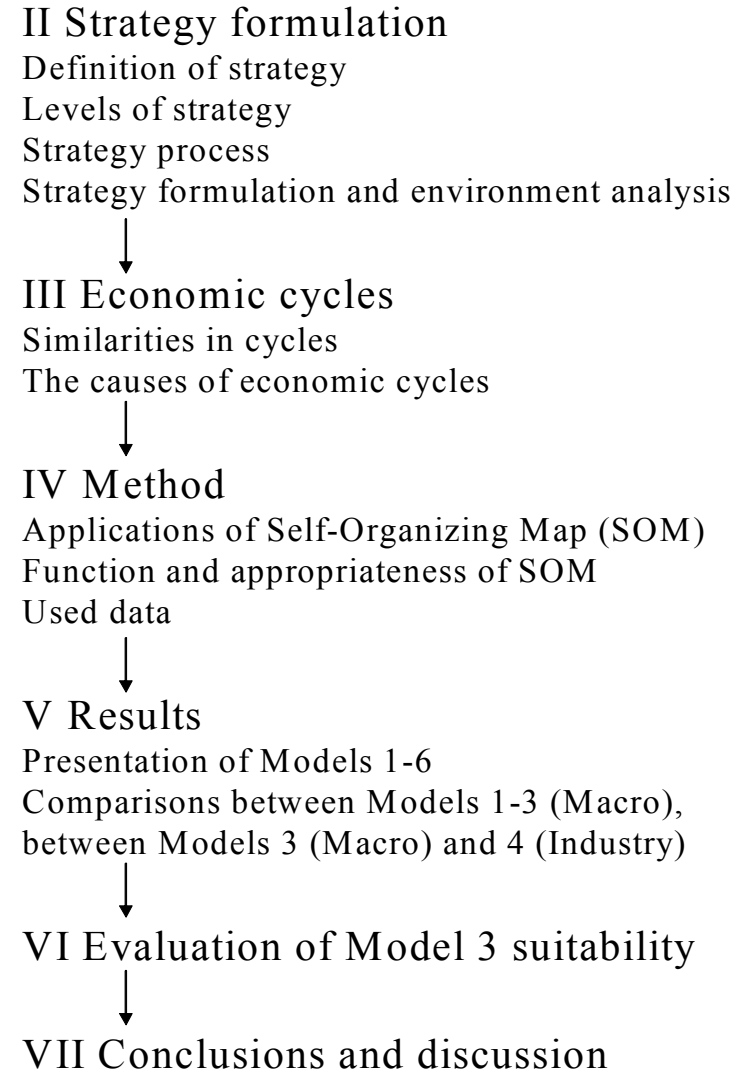

Figure 7: Outline of the thesis

Chapter 2 examines the field of strategy. Chapter 2 starts by defining the strategy concept, examining the different levels of strategies and introducing the requirement of environment analysis in the strategy process. Our primary focus is on the strategy formulation and environment analysis although the analysis can also be used in the other phases of the strategy process. Therefore, in strategy implementation the environment analysis can provide a basis for reasonable and achievable targets. In the control phase the environment analysis may provide explanations and causes for the possible deviation between anticipated and actual performance. In the strategy control phase, the environment analysis can be used to analyze the viability of current strategy and the requirements of the possible strategic changes as a result of changed environmental conditions.

Chapter 3 investigates earlier studies concerning business cycles. We focus on studies that have considered the similarities between business cycles in different countries. We also try to find out some factors which are behind the

business cycles causing these cycles. The end of Chapter 3 considers the necessity of economic growth for nations' prosperity.

Chapter 4 introduces the used technique, i.e. Self-Organizing Map (SOM). We introduce the applications of the SOM and focus on the applications which are the most interesting from the perspective of our study. We also explore reasons why the technique is chosen for this study. We present our database and the normalization of data in this chapter. We describe the process of map construction and the properties of maps at the end of Chapter 4.

Chapter 5 presents the results. We present the results (three models) concerning the macro environment in three phases. First, we briefly present the result of Model 1 where we had three financial variables. Second, we also present shortly the results of Model 2 with six production-oriented variables. Finally, we present the results of Model 3 with nine variables (the financial and production-oriented variables are combined together) in more detail than the results of Models 1-2. The consideration of the possible differences between the macro level models is examined at the end of the chapter.

Chapter 5 presents also the industry level models. First, we analyze the trends in pulp and paper industry (Model 4). The second industry level analysis focuses on the Finnish grocery industry by analyzing the possible price differences between the retailers (Model 5). The last model (6) illustrates how the SOM can be used for the analysis of changing price policy effects on the retailers' positions on the map. We compare the macro and industry level trends by using the first four models at the end of Chapter 5.

We evaluate the usability of Model 3 in Chapter 6. The evaluation is performed in the selected Finnish public noted companies. The willingness of the companies to participate in the demonstration and evaluation was inquired by one question in the state of the art survey. The study finishes with the conclusions and the consideration of future research opportunities.

2 FORMULATION OF STRATEGY

This chapter discusses the formulation of strategy. First, we investigate the strategy concept and what kind of strategic levels can be found. Although we focus on the strategy formulation, we briefly present the whole strategy process before focusing on the formulation of strategy. We also discuss the levels of the macro environment, industry and firm that should be considered during the strategy process. We present some techniques that could be used in the formulation of strategies.

2.1 Definition and purpose of strategy

The term strategy has been used originally in military literature (cf. Guilding et al. 2000). Strategy is defined as "art of projecting and directing the larger military movements and operations of a campaign" (Oxford dictionary 2004). As the official definition describes the main focus is rather on the larger issues than in the smaller ones. However, the strategy concept has also been used in other areas such as in business administration, which is more interesting from the point of view of the current study. Oxford dictionary (2004) defines strategy as used in business administration as a plan for successful action based on the rationality and interdependence of the moves of the opposing participants. The latter definition like most strategy definitions (Bromwich 1990, 28, Lord 1996, Mintzberg 1999, Quinn 1999) highlights the consideration of movements of the opposing part (i.e. competitors) in the process of strategy formulation.

Strategy has been understood as long range planning[33] in a large number of studies (see for instance Atkinson et al. 1997, 11-12, Caillouet & Lapeyre 1992, Johnson & Scholes 1997, 10, Lord 1996, Mintzberg 1999, Porter 1996 and Thompson & Strickland 2001, 19-20). Long range planning allows an organization to build unique capabilities and skills, to clarify the goals and policies of the company and allocate resources tailored to its strategy (Larsen

[33] However, successful strategy can also emerge without prior planning by thus responding to unforeseen circumstances (Marsden 1998, see also Mintzberg (1999) who considers strategy as a pattern where the realized strategy is the function of intended strategy and new emerged issues which cause pressures to act differently as intended.)

et al. 1998, Porter 1996 and Quinn 1999). According to Larsen's et al. (1998) study, the time horizon of strategic planning has been one to three years in the fast growing companies although the horizon can also be up to 10 years.

The purpose of strategy is to ensure the achievement of competitive advantage (see for instance Lord 1996, Hinterhuber 1997, 1, Rumelt 1999 and Ward 1993) by defining the direction and scope of an organization (Hofer & Schendel 1978, 25-26). The number and focus of industries and activities are typical decisions if organizations are determining their strategic direction and scope. The achieving, developing and maintaining of competitive advantage is the primary purpose of strategy because it enables companies to earn a superior profit. Therefore, competitive advantage is the ability of a firm to outperform its industry, that is, to earn a higher rate of profit than the industry norm (Besanko et al. 1996, 441, 543). According to Rumelt (1999 see also Hofer & Schendel 1978, 26 and Marsden 1998) competitive advantage can be based on superior skills (the skills which are learned by the doing of many people in an organization), resources (patents, trademark, specialized assets etc.) or position at a special market. Therefore, the competitive advantage can be based on intangible resources[34] because they are less visible and subsequently more difficult to understand and imitate than tangible resources (Marsden 1998).

Another purpose of strategy is to fulfill stakeholders' expectations and objectives by matching the resources and competencies of an organization within a changing environment (Hinterhuber 1997, 1, Hofer & Schendel 1978, 23-25, Horngren et al. 2000, 462, Johnson & Scholes 1997, 5, 10, Mintzberg 1999, Quinn 1999 and Rumelt 1999). Therefore, the organization's resources and competencies should be in congruence with anticipated changes in the environment. The resources can be physical (machines, vehicles etc.), human (employees' skills), financial and intangibles (especially "goodwill" which may result from brand names, good contracts or corporate image) (Johnson & Scholes 1997, 143). The competencies of a company can be based on exceptional cost efficiency, value added to customer, excellent management of linkages within the organization's value chain and linkages into the supply and distribution chains and the difficulties in transferring and imitation of competencies and skills between organizations (Johnson & Scholes 1997, 144-163).

However, the environmental forces and a company's resources and competencies do not only affect the strategy of an organization because the values and expectations of those who have power in and around the

[34] Resource-based view emphasizes the importance of resources in creation of the competitive advantage (cf. Conner 1991 and Peteraf 1993).

organization have their own effect on strategy (Johnson & Scholes 1997, 10 see also Francis 1992). Shareholders, financial institutions, the managers of an organization, employees, suppliers, customers, communities are the instances that have power concerning companies' strategy.

There are two possible ways to consider the relationship between a company's strategy and its environment if companies are planning their strategies. Strategy development can be based on either fit or stretch. The fit sees managers trying to develop strategy by identifying or being sensitive to the organization's environmental forces and developing the organization's resources to address these forces (i.e. industrial organization theory see Chapter2.4.3.2). The stretch emphasizes the need to be acutely aware of the special competencies of the organization (i.e. resource-based view see Chapter 2.4.3.3), how these competencies might be developed to give competitive advantage and the need to search for opportunities on the basis of these. (Johnson & Scholes 1997, 25 who refer to Hamel & Prahalad 1994 when they consider the difference between stretch and fit.) Therefore, stretch and fit exploit strategy in different ways. Stretching focuses on an organization's competencies whereas fitting focuses on the environment that should be considered before the analysis of an organization's capabilities. We understand that fit and stretch are two extremes and actually both companies' capabilities and environment drive companies' strategy and performance (cf. Henderson & Mitchell 1997). However, we consider that strategic fit is closer to purpose of this study because we are constructing models that can be used in the analyses of companies' external environment.

2.2 Different levels of strategy

In large or diversified companies strategy can be formulated at several different levels. The strategy can be formulated at corporate, business and operational levels (Hofer & Schendel 1978, 27-29, Johnson & Scholes 1997, 11-12 and Thompson & Strickland 2001, 50-57). The prerequisite of an organization's success is that all the levels of strategies fit together to form a coherent and consistent whole (Hofer & Schendel 1978, 29).

Corporate level strategy is the broadest. It determines the businesses where the organization chooses to compete and chooses the most effective way of allocating scarce resources among business units (Simons 1990 see also Cook & Farquharson 1998, 337, Fahey & Narayanan 1986, 193,196-198 and Johnson & Scholes 1997, 11). The corporate strategy reveals the nature of the economic and non-economic contribution it intends to make to its shareholders, employees, customers and communities (Andrews 1999).

According to Porter (1999a see also Hofer & Schendel 1978, 27 and Joyce & Woods 1996, 152-154), corporate strategy should also answer the questions: how the corporate office should manage the array of business units and why the corporate is more and better than the sum of its business units. The latter question relates to the synergy concept. Porter (1998b) proposes that global companies have to decide how to configure the activities across countries and how to coordinate these international activities.

Business unit strategy is the second level of strategy. It concerns the creation of competitive advantage and how to compete successfully in each of the businesses in which a company competes. (Cook & Farquharson 1998, 337, Hofer & Schendel 1978, 27, Porter 1999a and Simons 1990) Therefore, business unit strategy answers the questions: how can advantage over competitors be achieved, what new opportunities can be identified or created in markets, which products or services should be developed in which markets, and to which extent these meet customer needs in such a way as to achieve the objectives of the organization (Johnson & Scholes 1997, 11).

Finally, strategies should be linked to the operational level, in case the success of strategy will be guaranteed and if the real strategic advantage will be achieved (Johnson & Scholes 1997, 9). Operational strategies are concerned with how the component parts of the organization in terms of resources, processes, people and their skills are pulled together to form a strategic architecture[35] which will effectively deliver the overall strategic direction (Johnson & Scholes 1997, 12). Therefore, Hofer and Schendel (1978, 29) propose that the principal focus of strategy is on the maximization of resource productivity in the operational level[36].

Accounting information can be used at the several earlier presented levels of the organization. At the highest organizational (i.e. corporate) level management accounting should produce information about the enterprise's financial and long-run competitive performance, market conditions, customer preferences, and technological innovations. At the management level the information is financial and the purpose is to measure the costs of resources used to produce a product or service and market and deliver the product or service to customers. At the operational level the information is nonfinancial by providing feedback about the efficiency and quality of tasks performed. (Atkinson et al. 1997, 11-12)

The models which will be constructed can be used at least at the two highest strategic levels (i.e. corporate and business). At the corporate level

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[35] Johnson & Scholes (1997, 13) define strategic architecture as the combination of resources, processes and competencies to put strategy into effect.

[36] Hofer & Schendel (1978, 29) use functional term instead of operational level strategies.

these models can be used at least in two different situations. First, the models can be used in the allocation of scarce resources to the market areas with the most prospective economic development. Second, the models can show a retailer price position compared to the competitors and a possible need for the change of a retailer's strategy. At the business level, the models can be used in production decisions (i.e. where to produce so that the lowest production costs can be achieved). Despite the levels of strategies, our models can be used to explain the reasons for the good or poor performance of subsidiaries or operations in different market areas.

2.3 Strategy process

Determination of strategy can be understood as a process. Although the final determined strategy would be similar (for instance, differentiation or cost leadership), the reasoning (i.e. decision-making) can be based also on intuition rather than a logical process (cf. Langley et al. 1995 and Simon 1997, 129-137). Therefore, for instance the formal strategic planning process that will be presented here, can also be more informal in some cases. The process can also be more or less sequential, anarchical (which refers to garbage can model[37]) or iterative (cf. Langley et al. 1995).

Ahola (1995) constructed a model of continuous strategy process. The iterative model includes five phases and it emphasizes continuous issue assessment during strategy formulation and implementation (Ahola 1995, 194-195, 216-217 see also Boshoff 1989, Cook & Farquharson 1998, 338-358, Hofer & Schendel 1978, 49-53, Johnson & Scholes 1997, 17, Rumelt 1999, Simons 1990 and Spulber 1994). Strategic issues are something which should be considered because they have an impact on the aims of the organization (expressed as goals, mandates, mission or values). The issues require urgent action when the environment or companies' operations and capabilities change if the organization wants to survive and prosper (Joyce & Woods 1996, 58 and Varadarajan et al. 1992). Therefore, managers need real-time information concerning the environment because it quickens the strategy process by speeding issue identification, allowing managers to spot problems and opportunities sooner (Eisenhardt 1989). Issue assessment is highlighted in Ahola's model and the changes in these issues should be considered during every phase of the strategy process. Figure 8 introduces Ahola's model of continuous strategy process. The dashed line shows the explored area in this study (i.e. definition of the basic beliefs and premises at the macro and

[37] More about garbage can model see from Cohen et al. (1972).

competitive/industry level) although our models can be used also in the last phase of strategy process.

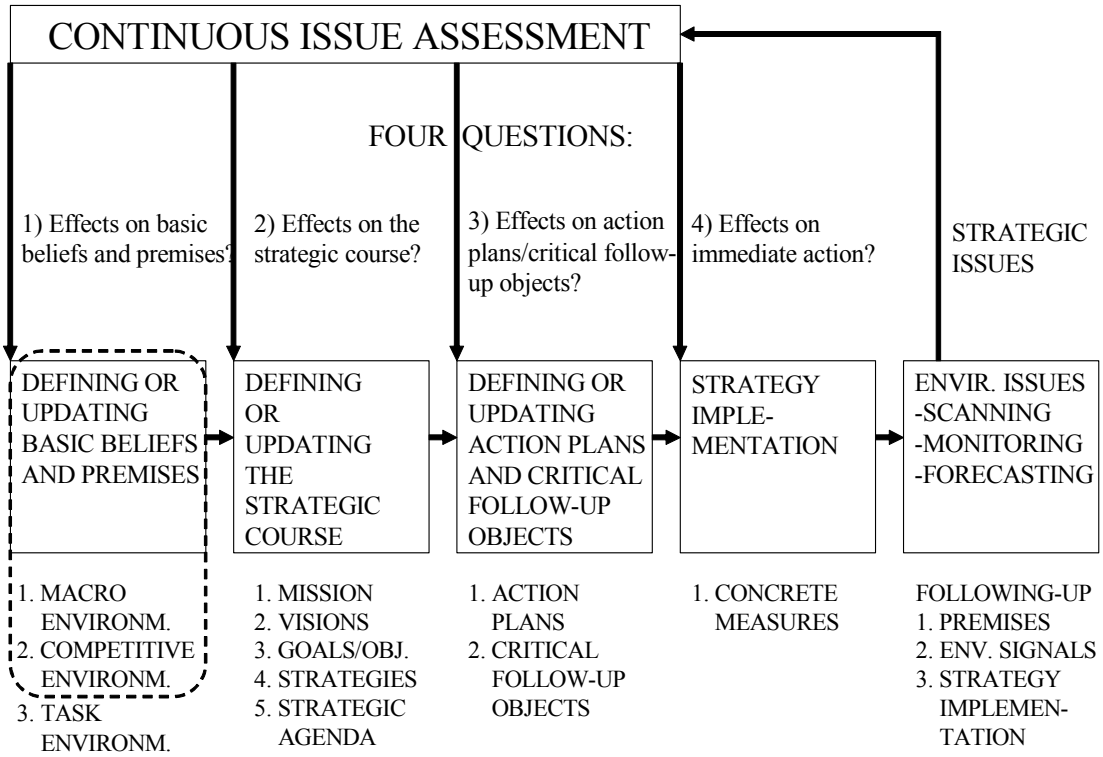

Figure 8: The continuous strategy process (Ahola 1995, 216)

Figure 8 shows that the strategy process starts by analyzing different trends relating to the organization (e.g. technology, customer behavior, environment, and profitability). These kinds of systematic analyses are important because they bring out important facts and considerations that impact on the success of companies. (Ahola 1995, 188, Andrews 1999, Joyce & Woods 1996, 60-61 and Varadarajan et al. 1992). Therefore, Macmillan and Tampoe (2000, 61) propose that the purpose of strategy formulation is to cause strategic thinking that conceives the future of an organization and how that future may be secured.

Environment analyses – further consideration in Chapter 2.4 - help managers to develop a strategic course, mission and vision that reflect the aspiration of managers for the organization and its business (Ahola 1995, 189-190, Boshoff 1989 and Larsen et al. 1998). The vision should answer several future oriented questions – such as where we are going, what kind of enterprise the company is trying to become, what kind of technology and customers we are focusing on (Cook & Farquharson 1998, 337, Johnson & Scholes 1997, 13,15 and Thompson & Strickland 2001, 6-7). Before the formulation of a vision the organization considers its mission. The mission defines the overriding purpose in line with the values or expectations of

stakeholders and concerns with the scope and boundaries of organization (Johnson & Scholes 1997, 13-14).

By setting objectives and goals the visions are converted into more specific performance targets for the company to achieve (Thompson & Strickland 2001, 9); these can be seen as the second phase in Figure 8. The objectives are important because they enable managers' control, and both motivate and lead employees' performance toward decided goals. The goals should be both financial (profitability ratios, stock price appreciation) and strategic (the change of market share, customer satisfaction, our costs versus rivals etc.) (Thompson & Strickland 2001, 9-10 cf. Larsen et al. 1998). Furthermore, the goals should be both short-term and long-term so that the former goals do not prevent the future success of companies (Caillouet & Lapeyre 1992 and Larsen et al. 1998).

In the third phase of Ahola's (1995, 216) model, action plans and critical follow-up objects are created. The fourth phase of the strategy process is strategy implementation which concerns the managerial exercise of putting a freshly chosen strategy into place (Ahola 1995, 39, Cook & Farquharson 1998, 357-359 and Thompson & Strickland 2001, 19). Therefore, strategy implementation concerns how corporate goals and strategy are translated into effective functional operations such as research and development, production, marketing, finance and human resource management. The implementation of strategy also includes the decisions concerning resource allocation, the specific setting of concrete measures and appropriate policies. (Joyce & Woods 1996, 219 and Spulber 1994). As the model shows, strategic implementation should be based on basic beliefs and premises, visions, goals and objectives, strategic agenda and action plans (Ahola 1995, 187-192).

The last phase of the strategy process is evaluating performance, monitoring new developments and environment, and initiating corrective adjustments in a company's long-term direction, objectives, and strategy (Rumelt 1999 and Thompson & Strickland 2001, 19-20). Strategy evaluation should produce answers to three questions. First, are the objectives of the business appropriate? Second, are the major policies and plans appropriate? Third, do the results obtained to date confirm or refute critical assumptions on which the strategy rests? (Ahola 1995, 172, 192-193 and Rumelt 1999) The purpose of strategic evaluation is subsequently to provide important information to managers so that they can evaluate the effect of possible changes in the environment to the previous phases in the strategic process (i.e. basic beliefs and premises, strategic course, action plans and strategy implementation) (Aguilar 1967, Ahola 1995, 194-195 and Fahey & Narayanan 1986, 3-4).

The accounting process should produce information in all the five phases of the strategic management process although one of its most important roles has

been in the evaluation phase (Caillouet & Lapeyre 1992). Therefore, Caillouet and Lapeyre (1992) suggest that accounting information system should produce at least the following information to managers:

1 Planning reports that estimate the effects of alternative actions.
2 Designing and implementing procedures for the accumulation of data to all interested users.
3 Preparing budgets and budget analysis to focus on the comparison of the actual results to those planned.
4 Providing performance reports of these variances.
5 Providing special reports as needed in analyzing current problems and their effect on future operations.

This study provides information to the fourth and fifth steps: do the countries' different economic trends explain the probable deviation in performance between market areas or what is the reason for the possible price differences between the products of the grocery retailers, a globalizing company should also consider the possible deviation in the economic environment between countries or how can a grocery retailer decrease the possible price gap between itself and its competitors. These steps are subsequently marked with a dashed line in the list.

2.4 Environment analysis in the formulation of strategy

Chapter 2.4 discusses the role of environment analysis in the strategy formulation. First, we define the purpose and methods of environment analysis. Second, we discuss the uncertainty of environment. Finally, we identify the levels of environment, i.e. macro, industry and firm and summarize the discussion about environment levels and the importance of its results to the study.

2.4.1 The purpose and methods of environment analysis

A large number of studies highlight the importance of the environment when companies are planning their strategies (Andrews 1999, Caillouet & Lapeyre 1992, 22, Fahey & Narayanan 1986, 188, Garg et al. 2003, Ginter & Duncan 1990, Hinterhuber 1997, 1, Johnson & Scholes 1997, 5, Larsen et al. 1998, Marsden 1998, Mintzberg 1999, Pettigrew 1992, Porter 1998a & 1999b, Subramanian et al. 1993, Quinn 1999 and Rumelt 1999). In this subchapter we introduce some ways to utilize environment analyses in the formulation of strategy. The analyses are important because the chances of strategic success

obviously improve if the chosen strategic options are consistent with changes in the environment (Fahey & Narayanan 1986, 203).

Some researchers have approached strategy formulation from the point of view of the need to match the organization and its strategy to the environment (e.g. Varadarajan et al. 1992). Others have argued that environmental assessment is important so that strategy can be used to position the firm within its environment (see for instance Fahey & Narayanan 1986, Johnson & Scholes 1997, 18, Mintzberg 1999 and Yip 1999). The former approach tends to imply that there is a unitary environment which can be matched by the firm, although this simple picture can be made more complex by assuming that the environment is evolving and industries may be lagging or leading the overall pace of evolution. The second approach suggests that there are more favorable and less favorable locations contained within the environment and that the firm should position itself at the location that is most accommodating to its interest[38]. (Joyce & Woods 1996, 105) However, despite the form of the perspective toward the strategy, the environment is still critical to the survival of organizations (Marsden 1998) although the second approach is more interesting from the point of view of the current study.

There are different models which can help environment analysis in the strategy formulation. One of the most frequently used models is SWOT-analysis which is constructed by Andrews (1999). The results of our state of the art survey showed that SWOT-analysis is utilized in the Finnish public companies from one to several times per quarter on average. One of the 24 respondents even answered that he uses SWOT-analysis once a week or more frequently. The basic idea of SWOT-analysis is that a company's strategy must achieve a fit between the internal capability (Strength and Weaknesses) and external environment (Opportunities and Threats). The threats and opportunities can be grouped into six categories – economic, social and political, products and technology, demographic, markets and competition and other factors (Joyce & Woods 1996, 87). The categories are investigated more specifically in Chapter 2.4.3. The strategy type of a company may have an impact on the scanning of the opportunities and threats of the environment. Hagen and Amin (1995) found that the Egyptian and Jordanian CEOs of companies with a differentiation strategy tend to scan the environment looking for business opportunities for acquisition, investment and customer needs, whereas the CEOs of companies with a cost-leadership strategy tend to scan the environment searching for facts to monitor threats from competitors and regulatory changes. Hagen and Amin (1995) conclude that despite the strategy

[38] Strategic fit refers to this approach (see for instance Marsden 1998). Industrial organization theory generally refers more on this way of thinking (cf. Conner 1991).

type both the opportunities and threats were scanned but the importance of focus differs, which can be explained by the strategic type.

Strengths and weaknesses can be based on organizational, personnel, marketing, technical and financial capabilities. Organizational strengths or weaknesses can be related, for instance, to the form and structure of an organization, top management interest and skill, or control and planning system in the organization. The personnel capabilities can be based on employees' attitudes, technical skills and their experience. The breadth of product line, efficient sales force, knowledge of the customers' needs, reputation and customer services are factors that can create strengths and weaknesses in marketing. Modern production facilities and innovative development and research may be technical factors that may formulate the strengths and weaknesses for companies. Finally, the strengths and weaknesses can be based on companies' financial prosperity. (Joyce & Woods 1996, 88)

Strategic analysis should answer the questions such as what changes are taking place in the environment, and how they will affect the organization and its activities. Environmental changes will give rise to opportunities and others will exert threats on the organization. (Johnson & Scholes 1997, 18) If the organization wants to achieve the anticipated goals they have to exploit the emerging opportunities concerning the environment and concurrently to minimize the effects of damaging threats (Piercy & Morgan 1989). Environment analysis provides time to anticipate the opportunities and carefully develop responses to change (Ginter & Duncan 1990). Strategic analysis should also consider the resources and competencies of the organization and especially how these provide special advantages or yield new opportunities for the organization (Johnson & Scholes 1997, 19). Therefore, the SWOT-analysis highlights the importance of environmental analysis at the beginning of strategy formulation by focusing on the identification of the opportunities and risks in its environment (Andrews 1999).

Figure 9 summarizes the basic idea of SWOT-analysis. Strengths, weaknesses, opportunities and threats should be carefully analyzed when companies choose products and operative markets. Figure 9 also shows the location (dashed line) of this research concerning the SWOT-analysis. This research focuses first on the economic trend analyses of nations by providing information about the country specific economic risks and opportunities concerning the organizations' actions. The second focus of the study is on the industry level analysis, where the movements in the pulp and paper industry and the pricing differences between grocery retailers are examined.

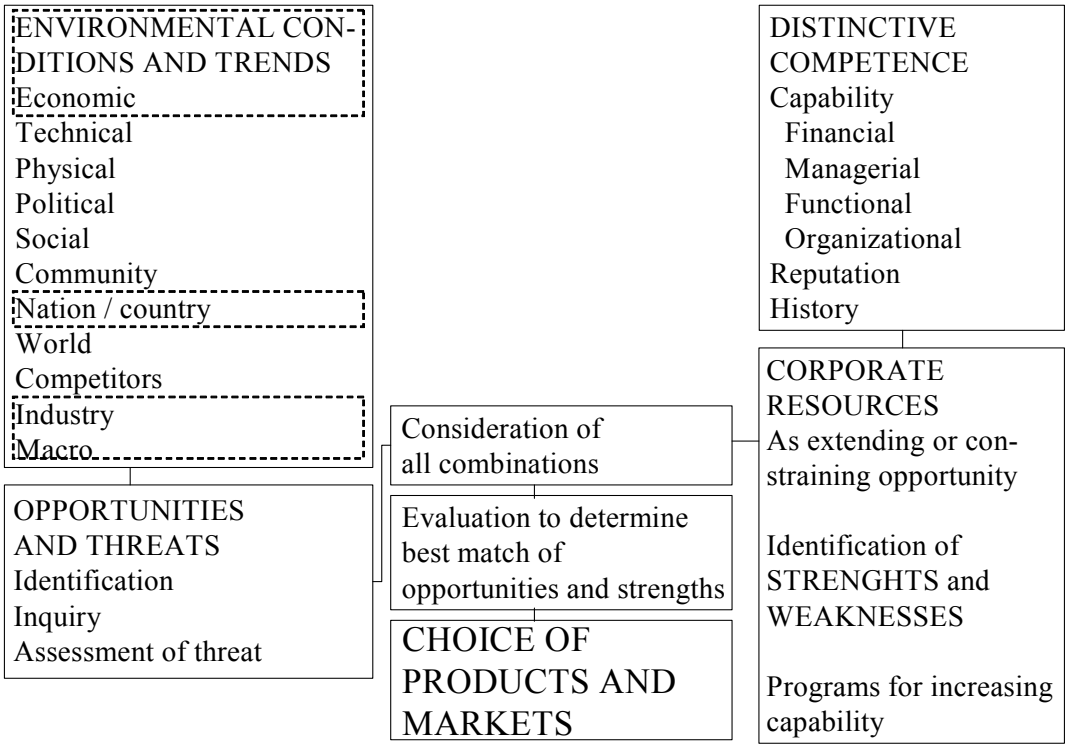

Figure 9: The SWOT-analysis as a tool in the formulation of strategy (adapted from Andrews 1999)

Porter (1999b) focuses on industry and competitive analysis whereas Andrew's model introduces it as a part of environment analysis where companies are analyzing their opportunities and risk concerning environment. Porter (1999b) argues that five forces define the structure and attractiveness of an industry: the bargaining power of existing suppliers[39] and buyers[40], the threat of substitutes[41] and new entrants[42], and the intensity of competitive rivalry[43]. The forces affecting competition should be identified in the strategy formulation so that companies could defend against or influence these forces

[39] Porter (1999b) describes some determinants in a company's analysis of the power of a supplier. The determinants are for instance the number of suppliers, the importance and uniqueness of the suppliers' input for company, switching cost of suppliers and firms in the industry, the presence of substitute inputs and importance of volume to supplier.

[40] The determinants which affect the bargaining power of a buyer are buyers' volume, information, the availability of substitute product, the price sensitivity of buyer, the product impact on quality/performance. (Porter 1999b)

[41] Substitute creates threats to a company if it has relative price performance, buyers show propensity to substitute and the switching costs are low for customers. (Porter 1999b)

[42] According to Porter (1999b), the seriousness of the threat of entry depends on the different barriers such as economies of scale in production and/or marketing, brand identity, capital requirements, learning curve effect on cost and government policy (pollution standards, safety regulations).

[43] The intensity of rivalry is affected by the factors such as industry growth, fixed cost/value added, intermittent overcapacity, diversity of competitors, switching costs of buyers and the exit barriers due to the specialized assets. (Porter 1999b)

and cope with the forces. Because Porter's five forces focus on industry level analysis, Porter (1998a, 155-195) analyzes also the national level competitiveness. Porter (1998a, 166-182) states that companies achieve competitive advantage through innovation which is affected by four attributes concerning nation: factor conditions[44], demand conditions[45], related and supporting industries[46] and finally firm strategy, structure and rivalry[47]. Porter (1998a) nominates these four attributes as the diamond of national advantage.

Environmental analysis should provide an understanding of current and potential changes taking place in the environment. The analysis can be based on the analysis of five forces of industry and also the factors in the diamond of the national competitiveness. Therefore, the understanding of changes taking place currently and historically are important guides to anticipating the future because the history is alive in the present (see for instance Langley et al. 1995 and Stoffels 1994, 129) and may shape the emerging future. Furthermore, trend analysis can reveal patterns (rising demand, seasonal fluctuations) which may be extrapolated into the future. (Fahey & Narayanan 1986, 3, 53, 114, Joyce & Woods 1996, 79 and Pettigrew 1992) Therefore, environment should be scanned, for instance, by using trend analysis because companies have generally little control over external events (such as exchange rate movements) and we have to understand these trends that we can anticipate the possible events and to response these events by changing the strategy (cf. Stoffels 1994, 2 & 129).

Trend analysis can also be used to support the portfolio analysis. The analysis thus indicates market growth in economy, in competitive industry or more specifically in the different market areas of products (see for instance Fahey & Narayanan 1986, 118). Therefore, the growth of the product demand can be a result of the growing economy in a country or on the other hand the improved price-benefit ratio and quality of the product, the changing preferences and needs of customers or some other factor which is associated to the company's and product's superiority. The state of the art survey showed

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[44] Porter (1998a, 172-174) states that the factors (i.e. labor, capital and infrastructure) must be highly specialized to an industry's particular needs so that they are difficult to imitate by foreigners.

[45] The demand conditions in home market are important because they give a clear and earlier picture of emerging buyer needs to companies. This pressurizes the company to make innovations which improve products later. (Porter 1998a, 174-176)

[46] Supporting industries can produce cost-effective inputs in an efficient, early, rapid and sometimes preferential way. Furthermore, the co-operation, for instance in production and R&D, is easier if supporting industries are close to main industries. (Porter 1998a, 176-178).

[47] Firm management practices should be in congruence with the modes favored in a country. Porter (1998a, 178) presents an example from Italy who is a world leader in lighting, furniture, footwear and woolen fabrics. In these industries a company strategy emphasizes focus, customized products and flexibility which fit both the dynamics of the industry and the character of Italian system. Strong rivalry in industry is powerful stimulus to the creation and persistence of competitive advantage (Porter 1998a, 179-181).

that the Finnish companies utilize portfolio matrices from one to several times per quarter if the frequency is measured by median.

One of the most popular portfolio matrixes has been constructed in the Boston Consulting Group[48]. This matrix has been known as BCG growth-share matrix (Henderson 1999). Product market share (scaled from high to low) and growth (also scaled from high to low) are the dimensions in the BCG matrix. The product or business area can be in one of the four cells in the matrix. The market share of product is the most important dimension because it generates cash for a company. Growth is important by providing favorable opportunities for a company's future. Companies should have products which have high growth and high market share (s.c. stars, which assure the future), low growth but high market share (s.c. cash cows that supply funds for future growth), and high growth but low market share (s.c. problem children[49] that can be converted into stars with added funds). The BCG matrix proposes that the products with low growth and low market share should be divested (s.c. dogs).

Environment analysis can also be used in the decisions of production location. Therefore, if a company has manufacturing plants in several countries, the company can move production from country to country after some attractive environmental changes (i.e. exchange rate fluctuations, decrease of tax rates, changing costs and prices etc.) occur in a country (Yip 1999). There is still at least one possible way to utilize trend analysis of environment. Therefore, trend analysis can be used both as a basis for sensitivity analysis and an answer to the "what-if" questions (Aguilar 1967, 198-199 and Fahey & Narayanan 1986, 53). This kind of what-if question can be for instance, what will the impact be on our company and industry if the economy grows or declines, or how does our profitability change if interest rates or product prices decline or increase.

Although we have explained the possible utilization of environmental analysis in the strategy formulation, it can also be used in other phases of strategy process. In the evaluation of companies' strategy and performance, environmental analysis can be used for explaining the extent to which unanticipated environmental events contribute to deviations from expected results (Fahey & Narayanan 1986, 202-203 and Joyce & Woods 1996, 81). Therefore, the performance analysis of firms should be linked to higher levels of analysis (sector changes and alterations in national and international economic context), and lower levels of analysis (the drivers and inhibitors of

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[48] A large number of other matrixes with other dimensions have been also developed (Hofer & Schendel 1978, 32-34 and Johnson & Scholes 1997, 170-173).

[49] Johnson and Scholes (1997, 170-173) nominate question marks those products whose market share is low but the markets have high growth.

change characteristic of different firms' culture, history, and political conditions, efficiency as well as price and cost development) so that we can verify the actual reasons for the changing performance levels of companies (Pettigrew 1992). Environment analysis should be performed continuously because continuous analysis of environment has been observed to have positive correlation with return on assets and companies growth (Subramanian et al. 1993).

Studies concerning environmental scanning[50] have been made. For instance, Muralidharan (1999) found that multinational companies scan in the environment of their foreign subsidiaries most often such aspects as exchange and interest rates, competitor actions of foreign subsidiaries and market response. Muralidharan (1999) also found that aspects such as demographic trends, social attitudes, and trade aspect are scanned less frequently than the before mentioned aspects.

2.4.2 Uncertainty of environment

In strategic planning the uncertainty of environment should also be considered because the type of environment uncertainty impacts on the technique that will be used in the analysis of environment currently and in future situations. According to Johnson and Scholes (1997, 91-93) environment can be either simple, static, dynamic or complex. Simple/static environment is straightforward to understand and there is no undergoing significant change. In simple/static environment technical processes are simple, and competition and markets are fixed over time. In such circumstances, if change does occur, it is likely to be predictable. Therefore, the simple/static environment can be analyzed on a historical basis. (Johnson & Scholes 1997, 91-92) Garg et al. (2003) found that companies with higher sales growth and profitability in stable environment increased their relative scanning emphasis on the general sectors - social, economic and regulatory – (Chapter 2.4.3.1 discusses these factors at the macro level of environment) of external environment and on efficiency functions - cost control and operational efficiency - in internal environment. Therefore we can suggest that Models 1-3 should be interesting for the firms in stable industries.

If the environment is dynamic, the planners of strategy need to consider the environment of the future by using intuition or scenario analysis. In a complex environment an organization faces the greatest level of uncertainty because the environment is difficult to comprehend. With more and more sophisticated

[50] Stoffels (1994) gives a list of references concerning the environment scanning issues.

technology, there is an increasing move toward this condition. The complexity is difficult to handle by analysis although this analysis could precede intuition and scenario analysis. Therefore, companies have decentralized their organization's decision-making and they have to learn to cope with complexity. (Johnson & Scholes 1997, 92-93) Garg et al. (2003) observed that companies with higher sales growth and profitability in a dynamic competitive environment increased the CEOs' relative scanning emphasis on the task sectors of the external environment (i.e. customer, competitor and technological sectors) and on innovation functions in the internal environment. Chapter 2.4.3.2 discusses about task sector issues at the industry level of environment. Therefore, especially our Models 5 and 6 will be interesting if the Finnish grocery retailers perceive their environment dynamic. This can be the case already, since a new grocery retailer has entered the Finnish market and gained better success than was anticipated (Lidl 2003).

Ansoff and McDonnell (1990, 31-32) use five levels to define the turbulence of environment. At the lowest level the environmental turbulence is called repetitive. Then the complexity refers to national development, successive challenges are a repetition of the past, change is slower than the firm's ability to respond and the future is expected to replicate the past. The highest level of environment turbulence is called surprising because companies cannot predict the future, change is faster than they are able to respond and the events are discontinuous and novel. The other three levels of environmental turbulence are expanding, changing and discontinuous. Ansoff and McDonnell (1990, 31-32) claim that the first level turbulence called repetitive is rarely observable in so-called free market economies where new superior products substitute the old products. They claim that all the other four levels of uncertainties are observable.

Ansoff and McDonnell (1990, 32-34) also consider the relation between strategic aggressiveness and the turbulence of environment. Strategic aggressiveness is defined by the degree of discontinuity from the past and the timeliness of the introduction of the firm's new products relative to new products which have appeared on the market. However, at Level 1 strategic aggressiveness is common in the not-for-profit organizations which do not change their products or services unless forced by a threat of survival. At Level 5 companies develop products by incorporating the cutting edge of innovation and technology. Table 2 introduces the special characteristics at different levels of environmental turbulence.

Table 2: The levels of environmental turbulence (Ansoff & McDonnell 1990, 31, 33)

Environmental Turbulence	***Repetitive***	***Expanding***	***Changing***	***Discontinuous***	***Surprising***
Complexity	National Economic	+	Regional Technological	+	Global Socio-political
Familiarity of Events	Familiar	Extrapolable		Discontinuous Familiar	Discontinuous Novel
Rapidity of Change	Slower than Response		Comparable to Response		Faster than Response
Visibility of Future	Recurring	Forecastable	Predictable	Partially Predictable	Unpredictable Surprises
Strategic Aggressiveness	Stable Based on precedents	Reactive Incremental Based on experience	Anticipatory Incremental Based on Extrapolations	Entrepreneurial Discontinuous Based on expected futures	Creative Discontinuous Based on Creativity
Turbulence Level	1 (low)	2	3	4	5 (high)

Our study seems to be the most interesting in the repetitive and expanding environment if we consider Ansoff and McDonnell's (1990, 31 see also Stoffels 1994, 162-165) classification of environmental turbulence. However, the study is interesting also for companies which are operating in a more turbulent environment because the understanding of trends enables managers to analyze the current situation and to asses how these trends could develop in the future (cf. Joyce & Woods 1996, 79).

Some studies have considered the uncertainty order of different environment aspects (Daft et al. 1988, Elenkov 1997 and Miller 1993). Elenkov (1997) studied uncertainty factors in Bulgaria and found that the greatest strategic uncertainty[51] was associated with political/legal environment. Contrary to Elenkov's (1997) study, Daft et al. (1988 see about similar results concerning the order of uncertainty in Russian from May et al. 2000) studied uncertainty factors in Texas and found that CEOs associated the largest strategic uncertainty with customer. One reason for the difference can be that the market had capitalized later in Bulgaria than in Texas and Bulgarian people do not trust the legal and political environment yet.

[51] Strategic uncertainty is defined as rate of change plus complexity weighted the importance of issue by Daft et al (1988) and Ahituv et al. 1998.

According to Elenkov (1997), the other sectors of environment in decreasing order of strategic uncertainty were suppliers, customer/market, economic, competitor/industry, technology and sociocultural in Bulgaria. The uncertainty order of Daft et al. (1988) was approximately similar with Elenkov (1997) but the sample of Daft et al. (1988 see also Subramanian et al. 1993) indicates more strategic uncertainty concerning economic environment than Elenkov (1997) because economic uncertainty was in the second place by Daft et al. (1988). Daft et al. (1988) found that the economic environment contained many uncertainties as a result of declining inflation and a moderate recession in their research period. The competitor environment had also quite high strategic uncertainty (the third highest) in Daft et al. (1988) study. We notice that Daft et al. (1988) and Elenkov's (1997) uncertainty order is slightly different from that of Ansoff and McDonnell (1990, 30-32) because Ansoff and McDonnell (1990) claimed that economic information is needed before technology information if the environment turbulence increases. In summary, we can find both economic and competitor environments having quite high uncertainty, which shows the importance of the environment analyses.

The perceptions concerning the uncertainty of environment can differ between countries. Miller (1993) observed that Latin American managers' political, government policy, and macroeconomic perceptions of uncertainty differed significantly across countries but not across industries. Miller (1993) also observed that the perceived uncertainty concerning resources, demand and competition did not differ between countries and industries because these uncertainties are idiosyncratic to firms. Therefore, according to Miller (1993) country level assessments of political and macroeconomic uncertainties are relevant but competitive, resource and market demand uncertainties should be analyzed separately in each firm and concerning each investment.

Due to the possible uncertainty differences between countries we measured the perceived uncertainty in Finnish companies in our state of the art survey. One factor concerning strategic uncertainty is complexity of environment (Daft et al. 1988). We measured macro level complexity because the evaluation of Model 3 focused on the macro level.

In our survey the technological aspect of the environment showed the greatest complexity. Even 5 of 22 respondents perceived technological aspect very complex. The economic environment had the second highest average of complexity. 3 of 22 respondents perceived economic environment very complex and one not complex at all. The political environment had the third highest average of complexity. The lowest complexity was found in the social environmental aspect with the median and average being at the lowest level. Our survey indicates a very different uncertainty order compared to the order of Ansoff and McDonnell (1990, 31 and 33). Ansoff and McDonnell (1990, 31

and 33) showed that social and political aspects have the greatest uncertainty whereas we showed that these two aspects have the lowest uncertainty compared to the economic and technological aspects. On the other hand, the results of our questionnaire are more similar with Daft et al. (1988) and Elenkov (1997)[52] who showed the strategic uncertainty concerning different environment aspects. Daft's et al. (1988) study observed the greatest macro level rate of change possessing economic environment. The other aspects of environment with decreasing order of rate of change were technological, regulatory and socio-cultural aspects. Therefore, our results show slightly higher instability for the technological aspect than Daft et al. (1988) but on the other way the order is similar with them. One reason for this difference can be that our subjects were usually persons responsible for business intelligence tasks and Daft's et al. (1988) subjects were CEOs.

The level of strategic uncertainty affects the used source of information. Daft et al. (1988) found that if strategic uncertainty increases, CEOs will use more personal[53] (i.e. face to face communication and telephone) than impersonal (written formal reports, output of information systems) sources to get information both from outside (Aguilar 1967, 64: customers, suppliers, bankers etc.) and inside (Aguilar 1967, 64: subordinates, superiors, salesmen etc.) the organization. This does not mean that the increasing strategic uncertainty eliminates the use of impersonal sources to gather environmental data because multiple sources were used if the strategic uncertainty increased by leading the increase of information need (cf. Ahituv et al. 1998, Daft et al. 1988 and May et al. 2000). If we use several sources to conduct environmental scanning we can achieve many advantages: a weak signal from a personal source may be supplemented by objective data and one medium may trigger the use of complementary sources (Ahituv et al. 1998). We have to notice that the increase of strategic uncertainty itself does not affect the frequency of environment scanning if no information is accessible (e.g. May et al. 2000). Ahituv et al. (1998) observed that the CEOs of successful companies in introducing new products used more objective and formal information from external sources than did less successful companies. Ahituv's et al. (1998) result is interesting if we compare it with Daft et al. (1988) because Ahituv et al. (1998) consider the success of companies and information source whereas Daft et al. (1988) consider only the correlation between uncertainty and information source.

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[52] Elenkov (1997) did not report sector importance and environmental uncertainty perception separately.

[53] Aguilar (1967, 63-67) presented the classification of information sources originally. Information locates outside or inside of organization and this information can be obtained from personal or impersonal sources.

However, Daft et al. (1988) found that if CEOs are searching information concerning the economic environment they use most often written external sources (i.e. newspapers, formal reports, survey results and output of management information systems) although personal external and internal sources are also utilized. Our state of the art survey showed also that the media (i.e. newspapers, TV, internet) was the most often used source for macro economic environment analysis in the Finnish public companies. According to our survey media was used once a week or more often on average. Our survey also showed that other sources of information were used, i.e. external consultants, colleagues, internal reports, seminars and conferences. Ahituv et al. (1998) observed that CEOs in more successful companies conducted the environmental scanning more often if the strategic uncertainty increased in the technological, economic and social-cultural environment than was conducted in less successful companies. Therefore, the earlier results support the purpose of this study, i.e. the utilization of self-organizing maps for analysis in the different forms of environment.

2.4.3 The levels of environment analysis

Fahey and Narayanan (1986, 25-26 see also Pettigrew & Whipp 1991, 25-29 & 32-34) describe the levels of the environment where companies are operating and competing. They propose that the three levels of environment influence a company's operations: macro, industry and a firm specific environment. The broadest level of environment is macro environment. Therefore, changes in macroeconomic factors, such as inflation or interest rates, influence all the companies although the changes may have different impact on the companies (cf. Francis 1992). Pettigrew and Whipp (1992, 28) emphasize that conditions in the different levels are unstable and management have to respond continuously to these changes by assessing the viability of their current strategy. We discussed the model of strategy process by Ahola (1995) in Chapter 2.3. The model also showed the importance of the analyses at different levels at the beginning of strategy process[54].
According to Simon (1997, 241-242) the most relevant information to top-level and long-run organizational decisions typically originates from outside

[54] Ahola (1995, 216) defines different levels of environment as macro, competitive and task environment. We use the same names of the levels of environment with Ahola although we replace the task environment by firm level environment. Stoffels (1994, 19 & 30) discusses also task and operational environment (e.g. customers, suppliers, bankers etc.) and remote environment when it comprises forces and relationships beyond a firm's operating situation but which may impose change on its task environment.

the organization, and hence in forms and quantities that are beyond its control. Therefore, organizations must have a database which contains information from the external environment (i.e. macro and industry level). McGahan and Porter (1997) conclude that organizational profitability differences can be explained by the resource-based view but it is misguided to disconnect the influence of organization from the industry and competitive context in which firm operates (see also Henderson & Mitchell 1997). In this subchapter we briefly introduce all the three levels of environment analysis.

2.4.3.1 Macroeconomic level

Macro environment analysis includes four interrelated activities –scanning, monitoring, forecasting and assessing. Scanning means environment analysis of warning signs and possible environmental changes that will affect the business (see more about scanning from Aguilar 1967 and Stoffels 1994). The analysis should also monitor environments for specific trends and patterns. Finally, the analysis should try to forecast future directions of environmental changes and assess how the current and future trends create new opportunities and threats (more about SWOT analysis see Andrews 1999) and affect the company's performance and plans. (Ahola 1995, 192-193, 216-217, Fahey & Narayanan 1986, 36-44, Ginter & Duncan 1990 and Hofer & Schendel 1978, 90-91). Our state of the art survey showed that the Finnish public companies are performing all four activities of environment analysis once per quarter or even more often. On the other hand, the scanning and monitoring of the environment for trends and potential changes in these trends becomes even more important because of the accelerating rate of change (Marsden 1998 and Stoffels 1994, 14).

It is important to consider the effects of changes in the macro environment. This kind of consideration is increasing its importance because the respondents of our state of the art survey perceived a greater turbulence of macro environment compared to the past. The changes of macro environment may affect (1) the boundaries of the industry[55]; (2) the forces shaping industry structure (more about five forces see Porter 1999b), like suppliers, customers, rivalry, product substitution, and entry barriers[56]; (3) strategic groups; (4) the key success factors; and (5) the general expectations within the industry[57]

[55] Two examples are regulatory changes in financial services and telecommunications in the 1980's.

[56] For instance changes in social values and life-styles

[57] The expectations of industry have an impact on the level of investment funds into industry and on the stock price behavior of the firms within it.

(Fahey & Narayanan 1986, 189-193). Therefore, companies should have a deep understanding of the trends and discontinuities concerning economic, technological, demographic, regulatory, or lifestyle that could be used to transform industry boundaries and create new competitive space (Hamel & Prahalad 1994, 50).

As we have pointed out the importance of macro environment to companies, there are still some benefits which can be achieved by using macro environment analysis. Macro environment analysis increases the managerial awareness of environmental changes. This enhances strategic planning by enriching industry and market analysis, increasing our understanding of multinational settings, improving diversification and resource allocation decisions, and facilitating management (Ginter & Duncan 1990). Therefore, the macro environment analysis provides organizations with lead time to identify, understand, and adapt to external issues, to anticipate the consequences of environmental trends, and to develop well thought out positions, strategies and policies (Fahey & Narayanan 1986, 4).

Yip argues that the need for macro environment analysis increases if organizations are large, have diverse product lines, require large investments, face complex and turbulent markets, and experience high competitive threats (Ginter & Duncan 1990). Although Yip claims that environment analysis is most important in the complex and turbulent markets, you can also observe the importance of environment analyses in the other forms of environmental turbulence (see for instance Ansoff & McDonnell 1990, 30-32 and Johnson & Scholes 1997, 91-92).

Macroeconomic analyses are important because they affect companies' financial performance. McGahan and Porter (1997) and Hawawini et al. (2003) showed that 2 percent variance in profits was associated with the fluctuations in macroeconomics. McGahan and Porter (1997) observed that the macroeconomic fluctuations have different impact on different industries and the largest effects were on the service sector (over 4 percent). We have to notice that McGahan and Porter's (1997) study includes only the USA public companies and subsequently the macroeconomic effect can be dissimilar in privately owned and other foreign companies. On the other hand, the macroeconomic fluctuations are more important on the basis what can be concluded from the McGahan's and Porter (1997) and Hawawini's et al. (2003) studies because the former model cannot explain over 48 percent and latter 52-60 percent of the profit variation.

Aguilar (1967) has studied the importance of external information. Aguilar (1967, 50-53) found that managers made the macro analysis (i.e. Aguilar discusses broad issues in this context) more often in the large than small companies. There are at least two reasons for that. First, the larger may have

bigger resources to conduct environment analysis (cf. Stoffels 1994, 15). Second, the managers of large firms may consider the environment more important if they are operating in many areas with many currencies (cf. Stoffels 1994, 69-70). Aguilar (1967, 44-47) also found that among technical managers the macro analyses were more important than among general or marketing managers. On the other hand, Aguilar (1967, 48-50) did not find any larger correlation between managers' level of responsibility and the importance of macro analyses (i.e. at the different levels the importance was perceived almost similar).

The so-called PEST-analysis enables specific macro environment analysis in the strategy formulation process. The PEST-analysis considers the importance of Political, Economic, Social and Technological influences on an organization's performance, opportunities and threats and its strategies (Cook & Farquharson 1998, 346-348, Ginter & Duncan 1990, Hofer & Schendel 1978, 153-154, Johnson & Scholes 1997, 93-96 and Spulber 1994). The conducting of PEST-analysis is important for companies who are operating or planning to operate in global markets because it is a systematic way to consider the different aspects of the environment.

The first capital, P, of PEST-analysis emphasizes the consideration of political issues when organizations are analyzing their operation at environment. The political issues such as the government stability, changing relations between communist and non-communist countries, the relation between private enterprise and government, between workers and management, the impact of national legislation and taxation on corporate planning force threats and opportunities for companies (Andrews 1999, Cook & Farquharson 1998, 347-348 and Johnson & Scholes 1997, 96). These forces and opportunities that have risen from the political environment should be considered in organizations during the strategy process.

The second capital, E, of PEST-analysis focuses on the economic environment. The strategist should carefully and more often consider and monitor the effects and consequences of trends and events in the economic environment to the organization (cf. Elenkov 1997). Economic events and trends are related to the internationalization of competition, the slower than projected development of the Third World countries, recurrence of recession and persistence of inflation in all the phases of business cycles as well as changes in exchange and interest rates, unemployment and disposable income (Andrews 1999, Cook & Farquharson 1998, 347 and Johnson & Scholes 1997, 96). Strategic plans should be anchored in assumptions about the economy and the economic factors are ubiquitous in strategy formulation because economic conditions directly and clearly impact on the fortunes of industries and firms (Fahey & Narayanan 1986, 117). Economic environment analysis can also be

used for searching potential growth areas in a company's current businesses or in the potential new businesses.

Social development and its effect on an organization is the third important aspect which the strategist should consider within PEST-analysis. The social factors concern with the demand of women for opportunity and recognition, the changing patterns of work and leisure, the effects of urbanization, the rise of crime, the decline of conventional morality, the changing composition of world population, the form of income distribution, lifestyle and the levels of education (Andrews 1999, Cook & Farquharson 1998, 347 and Johnson & Scholes 1997, 96).

The last capital, T, of PEST-analysis refers to the technological development and its effect on a company's operations and strategic planning. Technological development refers, for instance, to discoveries of science, the impact of related product development, the less dramatic machinery and process improvements, and the progress of automation and data processing (Andrews 1999). Companies can use different variables such as government spending on research, usage of Internet, the number of mobile phones per thousand people, speed of technology transfer in the analyses and comparisons of countries' technological development (Johnson & Scholes 1997, 96).

Although there are methods for macro environment analysis, such as PEST-analysis and Porter's diamond of national advantage (presented in Chapter 2.4.1), they are used quite infrequently according to our state of the art survey. Both the two macro level methods were used more rarely than once a year on average. Even 12 out of 24 respondents answered never using Porter's diamond of national advantage while 10 out of 22 respondents never used PEST analysis. Also Larsen et al. (1998) observed that only some growing companies use environmental analysis such as PEST in their strategy process.

Some practical problems can explain the infrequent use of the macroenvironment analysis methods although the macro environment analyses are important. Ginter and Duncan (1990) define six major frustrations in macro environment analysis; inability to organize for effective environmental scanning, difficulty in matching individual beliefs and detectable trends, motivation of the management team to discuss the issues. Furthermore, environmental analysis can be frustrating, because it is not able to obtain pertinent and timely information, there are delays between the occurrence of external events and management's ability to interpret them and general inability to respond quickly enough to take advantage of the trends detected. Some of these problems, such as management team's lack of motivation to discuss, can be probably avoided (or at least decreased) by using new techniques such as self-organizing map.

2.4.3.2 Competitive/Industry level

The competitive or industry level refers to an environment where environmental factors directly affect all competitors in the same industry (Fahey & Narayanan 1986, 25). New regulations (concerning employees, pollution, trade agreements, taxes etc.), substitutes, competitors and their pricing policies, suppliers, customers, the growth rate of markets are some factors which affect all the companies in the same industry (cf. Aguilar 1967, 39-44 and Stoffels 1994, 34 & 48-50). Therefore, Porter's (1999b) analysis of five forces can be a technique in the industry level analysis. We have to remark that Stoffels (1994, 34 & 48) proposes that competitive environment includes also the analyses of economic conditions. One reason for the inclusion of economic factors to the competitive environment may be that Stoffels (1994, 34) does not separate the macro and industry levels from each other as we did in this study and subsequently the analyses of economic conditions are included in Stoffels definition of competitive environment.

Industry analysis should be used to gain the understanding of trends and discontinuities concerning technology, demographics or lifestyle that can be harnessed to rewrite industry rules and create new competitive space. The analysis should help managers to make decisions about the questions such as – what to do, which alliances to form, how much to invest, what kind of people to hire, how are customers' needs changing. (Hamel & Prahalad 1995) Therefore, an organization must thoroughly understand the industry in which it operates if an organization is formulating its strategy (Horngren et al. 2000, 462).

Hofer and Schendel (1978, 123-139) propose that industry level analysis should consider different factors because these factors affect companies' profitability in the industry. According to Hofer and Schendel (1978, 123-139), the factors are the level of rivalry, seller concentration and relative competitor size, barriers to entry and exit, capital intensity, vertical integration, value added, economies of scale and experience curve effects, rate of technological change and product differentiation.

Different studies show the effects of industrial factors on the variation of companies performance (e.g. Hawawini et al. 2003, Mauri & Michaels 1998, McGahan & Porter 1997, Powell 1996, Roquebert et al. 1996, Rumelt 1991 and Schmalensee 1985). These studies examine the industrial organization theory. The theory assumes that the strategy and performance of companies are primarily determined by the membership of an industry and they are sustained through entry barriers (McGahan & Porter 1997, Mauri & Michaels 1998 Pettigrew & Whipp 1992, 13-17). Much of this industrial organization theory has been developed by Porter (e.g. five forces) (Pettigrew & Whipp

1992, 15). Industrial organization theory has not considered the importance of national (i.e. macro) level factors to the industry and level analysis directly (cf. Pettigrew & Whipp 1992, 15), which is one extension of the current study if we compare it to industrial organization theory.

The research findings on how important industry specific factors are vary. A number of studies have found that it is important to consider the industry specific factors because they have at least some effect on companies' performance although the firm specific factors may dominate the companies' performance (Hawawini et al. 2003, Mauri & Michaels 1998, McGahan & Porter 1997 and Rumelt 1991). On the other hand, industry level drivers determine the intensity of other factors than only profitability. Mauri and Michaels (1998) found that industry affected companies' R&D and advertising investments more than firm specific factors. By eliminating outliers (i.e. the best and worst companies) from their database Hawawini et al. (2003) found, however, that industry effect is more important than firm specific factors for performance. Hawawini et al. (2003) conclude that superior (or poor) management leads to superior (or poor) firm performance irrespective of industry structure and subsequently industry structure matters for (the most of) firms that do not manage to be the leader or the loser, i.e. firms with average managerial capabilities and performance. Industrial factors may affect differently depending on the industry. McGahan and Porter (1997) found remarkable variation in the importance of industry effects on the variation of profitability. They found that in wholesale/retail, lodging/entertainment and services, industry accounts for over 40 percent of the variance of profit whereas in the manufacturing the effect was only 10 percent. We have to remember that a significant proportion of the performance variations between companies and industries cannot be explained (e.g. in Hawawini et al (2003) study 45-62, McGahan & Porter (1997) 30-54 and Scmalensee (1985) study 80 per cent of variation cannot be explained) and subsequently the relative explanation power of the industry factors is larger than could be noticed at the first.

2.4.3.3 Firm level

The narrowest level of the environment is firm level in the model of Fahey and Narayanan (1986, 25). This level refers to the set of customers, suppliers, competitors, financial institutions, and other environmental associations such as trade associations that are directly related to the companies' operations. On the other hand, according to Boshoff (1989) firm level analysis can also refer to the audit of internal functions i.e. marketing, production, financing etc.

The theory which emphasizes the importance of firm-level factors is called resource-based view (cf. Conner 1991, Mauri & Michaels 1998). The theory assumes that the competitive advantage is based on the unique resources and idiosyncratic processes which drive heterogeneity among companies. Therefore, the resource-based view suggests that the firm-specific attributes drive both strategies and performance which is in contrast to the industrial organization theory (Mauri & Michaels 1998).

In the field of accounting different techniques can be associated with firm level analysis. These techniques include the use of budgeting systems for planning and control[58], performance measures such as ROI, divisional profit reports, and cost-profit-volume techniques for aiding to make decisions (Chenhall & Langfield-Smith 1998). On the other hand, different analyses of balance sheets and profit and loss accounts are typical firm level evaluations in the field of financial accounting. As we can notice the (especially traditional management accounting) techniques have tight internal focus on the company's performance by forgetting the external operation environment and subsequently the other introduced upper levels of environment.

2.4.3.4 Summary of the levels of environment analysis

In this research we focus on the environment analyses of macro and industry levels in the formulation of strategy although the best practice could be found if all the environment levels were analyzed simultaneously (cf. Garg et al. 2003). The prioritization between the macro and industry levels depends on the perceived dynamism of the environment (Garg et al. 2003). The purpose of strategy formulation is to match the companies' capabilities (strength and weaknesses) and environmental opportunities. These opportunities can be systemically analyzed by using different techniques such as PEST-analysis, Porter's five forces, Porter's diamond of national advantage and BCG-matrix in the different levels of environment.

Figure 10[59] summarizes the levels of environment which we have examined in this subchapter. We circled macro environment, economic analysis and nations in Figure 10 because these areas are examined in this research.

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[58] A defect of budget is its inability to consider the immediate strategic questions concerning products and services, marketplaces, customers, competitors and distributors. Furthermore, budgets let alone the longer-term strategic issues of environmental change and how these will impact upon the way we need to do business in future. (Piercy & Morgan 1989)

[59] Adapted from the figure of Fahey and Narayanan (1986, 27 see also Andrews 1999, Hofer & Schendel 1978, 122-144, Pettigrew & Whipp 1991, 27 and Spulber 1994). The environment concerning industry and firm levels can be called also task environment and macro level of the environment can be called general environment (e.g. Ahituv et al. 1998 and Daft et al. 1988).

Competitors are circled also in the industry environment because they are examined in Models 5 and 6. The mentioned areas are difficult to analyze manually in the information rich era and subsequently we are looking for computational assistance for the task in this study.

Figure 10: Levels of environment

The primary idea in Figure 10 is that a company is operating in its own environment that is affected by industry and macroeconomic environments. Therefore, companies and their stakeholders (shareholders, suppliers, financial institutions and customers etc.) should analyze all the levels of environment if they are formulating a strategy or evaluating performance. Events in the upper levels of environment can create several threats and opportunities for companies that may explain the performance differences between companies and create pressures to change the original strategy (cf. Ahola 1995, 152). Figure 10 shows that industrial organization theory emphasizes the importance of industrial level analysis in comparing firm performance. Contrary to industrial organization theory, resource-based view sees the firm level analysis more important if we try to explain the differences between companies' performance. Although the theories seem to be quite opposite, they have also similarities. For example, they assume that firm's environment poses critical constraints on strategy (Conner 1991). It is a noteworthy issue that both industrial organization theory and resource-based view forget the importance of macro-level in the environment analyses.

3 BACKGROUND OF ECONOMIC TRENDS

In this chapter we will focus on earlier studies concerning economic cycles and trends which are closely related to macro level environment analysis (Chapter 2). The structure of this chapter is the following. First, we present earlier studies exploring national interdependencies on economic trends. Second, we report on the causes of these cycles. Finally, we focus on economic growth, which is one of the most vital requirements for countries' increasing prosperity.

3.1 Similarities in economic trends

One of the many studies on business cycle interdependency is presented by Schaefer (1995, 27). He observed that several economic downturns occurred at the same time in the United States, Japan, Germany, Great-Britain and France, which indicates some economic interdependence among these national economies (see also Kindleberger 1995, 97, Lumsdaine & Prasad 1999, 27 and Kaski & Kohonen 1996). Despite the interdependencies, the downturn began in each country at a different time with different lengths and severity. This indicates some ability to cushion against international economic interdependence and the impact of domestic factors.

Artis et al. (1997) observed that European countries (i.e. Germany, France, Italy, Belgium, the Netherlands and Ireland) have similar business cycles. They also noticed that Canada and the USA have very similar cycles (c.f. Gregory et al. 1997). Artis et al. (1997) observed that Germany, the USA and Japan have associated trends but the latter feature is not as substantial as the before mentioned similarities. Furthermore, they found that the United Kingdom has idiosyncratic business cycles and the UK has the most similar trends with Ireland and Belgium. Zimmerman (1997) presented one explanation for the similar trends. He found that two countries with long distance from each other translate into lower cross-correlation for output as a result of lower correlation of innovations and lower spillovers between countries.

Crucini (1997) introduced an explanation for Artis' (1997) and Schaefer's (1995) economic trend interdependency studies. Crucini (1997) found that G-7 countries (Canada, France, Germany, Italy, Japan, the United Kingdom,

United States) have less volatile investment, consumption, and trade balance ratios, higher correlation between domestic saving and investment rates, and about the same correlation of trade balance ratio and investment ratio as 68 smaller countries. Harjes (1997) and Yamagata (1998) also noticed that GDP, private consumption and investment tend to be more volatile in the East Asian developing countries compared to the USA. Crucini (1997) has argued that the dominant factor in these smaller fluctuations is the size of the country i.e. bigger (G–7) countries have smaller economic fluctuations than smaller ones (cf. Zimmerman 1997 and Lumsdaine & Prasad 1999, 4, 26). Crucini (1997) also observed that volatility has an international origin. This means that higher volatility in smaller countries is the inevitable result of their interaction with larger economies (cf. Yamagata 1998 who observed that one year-lagged U.S. and Japanese consumption is correlated with the consumption of other (smaller) East Asian economies due to consumption synchronization).

Different industry sectors can reflect general business cycles in different manners (Fahey & Narayanan 1986, 117-118). Berman and Pfleeger (1997 see also Hornstein 2000 and Cuadrado-Roura & Ortiz V.-Abarca 2001) observed that both employment and demand are highly correlated with the business cycles (GDP) in industries which provide goods that consumers and businesses can postpone purchasing during recession periods i.e. household furniture, motor vehicles and equipment, carpets and rugs. On the other hand, they found that neither employment nor final demand were highly correlated with business cycle in industries that provide necessities or public goods (i.e. drugs, educational services, insurance carriers, food-related activities, nation-related activities), and demand for these goods remained strong throughout different periods. Finally, Cuadrado-Roura and Ortiz V.-Abarca (2001) found that the volatility of the service sector was lower than in manufacturing activities. Cuadrado-Roura and Ortiz V.-Abarca (2001) also observed that both industry and service sectors had procyclical and coincident cycles with the general business cycle.

Using different economic variables can result in different conclusions in analyzing the trends of countries. Chyi (1998) found that the cross-country correlation of consumption is smaller than that of output (cf. Gregory et al 1997). Ravn (1997, cf. Basu & Taylor 1999, 8) observed in the OECD countries a very strong tendency to positive cross-country co-movements over the business cycle in output, productivity, total investments, employment, imports, exports and consumption. Furthermore, Paci (1997) found a clear tendency for aggregate labor productivity convergence (especially in industry and service sectors) across European regions over the 1980s, although income per capita does not show any convergence.

Weber (1997, cf. Basu & Taylor 1999, 3 and Cuadrado-Roura & Ortiz V.-Abarca 2001) claimed that business cycles are becoming less prevalent, severe and significant. Weber (1997) gave six reasons for that development: the globalization of production, changes in finance, the nature of unemployment, government policy, emerging markets and information technology. He examined only the U.S. economy in 1997 when the economic growth had continued for seven years, which may have influenced his conclusions.

Table 3 summarizes the most important earlier studies for this research concerning similarity of business cycles.

Table 3: Research findings concerning the similarity of business cycles

Authors	***Andreou et al. (2000)***	***Artis (1997)***	***Berman & Pfleeger (1997)***	***Chyi (1998)***	***Crucini (1997)***
Main findings	The most reliable forecasting indicator is the interest rate term structure	International character of cycles: European -as well as North American - countries have similar trends.	The severity of fluctuation of business cycles differs between industries.	The cycles are similar; cross-country correlation of consumption is smaller than that of output	Country's size is the describing factor of the severity of business cycle fluctuations and these fluctuations have international origin.
Variables used	Interest, stock market price indexes, dividend yields & monetary aggregates	Industrial production	GDP, industry specific demand and employment	GDP, consumption, investment, trade balance and terms of trade	GDP, consumption, investment and the trade balance
Period	1955-98 monthly	1961-93 monthly	1977-93 annual	1961-90 annual	1970-89 annual
Method	Statistical	Statistical	Statistical	Statistical/Mathematical model	Mathematical model
Explored countries	GER, UK & USA	G-7, BEL, IRE, LUX, NET & SPA	USA	G-7, Austria, FIN, SWE & 16 other countries	G-7 & 68 other countries

Table 3: Main research findings (cont.)

Authors	***Cuadrado-Roura & Ortiz V.-Abarca(2001)***	***Hornstein (2000)***	***Gregory et al. (1997)***	***Lumsdaine & Prasad (1999)***	***McKenzie (1999)***
Main findings	Private service (market) activities are more coherent with the general business cycle than public (non-market). Service sector had lower volatility than industry. Both sectors are coinciding with general cycle.	Industries move contemporaneously (i.e. positive correlation) with each other and aggregate variables industries in manufactur. sector move closer together than do the rest of the economy.	There is worldwide cycle although world (technology shocks, oil price increase etc.) and country-specific (changing policy, term of trade shocks etc.) factors play different roles in different business cycles.	They found worldwide - and also European wide -business- cycles. Macroeconomic fluctuations have become more closely linked across industrial economies in the post Bretton Woods period.	Exchange rate volatility has a different impact (i.e. positive or negative) on different markets.
Variables used	GDP	Gross output, value-added, K, employment, intermediate input aggregate, materials & energy	GDP, consumption and investment	Industrial production	
Period	1970-1998 quarterly	1950-1991 annual	1970-93 quarterly	1963-94 monthly	
Method	Descriptive statistics	Statistical	Mathematical model	Statistical	Literature review
Explored countries	Spain	USA	G-7	G-7, Austria, FIN, SWE & 7 other countries	

Table 3: Main research findings (cont.)

Authors	***Muellbauer (1997)***	***Paci (1997)***	***Ravn (1997)***	***Schaefer (1995)***	***Weber (1997)***	***Zimmer-man (1997)***
Main findings	The fluctuation of output correlates across countries.	Labor pro-ductivity (per capita income) has (not) converged across the European region.	Output, productiv-ity, em-ployment and investment variables have co-moved across countries.	Economic downturns have occurred almost at the same time although downturn began at different time with different lengths and severity, indicating countries' ability to cushion against int. economic interde-pendence.	Business cycles are becoming less prevalent, severe and significant.	Similari-ties of business cycles: Long distance decreases countries' cross-cor-relation.
Variables used	GDP & unem-ployment	Income per capita (GDP) & labor produc-tivity	Output, export, import, investm., consumpt., employme. & productive.	GDP		GDP, consumpt., investm., imports, exports, terms of trade, employme.
Period	1955-97 annual	1980-90 annual	1970-92 quarter	1970-93 annual		1965-89 quarter
Method	Liter. rev. / descriptive statistic	Statistical	Mathemati-cal model	Descriptive statistic	Narrative/ Literature review	Mathe-matical model
Explored countries	UK & GER	FRA, GER, ITA, UK & 7 other countries	G-7, Australia, SWI & SWE	CAN, FRA, GER, JPN, UK & USA	Mostly the USA	G-7, Austria, FIN & SCHW

As we have showed in this chapter, a large number of studies have discovered similarities in business cycles across countries.

3.2 The causes of economic trends

The causes of business cycles are explained in many different ways. In general, business cycles are defined as responses to persistent changes, or shocks that shift the constant growth path of the economy up or down (Prescott 1999, cf. Temin 1998, 1-2 and Zarnowitz 1997, 3-4). Sterne and Bayorni (1993, 23 cf. Weber 1997) observed that demand and supply shocks have equal importance in explaining variation in OECD countries' output growth and inflation. On the contrary, Temin (1998, 20-21 and 25) proposed that there is no single type of shock for business cycles although he claimed that shocks usually had domestic origin in the USA. Temin (1998, 28-30) also proposed that production lost in business cycles has been caused more by real shocks than monetary ones. On the contrary, Zarnowitz (1999 see also Hornstein 2000) focused more on the monetary side causing business fluctuations. Zarnowitz (1999) proposed that interaction of profits, investment, credit and financial market is an enduring feature of market economies, which plays a central role in business cycles. Kindleberger (1995, 97) concluded that business cycles may have primarily financial, structural (resulting from changes in demand, supply or institutional relationship) or mixed origins. To summarize previous research, Gregory's et al. (1997) study revealed that world level (technology shocks, oil price increase etc.) and country-specific (changing policy, term of trade shocks etc.) common components play different roles in different business cycles.

Different shocks and resulting business cycles can also be a consequence of psychological behavior (Bloch 1997, Chatterjee 1999 and Weber 1997). Bloch (1997) concluded that the different psychological factors, such as mass psychology and confidentiality in economy, lead to cyclical movements and speculation in economy.

Chatterjee (1999) proposed that fluctuations in the growth rate of total factor productivity explain the cyclical upward and downward trends in the economic activity. Productivity improves, for instance, as a result of increased efficiency or the decreased prices of raw materials. Therefore, Chatterjee (1999) proposed that cycles can sometimes be good for improving economic efficiency. Also Francis (1992) claims that recessions can be sometimes good because companies have to rejuvenate their strategies, structure and procedures to maintain and achieve their competitive advantage. On the other hand, business cycles can be disadvantageous to nations because a severe

recession can discourage risky long-term investment and hence reduce prospective growth (Zarnowitz 1997, 23).

Exchange rates also have their own impact on business cycles and foreign trade. Broll and Eckwert (1999) observed that as the exchange rate volatility increases so does the potential gains from international trade by making production more profitable. On the contrary, the more volatile exchange rate implies a higher risk for international firms. The net effect of exchange rate uncertainty on production and exports depends on the degree of the relative risk aversion of the firm. However, the exchange rate volatility depresses investments (Darby et al. 1999). Darby et al. (1999) discovered that exchange rate volatility has long-run impact in the United States, Germany and France but only a temporary effect in the United Kingdom and Italy. On the other hand, McKenzie (1999) perceived that exchange rate volatility might exert a positive or negative impact on trade. Therefore, exchange rate volatility seems to have a different impact on different markets. The firms' different risk aversion can be one describing factor for both Darby's (1999) and McKenzie's (1999) results.

Interest rates and share indexes are also business cycle indicators. High interest rates indicate unstable economic conditions, make investment more risky and discourage cross-border capital flows (Schaefer 1995, 219). Andreou et al. (2000) used four different financial variables - interest rates, stock market indexes, dividend yields and monetary aggregates- and found that the most reliable forecasting indicator was the interest rate term structure. Changes in interest rates and anticipated changes in company profits directly affect general stock market prices (Schaefer 1995, 214, 244). During economic expansions expected dividends rise enough to offset expected rising interest rates, which drives stock prices up (Hall 1990, 25, see Copeland & Weston 1992, 339-343; about the dividend expectations effect stock prices).

In this section we explained the causes of business cycles which can be found in earlier studies. Table 4 presents a summary of the most important studies for our research concerning factors that cause the cycles.

Table 4: The causes of business cycles

Authors	***Bloch (1997)***	***Broll & Eckwert (1999)***	***Chatterjee (1999)***	***Darby et al. (1999)***	***Hall (1990)***
The causes of business cycles	Mass psychology and people confidence toward economic develop-ment.	A higher volatility increases the potential gains from international trade by resulting in more profitable production.	Fluctuations in the growth rate of total factor productivity explain the cyclical upward and downward trends in the economic activity.	Exchange rate volatility depresses investments.	The change of expected dividends and interest rates drives stock prices e.g. business cycles.
Method used	Literature review/ Narrative	Mathematical (theoretical) model	Literature review	Mathematical model	Mathematical model
Explored countries			USA	FRA, GER, ITA, UK & USA	

Authors	***Kindleber-ger (1995)***	***McKenzie (1999)***	***Muellbauer (1997)***	***Schaefer (1995)***	***Sterne & Bayorni (1993)***
The causes of business cycles	Primarily financial, structural (resulting from changes in demand, supply or institutional relationship) or mixed origins.	Exchange rate volatility has a positive or negative impact on different markets.	Shifts in technology, regulations and institutions mostly do not take place at business cycle frequencies but financial factors may cause business cycles.	Changes in interest rates and anticipated changes in company profits directly affect general stock market prices.	Demand (transitory effect on output) and supply (permanent effect on output) shocks have equal importance on explaining variation in OECD countries' output growth and inflation.
Method used		Literature review	Liter. review / descriptive statistics	Descriptive statistic	Statistical
Explored countries			UK & GER	CAN, FRA, GER, JPN, UK & USA	G-7, AUS, FIN, SWE & 10 countries

Table 4: The causes of business cycles (cont.)

Authors	***Temin (1998)***	***Weber (1997)***	***Zarnowitz (1999)***	***Zimmerman (1997)***
The causes of business cycles	More usually real shocks (decline in spending, Ford's shutdown in 1927 etc.) than monetary shocks (changing interest rate, monetary stringency etc.)	Errors in monetary policy, psychology behavior, productivity shocks.	Interaction of profits, investment, credit and financial market plays a central role in business cycles.	Countries' size affects volatility of business cycles.
Method used	Literature review	Narrative / Literature review	Literature review (/ mathematical model)	Mathematical model
Excplored countries	USA	Mostly the USA		G-7, AUS, FIN & SCHW

As the presented studies showed us, the researchers have explained different causes of business cycles. However, business cycles can sometimes be good for improving economic efficiency (Chatterjee 1999) although a severe recession can discourage risky long-term investment and, hence reduce prospective growth (Zarnowitz 1997, 23). In this study we do not make the decision if business cycles are a result of changes in financial (interest or exchange rates etc.) or structural (productivity, export, import, consumption etc.) variables and subsequently our research includes both financial and structural variables.

3.3 Economic growth

Numerous studies relating to economic growth can be found because economies have to expand as a result of growing population and expected living standard (cf. Francis 1992). Zarnowitz (1998) even concluded that the biggest risk to the U.S. expansion is that growth may slacken, bringing down companies' profits, the stock market, business capital investment, and eventually overall demand (falling export), output and employment. Deheija and Rowe (1998 cf. Martin & Rogers 2000) present a mathematical model where more severe business cycles reduce the growth rate of economy.

Some researchers have tried to find the descriptive factors of economic growth. Life expectancy, democracy, inflation, fertility rates (Barro 1997, OECD 2000), unemployment (Gylfason 1998, Haveman & Schwabish 2000 and Martin & Rogers 2000) and expenditure on health and education are some factors causing economic growth. Favorable terms-of-trade, gross domestic investment and accounting information adequacy (Riahi-Belkaoui 1995) both technology advances[60] (Fahey & Narayanan 1986, 112, Hunt 1998 and Prescott 1999) and consumption (Chyi 1998) are also factors causing economic growth. Martin and Rogers (2000) noticed that learning by doing drives growth only at high levels of development. Contrary to technological factor, Muellbauer (1997 see also Zarnowitz 1997, 20-21) claimed that shifts in technology, regulations and institutions mostly do not take place at business cycle frequencies.

Some studies describe the counter and procyclical movement of variables. Chyi (1998) found that consumption, investment and saving co-move with output and therefore these variables are procyclical. On the other hand, trade balance/output ratio is countercyclical (cf. Harjes 1997, Basu & Taylor 1999, 7, 14). Researchers have also explored the correlation of economic growth between different countries. Gregory et al. (1997) found a statistically significant world cycle in the growth rates of output, consumption and investment in G7 countries. Peiró (1998) observed short-term dependence of quarterly growth rates in industrial production in Japan and the U.S. However, in France, Germany and the United Kingdom he found only weak, non-existent or unstable dependence.

To sum up this chapter, there are a large number of studies relating to business cycles and interdependencies in these cycles (Artis et al. 1997, Crucini 1997, Gregory et al. 1997, Kindleberger 1995, 97, Lumsdaine & Prasad 1999, 27, Peiró 1998 and Schaefer 1995, 27-29). There have also been several explanations of the causes and origins of business cycles (Crucini 1997, Kindleberger 1995, 97, Lumsdaine & Prasad 1999, 4, 26 and Sterne & Bayorni 1993, 23). Authors have usually used statistical calculations (Andreou et al. 2000, Sterne & Bayoumi 1993), mathematical models (Crucini 1997) or one-variable trend analyses (Schaefer 1995) in analyzing trends in their studies. These techniques have, however, some limitations; different cause-effect relations are not always straightforward, the visualization of results is unsatisfactory and it is difficult to find the underlying function for statistical analysis of economic time series and the function found can lead to complicated models. None of the reported studies have used advanced

[60] I.e. technology advances in information and computer industry in 1990s as well as electricity and internal-combustion engines in the early of 1900 (Gordon 1999).

information systems such as neural network based systems. These systems – like self-organizing map- do not make any assumptions of data linearity or nonlinearity, and data visualization is improved resulting in easier and faster interpretation of data coming from large databases.

4 SELF-ORGANIZING MAP (SOM) AND DATA

This chapter introduces the SOM technique and explains the reasons for the selection of the technique. Furthermore, we present our database, variables and the normalization of data in this chapter. We describe the process of map construction and the properties of the maps at the end.

4.1 Choice of appropriate technique for the analyses

There are several different clustering[61] techniques: partitioning techniques (k-means), hierarchical techniques (decision trees), model-based techniques (self-organizing maps), density-based techniques and grid-based techniques (Han & Kamber 2001, 346-81, see also Berry & Linoff 2000, 102-21). We focus on the first three techniques because they are the most comprehensive techniques in the field of data mining (i.e. clustering in this study). Furthermore, the first three techniques are most commonly used and they are also available on a wide range of computing platforms (Berry & Linoff 2000, 93-4 and 102-3 see also Wang & Wang 2002). In the following paragraphs, we introduce the three different clustering techniques briefly. We consider the characteristics of these techniques and clarify why we chose the SOM as a clustering technique for our research purposes.

The most well-known and commonly used partitioning algorithm is k-means (Han & Kamber 2001, 349 and Wang 2001). The k-means algorithm allocates patterns (or perceptions) to the cluster whose mean (i.e. the average of the cluster) is nearest to this pattern (Cios et al. 1998, 383). The users have to specify k, the number of clusters, in advance which is one disadvantage concerning k-means technique. Furthermore, the technique is not suitable for discovering clusters with nonconvex shapes or clusters of very different size. K-means is also sensitive to noise and outlier data points since a small number of such data can substantially influence the mean value. (Han & Kamber 2001, 350 and Kiang & Kumar 2001 see also Wang 2001 and Wang & Wang 2002)

[61] Clustering is the process of grouping the data into classes or clusters so that objects within a cluster have high similarity in comparison to one another, but are very dissimilar to objects in other clusters (Han & Kamber 2001, 335 and Wang & Wang 2002)

Hierarchical clustering (i.e. decision trees) techniques work by grouping data objects into a tree of clusters. The hierarchical decomposition can be either agglomerative (bottom-up) or divisive (top-down). This former (bottom-up) clustering strategy starts by placing each object (perception) in its own cluster and then merges these atomic clusters into larger and larger clusters, until all of the clusters are in a single cluster or until certain termination conditions are satisfied. By contrast, the top-down clustering starts with all objects in one cluster by subdividing the cluster in smaller and smaller pieces (i.e. more specific clusters) (cf. Berry & Linoff 2000, 113). The quality of a pure hierarchical clustering technique suffers from its inability to perform adjustment once a merge or split decision has been executed, which is the biggest problem concerning hierarchical techniques. (Han & Kamber 2001, 354-6) The greatest benefit of decision tree approaches is their understandability (Groth 1998, 25). Especially, if the perceptions are in congruence with each other (i.e. the perceptions are quite similar or easily divisible into only a few clusters) then the size of the decision tree is compact and, hence, the results are understandable (i.e. the size of decision tree is suitable for exploiting) (Berry & Linoff 2000, 120 and Cios et al. 1998, 256).

Model-based clustering techniques attempt to optimize the fit between the given data and some mathematical model. Model-based clustering techniques follow a neural network approach[62] (e.g. self-organizing map). Self-organizing maps are useful for visualizing high dimensional data in 2- or 3-D space. (Han & Kamber 2001, 376-81 and Wang & Wang 2002). The number of clusters does not need to be identified a priori with self-organizing map technique. Kiang & Kumar's (2001 see also Wang 2001 and Wang & Wang 2002) results indicate that the SOM networks provide a robust alternative to traditional factor analysis and clustering techniques (k-means), especially, if the input data is skewed (i.e. the data do not have normal distribution).

The introduced clustering techniques have their own strengths and weaknesses. We chose the self-organizing map technique because we could not determine the number of clusters a priori (as we should do by the using of k-means). Furthermore, some techniques (e.g. decision tree) produce sometimes quite complex cluster constructs especially if the data is multidimensional. We also wanted to use a technique that has a good visualization ability and that also performs if the data would be skewed. These reasons impacted on the selection of the self-organizing technique.

Visualization capability was one of the most important reasons to choose self-organizing map tool as the technique of this study because the

[62] Han & Kamber (2001, 376-379) introduce also a statistical approach as another model-based clustering technique.

visualization is especially important in the current information rich era (Kohavi et al. 2002). Furthermore, our state of the art survey showed that respondents were the most dissatisfied with format factor concerning their current macro-economic environment analysis methods. This creates pressures to try new methods with improved visualization capabilities so that the satisfaction level of respondents could be increased.

Earlier presented SMA practices, i.e. strategic pricing and the price level assessment of competitors in target costing, as well other competitive and economic environment analyses are daunting tasks because there is a simultaneous need to analyze many countries, products or retailers (e.g. grocery industry). These kinds of assessments are almost impossible to conduct without computational tools within an acceptable time. The requirements for the tool are demanding because it should not only handle huge amounts of data but also visualize this data effectively.

4.2 Applications of Self-Organizing Map

Kaski et al. (1998b) have conducted a bibliography concerning the applications of self-organizing maps. They found over 3300 papers concerning the usage of self-organizing maps by the end of 1997 (Kaski et al. 1998b). Oja et al. (2003) continued Kaski's et al. (1998b) bibliography and they found over 5000 SOM applications by the end of 2001. According to Kaski's et al. (1998b) and Oja's et al. (2003) bibliography self-organizing map algorithm has been applied in the fields such as engineering (image, signal processing and recognition, telecommunications, process monitoring and control, and robotics) and natural sciences to medicine, humanities, economics, mathematics, physics and chemistry. Recently, the SOM has been applied in language learning in a multiagent community (Honkela & Winter 2003).

Although the algorithm of self-organizing map has been applied in several different cases it has been used rarely in the field of accounting, economics and business administration (see for instance Kaski et al. 1998b and Deboeck & Kohonen 1998). In Accounting the SOM has been used in the analyses of companies' financial performance (cf. Back et al. 1997 and Eklund 2002), bankruptcy predictions (Kiviluoto 1998 and Serrano-Cinca 1996) and customer segmentation and profiling (Marttinen 1993, Dolnar 1997, Rushmeier et al. 1997, Ultsch 2002 and Vellido et al. 1999).

In Economics we found only four studies[63] which have been conducted with the SOM. First, Varfis and Versino (1992) compared self-organizing maps, principal component analysis and hierarchical clustering technique to cluster socioeconomic data. Varfis and Versino (1992) used fourteen variables where only one variable relates to the economic perspective of the environment. Furthermore, they did not make any trend analyses to investigate if socioeconomic situation differs between time periods. On the other hand, the study of Varfis and Versino (1992) did not explain the similarities or differences in socioeconomic variables in each area explicitly. Therefore, we focus on longer time series of economic variables than Varfis and Versino (1992). We also try to explain the similarities or differences in different geographical areas more clearly than Varfis and Versino (1992).

The second study where the SOM has been used for socioeconomic environment analysis is conducted by Kaski and Kohonen (1996). They used SOM to cluster nations according to study their welfare and poverty. They used 39 variables describing the areas such as health, education, consumption and social services. Kaski and Kohonen (1996) found that the standard of living is correlated with the geography of the nation. Thus the OECD countries were quite similar (i.e. close to each other in the map) and OECD countries were also best performing countries. Kaski and Kohonen (1996) used only one year data and subsequently the nations included in a certain cluster may change if the time period is longer. In our study this deficit is avoided by using a longer time period than Kaski and Kohonen (1996) used. On the other hand, Kaski and Kohonen (1996) did not make any analysis in the industry level by focusing only on the macro level analysis of nations. Therefore, they did not evaluate the possible differences between the industries in each country. We analyse in this study if the general macroeconomic situation affects performance in the forest industry.

The third study concerning the economic environment analysis is presented by Blayo and Demartines (1991). They used six variables: economic growth, the infant mortality, the illiterate ratio, the school attendance ratio, the gross internal product of a country (GIP) per habitant and the GIP annual growth. As we notice their study does not include any financial variables (i.e. interest/exchange rates, stock market indices) and economic variables are related only to productivity of a nation. Blayo and Demartines' (1991) data was from the year 1984 and it encompassed 52 countries. Blayo and Demartines (1991) observed different clusters (the nations who are close to each other) such as G7 countries, the African countries, the oil exporting

[63] The study of Blayo and Demartines (1991) was French which made more challenging to interpret their results.

countries. The strengths of the Blayo and Demartines' (1991) study are the comparison of the different methods (principal component analysis, self-organizing maps and the generalized Hebbian learning algorithm) and the investigation of a large number of countries. The weaknesses of their study are a single year analysis, the slight utilization of economic variables as well as the quite brief explanation of the results.

The most recent SOM application with economic data has been presented by Arciniegas et al. (2001). They used SOM for speculative attack analysis. According to Arciniegas et al. (2001) speculative attack is an economic event where a country's fixed exchange rate is under pressure by speculators. Their data included 59 speculative attacks between years 1970 and 1997. Arciniegas et al. (2001) found that speculative attack's real effects were associated with banking system health, the law origin, the level of economic development, the terms of trade and the financial development. Arciegas' et al. (2001) study is quite different compared to the purpose of this study because it does not analyze the economic trends between the countries. Furthermore, the database of Arciegas et al. (2001) does not include central European countries, north American countries or Japan due to the reason that they collected data only from the small open economies.

As we noticed above there are only four studies relating to the analysis of economic environment using the SOM. They have also limitations and subsequently this study tries to overcome these limitations by containing a longer time-period, a greater number of macroeconomic variables and industry level analysis. On the other hand, we did not find any studies where the industry level analysis, comparisons between macro and industry levels or the analysis of retailers' price levels would be conducted. Therefore, this study contributes in several ways to the utilization of the SOM technique in the new application areas.

4.3 Principle idea of Self-Organizing Map

The network of a self-organizing map usually consists of two layers of neurons: an input layer and an output layer. The neurons in the output layer are arranged in a grid and are influenced by their neighbors in this grid. The goal is to automatically cluster the input patterns in such a way that similar patterns are represented by the same output neuron, or by one of its neighbors. The outputs in our case are clusters of nations and grocery retailers which have similar properties. These clusters are not known before the training process starts, i.e., during the training process, the network has no knowledge of the desired outputs.

The training process is characterized by a competition between the output neurons. The input patterns are presented to the network one by one, in random order. The output neurons compete among each other to be activated or fired. The output neuron with a reference vector that is closest to the input vector is called the winner (Haykin 1999, 58). The reference vector of the winner is adjusted in the direction of the input vector, and so are the reference vectors of the surrounding neurons in the output array (Ultsch 1993). This process is called competitive learning (Haykin 1999, 58-60). The size of adjustment in the reference vectors of the neighboring neurons is dependent on the distance of that neuron from the winner in the output array. There are several different metrics for expressing the distance between two vectors (i.e. Euclidean, Manhattan and Minkowski distance see more from Han & Kamber 2001, 339-341). We use the Euclidean distance, which is often used in quantitative analysis (Kiang & Kumar 2001). It is defined as

$\mathrm{Min}\{|x - \mathrm{m_i}|\}$ where x is the input data vector and m_i is the reference vector (Kohonen 1997, 86).

Usually, neurons on the output layer are arranged in either a rectangular or hexagonal lattice (Kohonen 1997, 86 and Ripley 1996, 323). Figure 11 shows the difference between two lattices.

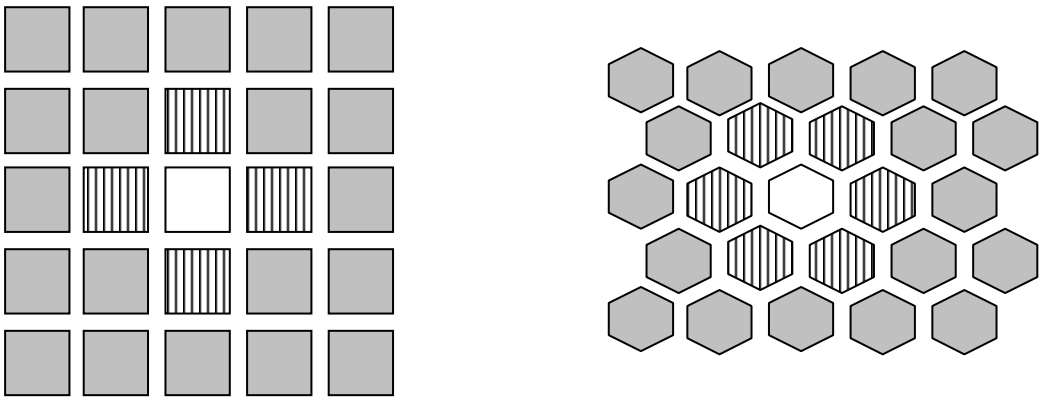

Figure 11: A) Rectangular and b) hexagonal lattices (SOM 2004)

According to Figure 11, a neuron in a rectangular grid has four neighbors and a neuron in a hexagonal grid has six neighbors, except for the ones at the edges of the grid.

When the SOM is started to be trained, the size of the output layer (i.e. the number of neurons in the output layer) has to be determined. The selection of an appropriate network size is crucial because if the size is too large then there can be a great number of clusters (Wang & Wang 2002). On the other hand, if the size is too small, then there can be only a few clusters and some important

differences can be hidden. Therefore, the size of the output layer is important to reach an optimal result (Bigus 1996, 89).

After the winner neuron has been found by measuring the Euclidean distance, there are two learning parameters that have to be stated: the learning rate and the neighborhood width parameter. These parameters control the learning. The learning rate influences the size of the reference vector adjustments after each training step, whereas the neighborhood width parameter determines to what extent the surrounding neurons, the neighbors, are affected by the winner. The utilized software uses term radius for indicating neighborhood width. The learning will result in a local smoothing effect on the reference vectors of the neurons in this neighborhood, which in continued learning leads to global ordering (Kohonen 1997, 87 and 117). This is identified as,

$$m_i(t+1) = m_i(t) + \alpha(t)\, h_{ci}(t)\, [x(t) - m_i(t)]$$

where $t = 0,1,2,\ldots$ is an integer, the discrete-time coordinate
$\alpha(t)$ is learning rate factor
$h_{ci}(t)$ is the neighborhood function (adapted from Kangas 1994, 15 and Kohonen 1997, 87 and 117 see also Kohonen 1982).

An additional parameter is the training length, which measures the processing time, i.e. the number of iterations through the training data. Training length also has to be stated before the training can start.

The stopping criterion of a training iteration is the average quantization error. The error in turn, is an average of the Euclidean distances of each input vector and its best matching reference vector in the SOM. The clusters of the data are formed by identifying neurons on the output layer that are close to each other using the reference vectors as a starting point.

A tool called the U-matrix (Kraaijveld et al. 1995, Ultsch 1993 and Ultsch 2002) can be used to visualize the distances between neighboring neurons. In the U-matrix presentation, relative distances between neighboring vectors are represented by shades in a black and white scale. Lighter shades represent smaller distances and darker shades larger distances. A "cluster landscape" formed over the SOM clearly visualizes the classification (Kohonen 1997). The clusters are groups of neurons surrounded by dark bordering nodes. The U-matrix is an accumulated description of all the inputs and used variables.

The learning process of SOM is summarized in Figure 12.

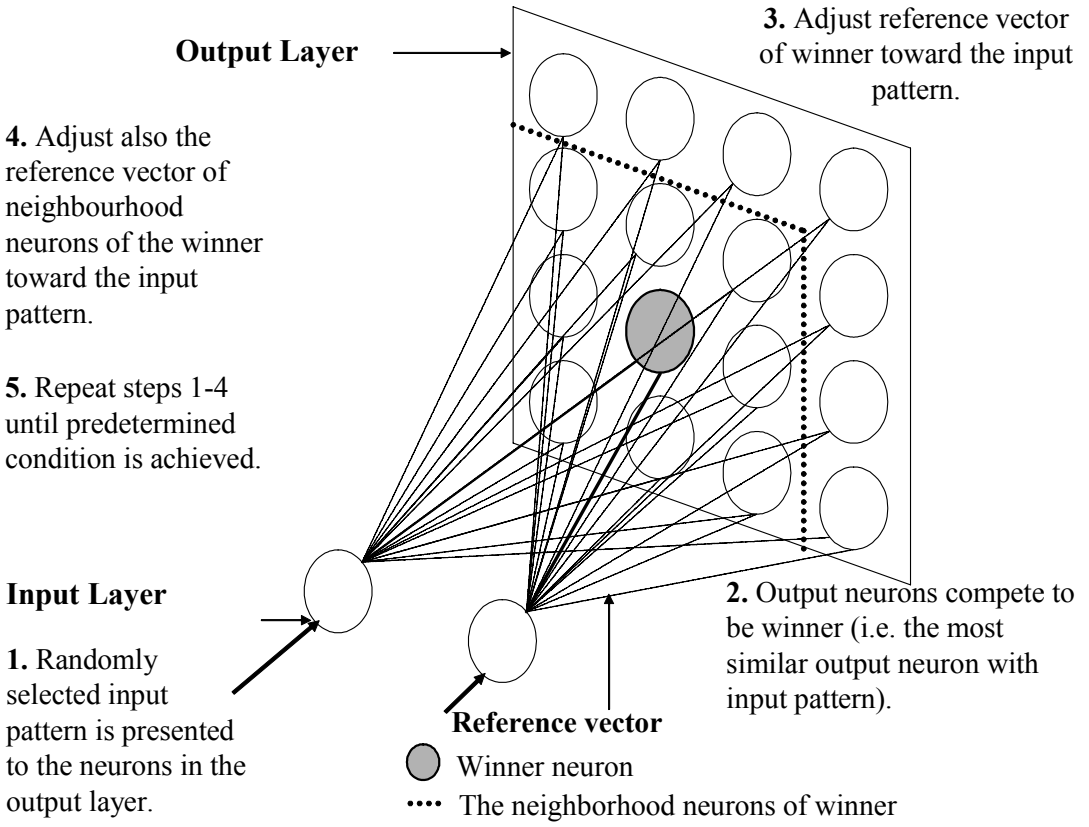

Figure 12: The learning process of self-organizing map[64]

The interpretation of the clusters is given by analyzing the reference vectors, i.e. feature maps[65]. Feature maps visualize the weight of each neuron with a color scale level imaging – light (warm in Model 3) shades representing high values and dark (cold in Model 3) shades representing low values.

4.4 Data

In this subchapter we introduce the used variables, data and data normalization. Data is normalized for the purposes of improving training.

4.4.1 Choice of variables and data

We selected nine countries - Canada, Finland, France, Germany, Great Britain, Italy, Japan, Sweden and the United States - for the macro level analyses. All

[64] The figure is adapted from the Bigus (1996, 72 and Nour & Madey 1996, 430 cf. Haykin 1999, 445 and Ultsch A. 1993, 308)

[65] Kaski and Kohonen (1996) call these feature maps as SOM groundwork.

the selected countries are important from a Finnish perspective and the larger countries are important from a worldwide perspective. We could also quite easily find reliable information about these countries, which gave another reason to choose the countries into the research. The Finnish Forest Industries Federation offered the database. The database is based primarily on OECD statistics and it encompasses the quarterly data between 1993 and 1999. The database concerning stock market indexes, exchange rates and interest rates contains also the first quarter in 2000. Therefore, the time period is 1993-2000:1 in the first model and in the second and third models 1993-1999.

Our study includes both financial and production oriented variables in the macro level analyses because earlier studies have shown that business cycles can be the result of changes in financial (interest or exchange rates etc.) or structural (productivity, export, import, consumption etc.) variables (cf. Gregory 1997, Kindleberger 1995, 97, Temin 1998, 28-30 and Zarnowitz 1999). The used database included nine variables i.e. industrial production, total volume of retail sales, gross domestic production (GDP), an indicator for forecasting future economic trends (s.c. leading indicator), import to GDP, export to GDP, interest rates, both exchange rates and stock market indexes. We excluded consumer prices from our original database because this variable increased linearly in all countries and therefore this variable did not have any contribution. The first four variables are indexed (1995=100).

We constructed three different models (i.e. self-organizing maps) with macro level data. In Model 1 we used three financial variables: interest rates, exchange rates and stock market indexes. In Model 2 we used six production-based variables: industrial production, total volume of retail sales, gross domestic production (GDP), an OECD indicator for forecasting future economic trends (s.c. leading indicator), import to GDP and export to GDP. In Model 3 we used all the variables and thereby this map includes nine variables. We describe the meaning of the variables in the following paragraphs.

Industrial production indicates the development of financial variables and the variable has been frequently used in business cycle research (Chatterjee 1999, Peiró 1998). In particular, it is assumed that the volatility of financial variables (interest rates, stock market indices, dividend yields and monetary aggregates) is related both to the growth of production and to the uncertainty of growth during the different phases of business cycle (cf. Andreou et al. 2000). The total volume of retail sales is a usable variable if we want to measure the purchasing and consumption volume of goods. The variable is selected because purchasing and industrial production can be unequal as a result from export and import. Purchasing volume also indicates people's general attitude toward future economic development. The retail sales index is

closely followed in firms that sell consumer goods (Fahey & Narayanan 1986, 118) because change in the index may describe the success of these companies. In earlier business cycle studies, as well in this study, variables concerning consumption (Ravn 1997, Basu & Taylor 1999, 8) have also been included.

Leading indicator can be used to predict economic turning points (peaks and troughs) and to assess the general behavior of the economy. Different short-term indicators such as observations or opinions about economic activity, housing permits, financial and monetary data have been used to construct the leading indicator. The purpose of the indicator is to predict the cycles of total industrial production or gross domestic product in industry, which is chosen as a proxy measure for the aggregate economy (OECD 2003). Therefore, we thought that the leading indicator indicates future trends in economy and it is subsequently included in this research.

Gross domestic production (GDP) indicates a nation's economic trends. If GDP is high, the consumption of firms' products is presumably also high. There are also some goods and services, which are negatively related to the GDP e.g. bus trips and insolvency practitioners. (Palmer & Hartley 1999, 35 & 189) Using the GDP variable is quite reasonable in our study because we are comparing economic cycles although relative consumption and production between industries and product groups can be different.

To assess the influence of the trade on countries' trends we selected import to GDP and export to GDP variables. These two measures are important because the fluctuations of the ratios describe countries' dependency on foreign trade (e.g. a higher relation of export to GDP increases dependence on foreign countries' trends). There is still another reason for the importance of import ratios due to the fact that the variation of the ratio may reflect the changing trade policies of a country. Therefore, a country may set up different tariffs and customs for imported products that may partly decrease import trade. On the contrary, export ratios are important because changing export ratios can also reflect a country's use of export subsidies.

Exchange rate describes the price of one currency in terms of another. Broll and Eckwert (1999) observed that as the exchange rate volatility increases, so does the value of the option to export to the world market. A higher volatility increases the potential gains from international trade, which makes production more profitable. However, the more volatile exchange rate implies a higher risk for international firms depending on risk aversion of the firm. McKenzie (1999) found that exchange rate volatility might exert a positive or negative impact on trade in different markets. Declining exchange rates cause domestic export prices to fall in foreign currencies, thereby improving their international competitiveness and therefore expanding export. Under falling

exchange rates, foreign investment income denominated in foreign currency increases in value, but obligations payable in foreign currency become more expensive and crippling to countries and companies carrying heavy foreign debt obligations (Schaefer 1995, 38). Expected currency fluctuations should be taken into account in companies' planning and budgeting (Mouritsen 1995) because companies' performance reflects currency changes if companies are operating with foreign currencies.

Interest rates represent the price that borrowers have to pay to a lender for the privilege of using their money for a specified period of time. Interest rates tend to follow business cycles (Palmer & Hartley 1999, 192). High interest rates usually indicate unstable economic conditions, make investment more risky and discourage cross-border capital flows (Schaefer 1995, 219). The forecasts of interest rates can be used in many different ways such as capital allocation, investment planning and pricing (Green 1997).

Share indexes indicate business cycles. The changes of interest rate, both anticipated changes in company profits and dividends directly affect general stock market prices (Hall 1990, 25, Copeland & Weston 1992, 339-343 and Schaefer 1995, 214, 244). Share price index is sometimes a misleading economic indicator especially in small countries because one big company can have a great effect on the share price index formulation (for instance, Nokia had over 50 percent weight in the Finnish share index (HEX 2004)). However, these large companies' success is also very substantial for many smaller companies' (i.e. subcontractors, competitors, other companies which are operating in the same markets) and naturally the nations' welfare. This supports the using of share price indexes for describing the countries' economic situation.

Model 4 focuses on the industry level analysis. We want to focus on one of the most important sectors for the Finnish economy and chose the forest industry and its biggest sector, i.e. pulp and paper (Industrial statistics 2000 and Value of paper export 2002). We selected eight countries - Austria, Canada, Finland, France, Germany, Japan, Sweden and the United States - for our research. All the selected countries are important from the perspective of the pulp and paper sector (Paper exporters 2002 and Paper producers 2002). We could also quite easily find reliable data about these countries.

The database for Model 4 was received from the Finnish forest industries federation. The database encompasses the years 1990-2000 and includes seventeen variables. Six variables relate to costs and prices i.e. total input price in Finnish mark (FIM), total unit costs in FIM, labor price in FIM, unit labor cost in FIM, raw material price in FIM and the unit price of raw material. Eight variables measure production and productivity i.e. the total quantity of production, total productivity, blue-collar productivity, white-

collar productivity, the productivity of raw material, the productivity of energy, the productivity of work and the productivity of capital. Furthermore the database includes three variables i.e. output to input ratio, capital/labor ratio and annual blue-collar working time. The variables –except annual working time- are indexed (1990=100).

The data of Model 5 is received from the National Consumer Research Centre (Finland). The institution is independent i.e. it is not allied in any way to any group of the grocery retailers. The data is from the year 1995, it includes the prices of 237[66] grocery products (see Appendix 1). The price range of the products is between EUR 0.12 (Fazer liquorice/#221) and EUR 27 (inner fillet of cattle/#20).

The database of the fifth model contains 135 grocery retailers whose turnover was between EUR 0,94 million and EUR 30,12 million[67] in 1995. The data consists of the five groups of Finnish grocery retailers; A-group[68] (40 retailers), B-group (32), C-group (27), D-group (15), E-group (3), independent grocery retailers (3) and finally fifteen retailers whose groups were unknown.

4.4.2 Data normalization

We had reasons to normalize the data. First, we tried to avoid the dependence on the measurement units and subsequently we attempt to give all the variables an equal weight to improve the accuracy and efficiency of the map training (Han & Kamber 2001, 105 & 339 cf. Kaski & Kohonen 1998). Second, Demartines and Blayo (1992) prove that normalization improves the quality of organization especially if there are few variables although the normalization improved the quality even in 200 variables. Therefore, according to Demartines and Blayo (1992) normalization improves the quality of training in our models where the maximum number of variable is 237 or less depending on the model. Normalization [-1,1] means, for instance, in our case, that stock market indexes and interest rates have an equal weight on the constructed maps (Han & Kamber 2001, 114-115). Thus normalization prevents the stock market indexes (large range) from outweighing with interest rates (smaller range).

There are a number of techniques for data normalization (e.g. min-max normalization, z-score normalization and normalization by decimal scaling)

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66 The original databases included 345 products and 158 retailers. We excluded some retailers and products due to the missing values.

67 The first quartile is EUR 5,21 million, median EUR 8,75 million and the third quartile EUR 13,79 million.

68 We are not able to mention the groups of the grocery retailers due to data confidentiality.

(Han & Kamber 2001, 115-116). In an earlier study (Back et al. 2001) the normalization of databases both by z-score (in this technique the normalization of attributes are based on mean and standard deviation) and min-max normalization technique have been tested. We chose the latter (min-max) technique because this normalization gave better results in the study. Therefore, we normalized all the three databases between -1 and 1[69] by the following equation (Sarle 2004):

$$S_I = \frac{X_i - midrange}{range/2}$$

where S_i is a standardized value and X_i is the value of the raw input variable X for the i^{th} training case

$$Midrange = \frac{\max X + \min X}{2}$$

where max$X$ is the maximum value of X_i

$$Range = maxX - minX$$

where minX is the minimum value of X_i

As we can see from the equations, we have to calculate midrange and range at first and after that we can normalize the original data.

We had some problems in normalization of Model 6 because we lost a file with original normalized values (which was used in the building of Model 5) and therefore we had to normalize a new file with new normalized values. We did not construct new SOM for Model 6 and we used these new normalized values within Model 5. We found that this new normalization did not result exactly equal results with the results of the previous normalization. We observed that two of six retailers were in the neighboring and cheaper neuron after the new normalization. However, this does not cause bigger troubles because the normalization has been done similarly within all the retailers of Model 6. Furthermore, Model 6 is built only for the illustration purposes (i.e. purpose is to show how the SOM can be used in the price sensitivity analyses) and subsequently the original positions of the retailers could also be invented.

[69] We checked if the normalization scale affects the results (i.e. economic trends) of Models 1-3. Therefore, we normalized also data [1,3] but the results were almost similar to what we can see from Chapter 5.

4.5 Constructing of Self-Organizing Maps

There are a number of software packages for constructing a SOM. Some of the packages are free, i.e. SOM_PAK (Self-Organizing Map Program Package), SOM Toolbox, Nenet and some are commercial, i.e., SAS Neural Network application, Matlab Neural Network Toolbox, NeuroSolutions v. 3.0, Viscovery®. (Deboeck 2004) Due to the budget limits we used free software. We had some reasons to utilize the SOM_PAK in the models training. First, SOM_PAK enables large and computationally intensive studies compared to the other two free softwares (Deboeck 2004). Second, the training of SOM is faster than with two free softwares (Deboeck 2004). Finally, our research group had used SOM_PAK before I joined the group and subsequently I had experienced supervisors for utilizing SOM_PAK.

We utilized SOM_PAK version 3.1. The SOM Programming Team of the Helsinki University of Technology has developed the SOM_PAK (Kohonen et al. 1995). SOM_PAK uses the competitive learning algorithm which is described in Chapter 4.3. The trained maps are visualized by using NENET demo version 1.1 whereby we have better visualization abilities than the abilities of SOM_PAK 3.1. Both the programs are free available (SOM_PAK 1995 and NENET 1997).

We constructed several maps when building different models. Because we used different numbers of variables in the five models (which are presented later), we had to train and construct a large number of new models with each set of variables to guarantee to find out the best map. We chose the map with the lowest quantization error (cf. Kaski & Kohonen 1996 and Kohonen 1997, 121). In this section we go through the basic principles which we have followed during the construction process.

In the beginning we had to decide the topology and size of the map. We chose the hexagonal lattice type because it does not favor horizontal and vertical directions as much as the rectangular array and is subsequently effective for visual display (Kohonen 1997, 86, 120). The problem when deciding the size of the map is that neither specific rules for the size determination nor the effective determination of the any other parameters of SOM (Wang 2001) are available. Therefore, we constructed several different maps and chose a map with dimensions 10 x 12. We used the same size in Models 1-4 so that the interpretation of trends would be easier. We chose a map with dimensions 4 x 5 when training Model 5. We tried to avoid the existence of a great number of clusters by selecting a smaller map size in the analyses of possible price differences.

After the determination of topology and size, we initialized the reference vectors of the output neurons. SOM_PAK provides two alternatives for

initialization: random and ordered, i.e. linear initialization (more about initialization Kohonen 1997, 114-115). We chose random initialization where a random value for the reference vectors is given and, thus, the reference vectors are topologically unordered. However it has been demonstrated that initially unordered vectors will be ordered during the learning.

We trained the network in three phases. We followed up some instructions of network training. It is important to select correct neighborhood width in the beginning because if the neighborhood is too small, the map will not be ordered globally (Kohonen 1997, 88). Neighborhood width and learning rate were wider at the beginning of the learning process, and the parameters decreased with time so that at the end of the process only the immediate neighbors of the winner were updated. (Cios et al. 1998, 349-350, Kaski & Kohonen 1998 and Kohonen 1997, 88 see also Wang 2001 and Wang & Wang 2002)

Table 5 summarizes the network parameters that we used. Now we have to remind that in the construction of Model 6, Model 5 was utilized, and subsequently Table 5 includes only the properties of three different models.

Table 5: The properties of the self-organizing maps

The number of the model (The number of variables)	***III (9)***	***IV (17)***	***V (237)***
Topology type	Hexagonal	Hexagonal	Hexagonal
Map size			
X-dimension	12	12	5
Y-dimension	10	10	4
Training length			
First part	10 000	10 000	10 000
Second part	150 000	100 000	100 000
Third part	250 000	250 000	200 000
Learning rate			
First part	0.5	0.7	0.5
Second part	0.05	0.04	0.05
Third part	0.01	0.01	0.01
Radius			
First part	7	7	4
Second part	2	2	2
Third part	1	1	1
Quantization error	0.47807	0.80495	4.52115

Table 5 shows that the quantization error has increased with the increasing number of variables. This does not mean that the map with 237 variables has

weak quality because the self-organizing map tries to project a multidimensional input space into bidimensional space. Therefore, the increasing dimensionality made it more difficult to perform this process and subsequently the quantization error increased.

5 RESULTS

The result part is divided into three different subchapters. The first subchapter deals with the macro environment models, i.e. Models 1 - 3. The second subchapter deals with the industry level models, i.e. Models 4 - 6. The third subchapter compares macro and industry level models. We draw preliminary conclusions after Model 3-6.

5.1 Macro level models

In this subsection we present three models that can be used in the economic environment analysis at the macro level. We present Models 1 and 2 only briefly and concentrate on Model 3, since that model was evaluated in our survey. The purpose of the construction of the three models was to examine if the use of different variables has an impact on the constructed models. Three models were constructed because earlier studies (Chapter 3.2) have explored a great number of causes for macroeconomic trends. Finally, we discuss the main differences between Models 1 and 3 at the end of this chapter.

5.1.1 Results of Model 1

Model 1 includes three financial variables. These variables are exchange rate, interest rate and stock market index. Model 1 was presented at the conference of Tenth Annual Research Workshop on: Artificial Intelligence and Emerging Technologies (AI/ET) in Accounting, Auditing and Tax in 2001 (Länsiluoto et al. 2001). Next we present the main conclusions of Model 1.

Model 1 showed the importance of considering countries' financial situation before operating on new continents. Model 1 shows all four areas having their own specific financial trends although the largest movements have occurred almost at the same time (see also Schaefer 1995, 27 Kindleberger 1995, 97 and Lumsdaine & Prasad 1999, 27). Inside European countries the financial trends have been quite similar, excluding Great Britain and Italy. In Italy interest rates were higher than in other European countries before their accession to the European monetary union. In Great Britain the exchange rates had not changed so much as in other European countries (see

also Darby et al. 1999 who have observed similar results). Furthermore, interest rates had been higher and stock market indexes more stable than in the rest of Europe, especially, in Great Britain between the years of 1993 and 1996.

According to Model 1, the fluctuations between recession (in 1995) and boom (in 1999) were larger in Scandinavian countries than in bigger European countries. Larger fluctuations have probably decreased foreign (and domestic) investments in Scandinavia (Darby et al. 1999) and therefore decreased economic growth, increased unemployment, initiated governments' protectionism (Mentzl 1998, 1) and subsequently decreased companies' ability to compete in the future. However, fluctuations might exert a positive or negative impact on trade (McKenzie 1999) depending on industry, form of trade (export/import) and the risk aversion of firms (Broll & Eckwert 1999).

In North America there was a very stable economic development during the whole researched period. Stock market indexes increased steadily and interest rates were stable, which was good for other countries' export companies (for instance, the Finnish forest industry) because during economic expansions American companies are probably willing to buy more from abroad. However, in Canada there was some recession indication between 1998 and 1999. The Canadian economy had followed the US economy closer than other economies (Artis et al. 1997 and Gregory et al. 1997 also drew a similar conclusion). This indicates interdependence between these two economies.

The Asian financial crisis appeared clearly in the Japanese financial trend. In Japan the interest rate was only slightly above zero and stock market index was on a similar level since 1993, which indicates a long-lasting recession period.

5.1.2 Results of Model 2

Model 2 includes six production variables: industrial production, total volume of retail sales, gross domestic production (GDP), import to GDP, export to GDP and an indicator for forecasting future economic trends (so called leading indicator). Model 2 was presented at the conference of Strategic Management Society Conference (Länsiluoto et al. 2002d).

Model 2 with the six production variables also shows- as well as Model 1 with the three variables - that it is important to consider countries' economic situation before operating on new continents although there were interdependencies and similarities between countries. The results support Crucini's (1997) conclusion that smaller (i.e. in our study Finland and Sweden) countries have larger fluctuations than bigger ones. Our study also

supports Artis' et al. (1997) research that the USA and Canada had similar trends. We can also observe that countries' distance from each other affects business cycles (see also Artis et al. 1997, Schaefer 1995, 27 and Zimmerman 1997) i.e. countries with lower distance have usually more similar cycles than countries with longer distance. Trend similarities were discovered in Central European, English speaking and Scandinavian countries. The easier trade and cooperation with neighbors is surely one attribute which makes countries more dependent on neighbors and therefore to some degree equalize their business cycles. Our study also revealed that the Japanese trend had similarities only with Italy in 1993 and 1997 but otherwise it did not have any similarities with any other studied countries' trends. The Japanese trend was exceptional because the economy achieved its best values already in 1997 and the retail sales index was at the highest level at the beginning of the studied period. Therefore, Model 2 revealed the Asian crisis and its effect on the Japanese economy.

However, the largest movements have occurred almost at the same time in all countries' trends (1995, 1997-8) although the strength of the movements varies from country to country. In general, the results of Model 2 show the expanding economies (except Japan) during the research period.

In the last model we combine all the above presented financial and production variables and examine once again the possible deviation of economic trends. We also investigate if the results of the last model are parallel with the models of three and six variables.

5.1.3 Model 3 - Trend analysis with nine variables

Model 3, excluding what-if simulations, was presented at European Conference on Accounting Information Systems (ECAIS) in 2002 (Länsiluoto et al. 2002a). Model 3 includes all the variables which we had in Models 1 and 2. Therefore, Model 3 includes both three financial variables (exchange rates, interest rates and stock market indexes) and six production variables (i.e. gross domestic production (GDP), industrial production, retail sales, export to GDP, import to GDP and an indicator for forecasting i.e. OECD leading indicator). The outline of this chapter is the following. First, we identify clusters, analyze the properties of these clusters, make simulations and investigate the deviations from and similarities between business cycles. Finally, we conclude the chapter by comparing our results and earlier studies.

5.1.3.1 Cluster identification and trend analysis

We identified nine clusters A-I with nine variables from the U-matrix (Figure 14) by using feature maps manually. With feature maps we can investigate the U-matrix analyzing only one variable at a time. However, the U-matrix can be understood as a map, which has been constructed by putting all the feature maps together. Figure 13 shows the feature maps of Model 3. Red cells on the feature maps indicate high values whereas black cells indicate low values.

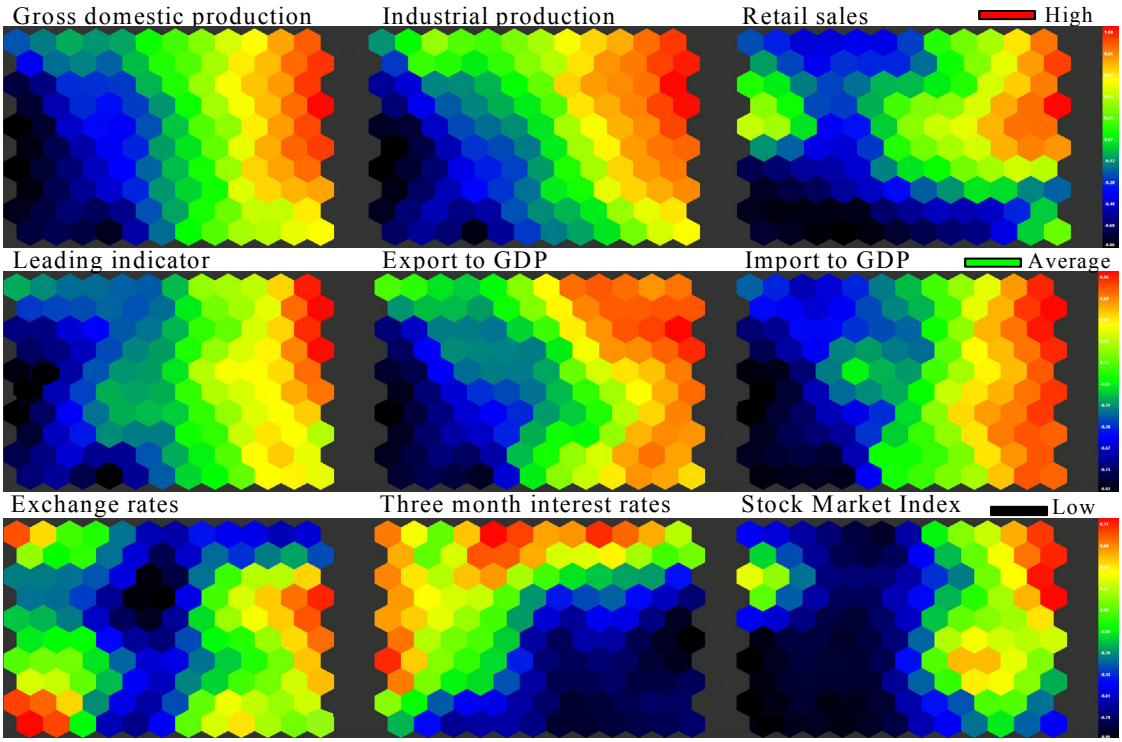


Figure 13: Feature maps of Model 3

We present these identified clusters with a dashed line in Figure 14. Dark cells on the map indicate a difference between two cells i.e. the border of a cluster. Some borders of the clusters are fuzzy and subsequently some clusters may be slightly different depending on the researcher (cf. Wang & Wang 2002). We have to notice that although the clusters would not have statistical strength the basic principle at using the SOM is that the usefulness of the clusters depends on the problem domain and not only on the statistical strength (Wang 2001). After cluster finding we are interested in what kind of properties these clusters have and how the levels of variables are changing.

Figures 13 and 14 show that all variables, excluding interest and exchange rates, are increasing from the left-hand side to the right-hand side of the map. Interest rates are increasing from the bottom right up and exchange rates from the center to three directions toward the corners of the map. We can find retail

sales and stock market indices having some kind of correlation if we compare the feature maps of Model 3. Therefore, both stock market indices and retail sales have the lowest values in the lower and central parts of the map and they have also one island of higher values in the left-part of the map.

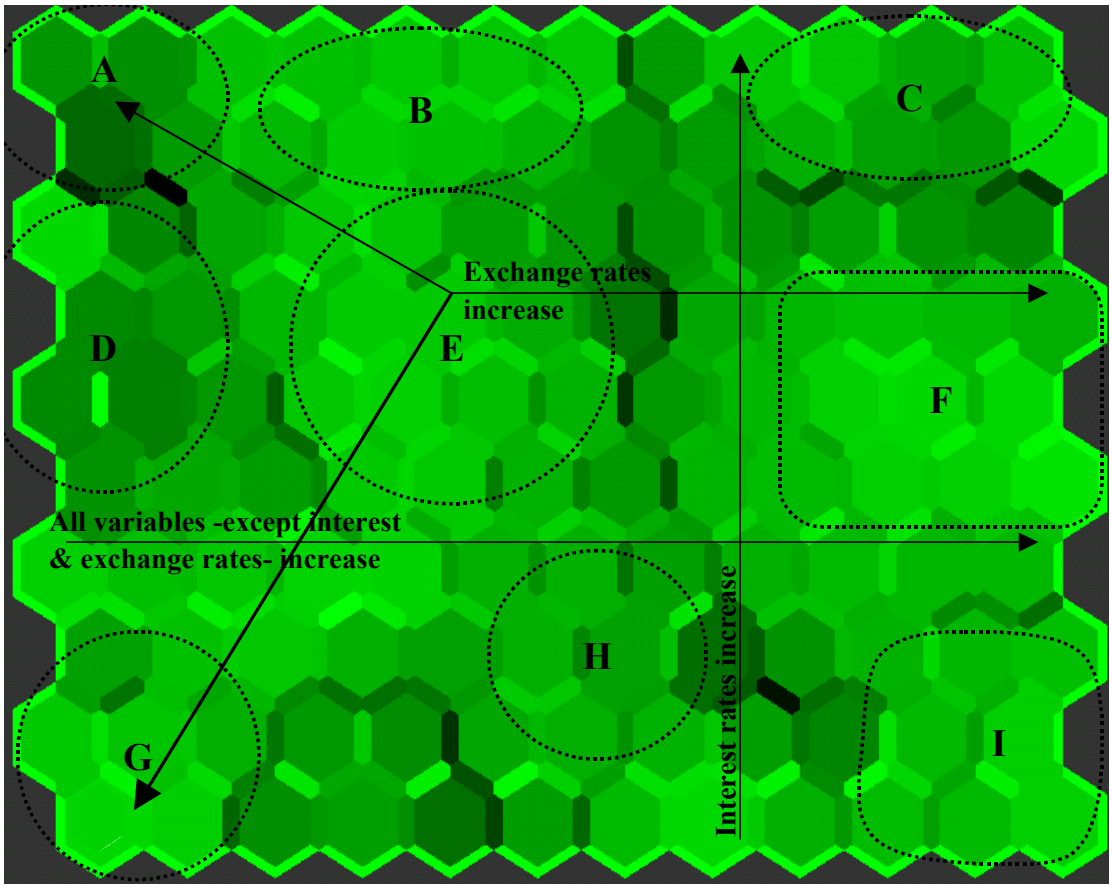


Figure 14: Clusters after training with nine variables (arrows and clusters are drawn manually)

Table 6 describes the properties of the different clusters. The properties of the clusters are described by nine variables and these variables have three different degrees (high, average, and low) with plus and minus signs (e.g. Aver- & Aver+). In Model 3, the high values of attributes are usually good values (i.e. high GDP is better than low). However, the interpretation of a variable's viability can also be bi-directional. The variable may achieve a superiority level if the value is at the low level (e.g. low interest rates are advantageous for companies with low solvency because, thus, these companies do not have to cover high financial expenses) or at the high level (low interest rates are bad – in principle - for financial institutions). In analyzing these kinds of bi-directional attributes (stock market indexes, exchange and interest rates) we have to decide a viewpoint of analysis.

Table 6 (and also Figure 14) shows that clusters G and H include the lowest values whereas the highest values are in clusters C and F. In the analyses of a country's trends, we have to consider our indexed data. Therefore, if one country would remain in clusters C or F all the time it is not optimal because then the country has not improved their economic situation, i.e. their GDP, leading indicator, retail sales, industrial production etc. has remained on the same level. Table 6 includes all the variables used: leading indicator (Lead), industrial production (IndPr), retail sales (RetS), gross domestic production (GDP), export to GDP (Expo), import to GDP (Impo), exchange rates (Exch), three months interest rates (Inter), general stock market indexes (SMI). The ranking of the clusters is introduced in the last row. The first ranked cluster (C and F) includes the highest values of the variables. Vice versa, the cluster which is ranked ninth (G and H) includes the lowest values of the variables. Both ranking (indicated by Rank) and the definitions of the properties of the clusters were made manually by using feature maps (see Figure 13) and subsequently the ranking can be slightly different depending on the author.

Table 6: The specifications of different clusters

Cluster	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***
Lead	Low+	Low+	High	Low	Aver-	High-	Low+	Low+	Ave+
IndPr	Aver-	Aver	High	Low	Aver-	High-	Low+	Low+	Ave+
RetS	Low+	Low+	High	Aver	Aver-	High-	Low	Low+	Aver-
GDP	Low+	Aver-	High	Low	Low+	High-	Low	Low+	Ave+
Expo	Aver	Aver	High	Low	Low+	High-	Low	Low+	High-
Impo	Low+	Aver	High	Low	Low+	High-	Low	Low+	High-
Exch	High-	Low+	Low+	Low+	Low	High-	High	Low+	Ave+
Inter	High-	High	Aver	High-	Low+	Low	Aver-	Aver-	Low+
SMI	Low+	Low	High	Aver	Low	High-	Low	Low	Low+
Rank	4	5	1	6	7	2	8	9	3

What-if analyses are important to perform if companies are formulating strategies. What-if analyses enable to investigate how changes of selected variables affect other variables, e.g. what is our estimated turnover if the growth rates of economy increase five percent. By using the SOM we can make several what-if analyses, called trends in this part of study. These what-if trends can be compared with actual trends. We constructed five what-if analyses and simulations for Model 3. The simulations are the following: all variables increased linearly (indicated by Up), all the variables increased linearly except decreasing interest rates (IN), retail sales (RS) or both interest rates and interest rates (RSIN). Finally, we can observe a simulation where all variables are linearly increasing except linearly decreasing exchange rates (Ex). We illustrate the simulations of Model 3 in Figure 15 where the numbers after the simulations, e.g. Ex194, means the exchange rate simulation and the

first quarter in the year of 1994. Figure 15 shows that simulations are usually moving from the left-down corner via the left-upper corner to the right-upper corner. We can also see that all the simulations are crossing in the first quarter of 1996.

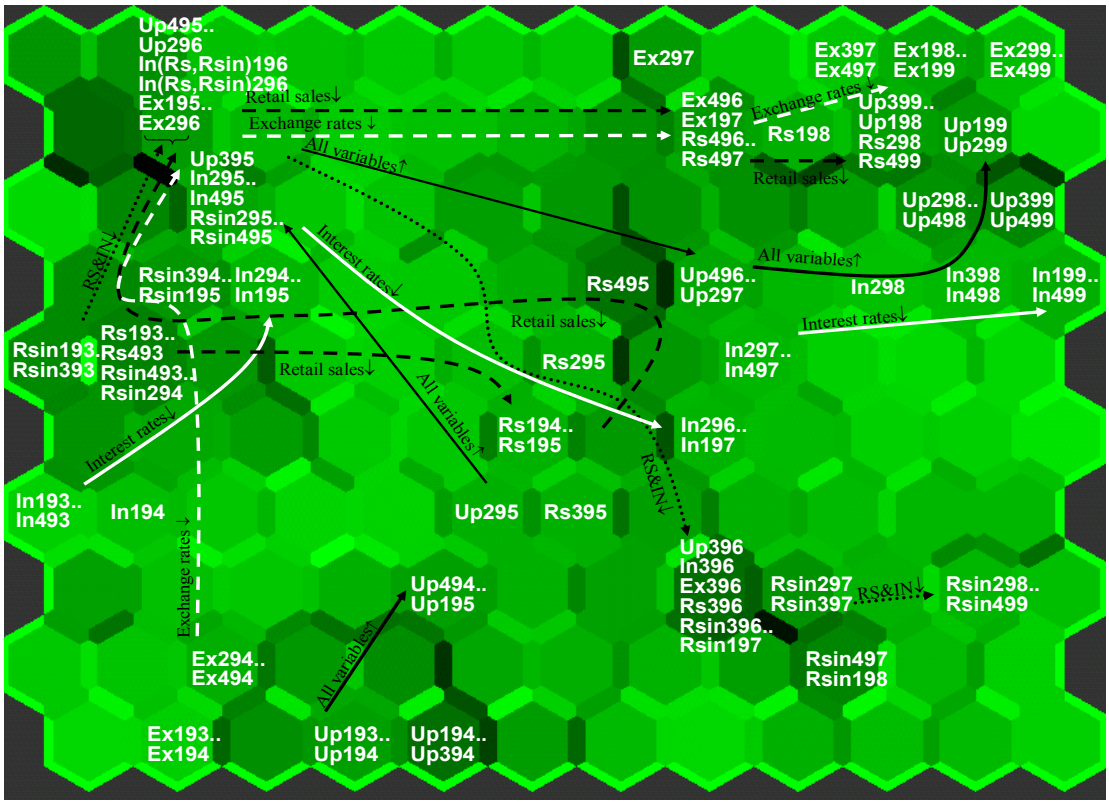


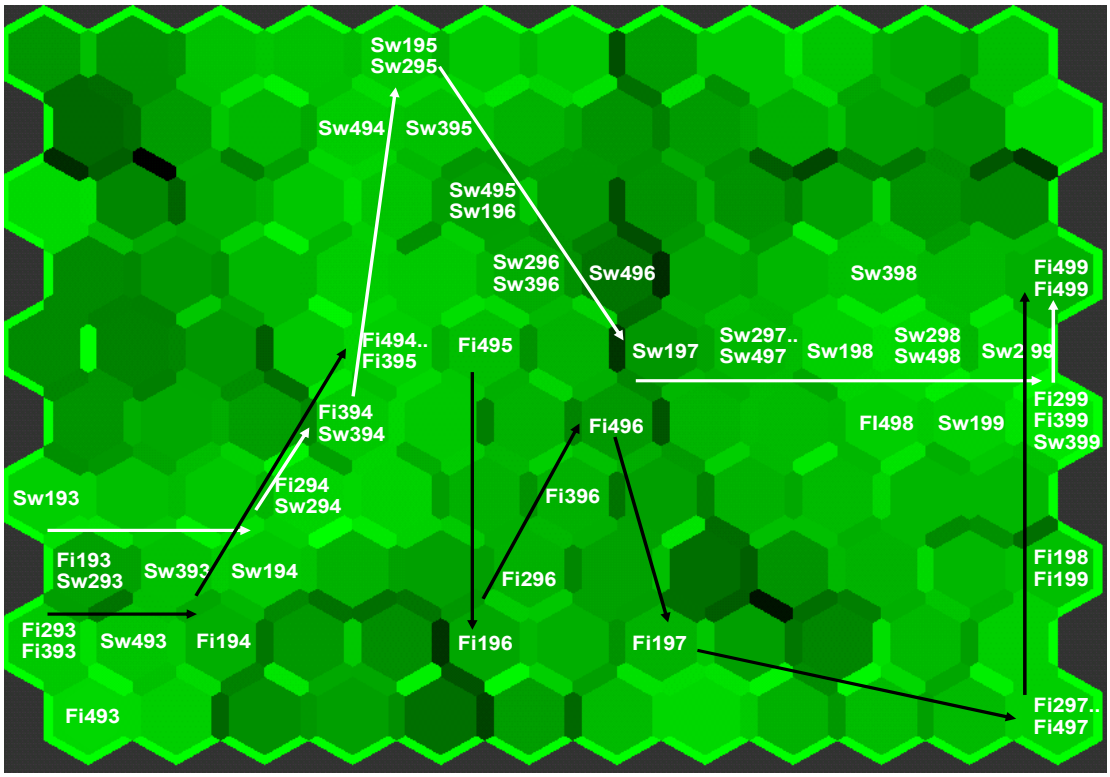
Figure 15: What-if simulations of Model 3

The purpose of this part of study was to examine the differences and similarities between countries' economic trends. Figure 16 presents countries' trends by using Model 3 with nine variables. We divide the countries into four areas[70] i.e. Scandinavian countries (Finland; Fi and Sweden; Sw), Central Europe (Germany; Ge, France; Fr and Italy; It), English speaking countries (Great Britain, GB, Canada; Ca and the United States, US) and Asia (Japan; Jp).

[70] The countries are divided into four different maps by the geographic location, i.e. the neighbor countries are in the same map. This has been done to reach an optimal result of visualization. Great Britain has been visualized with the USA and Canada (despite GB is not neighbor of these countries) because then we could have quite the same number of countries in each map. We also observe later that Great Britain has more similarities with the USA and Canada than with the other countries. Furthermore, these countries have also the same language, which gives one more reason for the visualization decision. We have used the same-trained map in the visualization and, thus, we can compare the trends between countries.

Figure 16 shows Scandinavian and Central European countries having quite similar economic trends but Japan and all the other countries having different trends. However, the largest movements have occurred again almost at the same time in all countries (1995-6, 1997, 1999) although the strength of the movements varies from country to country (similar results with Schaefer 1995, 27 Kindleberger 1995, 97 and Lumsdaine & Prasad 1999, 27). This indicates that some kind of shocks (see for instance Chapter 3.2, Prescott 1999, Temin 1998, 1-2 and Zarnowitz 1997, 3-4) have influenced the worldwide business cycle (see also Gregory et al. 1997, Kindleberger 1995, 97, Lumsdaine & Prasad 1999, 27 and Schaefer 1995, 27). Figure 16a presents the macro economic trends in the Scandinavian and the central European countries.

Scandinavia (FIN, SWE)



Central Europe (GER, FRA, ITA)

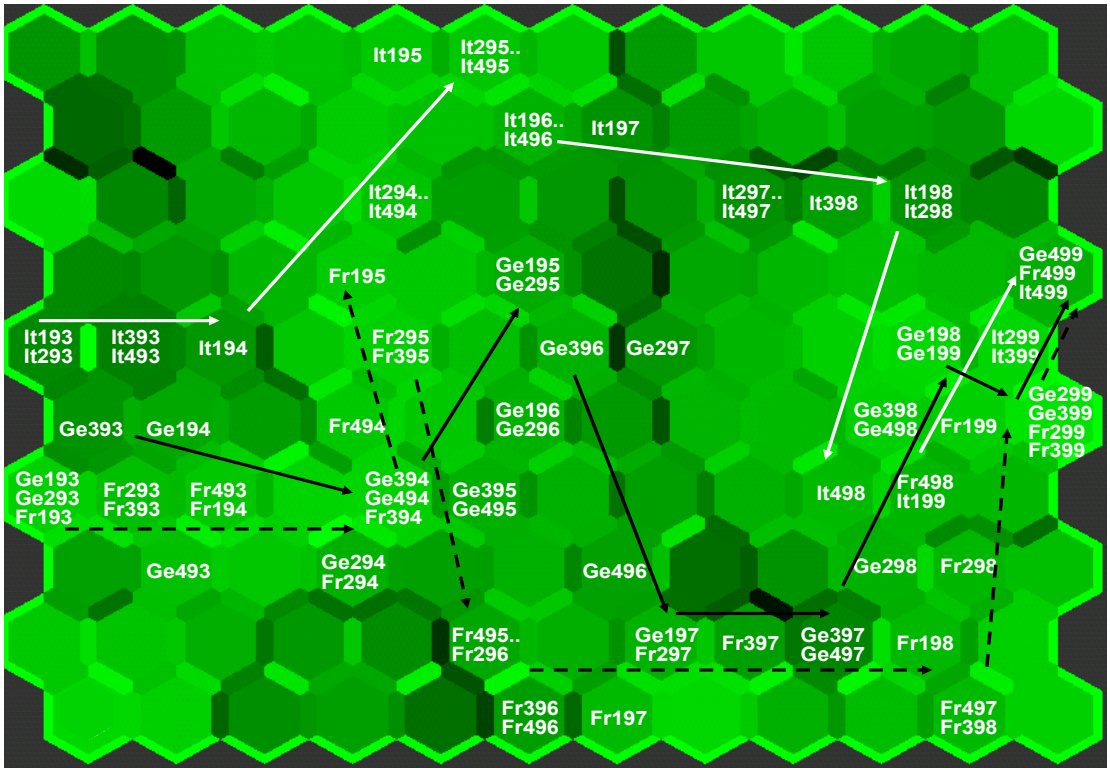


Figure 16a: Scandinavian and central European trends by nine variables (Model 3)

The upper part of Figure 16a shows that the Finnish (it is indicated by black arrows) and the Swedish (white) trends were similar during 1993-4 (all

variables had increased -except decreased exchange and interest rates- during the period), in the first quarter of 1997 and in 1999. At the end of 1995 retail sales[71] and interest rates dropped in Finland by causing a difference between the Finnish and the Swedish trends. GDP and import to GDP were higher while retail sales, interest rates and stock market indexes were lower in Finland than in Sweden during 1997, which is the reason for different financial trends in Scandinavian countries. If we compare the simulations and the trends of Scandinavian countries we observe the greatest similarities at the simulation with decreasing interest rates. These similarities can be observed at the beginning and at the end of the period. Furthermore, the Swedish trend was following quite closely the simulation after the year of 1997.

The lower part of Figure 16a shows France (dashed black arrows) and Germany (black) having quite similar trends. Decrease in exchange rates (franc (DEM) was strengthening against dollar) and increase in interest rates, GDP, import and export caused the first movement in France (Germany) during 1994. Decrease in interest rates and increase in leading indicator, industrial production, retail sales, import, GDP, exchange rates (currency against dollar is weakening) caused the last movement in Germany and France during 1998. In Italy (white) the trend had been similar to that in France and Germany. However, interest rates had been higher all the time, industrial production remained longer at the Italian maximum level (industrial production had increased only moderately after 1995) than in other central Europe and retail sales were decreasing until 1997. Since 1998 Italy has had similar development to Germany. If we compare the simulations and central European trends we could observe the similarity with the Italian trend and the simulation where the retail sales and interest rates are at the highest level at the beginning of the period. The comparison between the simulations and the trends also shows the similarity between the German and French trends and the simulation where interest rates are decreasing in the beginning. Finally, the comparison illustrates the similarity with the French, German and Italian last quarter perceptions of 1999 and simulation with the decreasing interest rates and the increasing of all the other variables. Next, we present the trends in the English speaking countries and in Japan.

[71] The Finnish retail sales index has a mysterious feature in every first quarter between 1996-9. Then, the first values are always at the lowest level of the year and they are increasing during the year and again dropping to the lowest level in the first quarter.

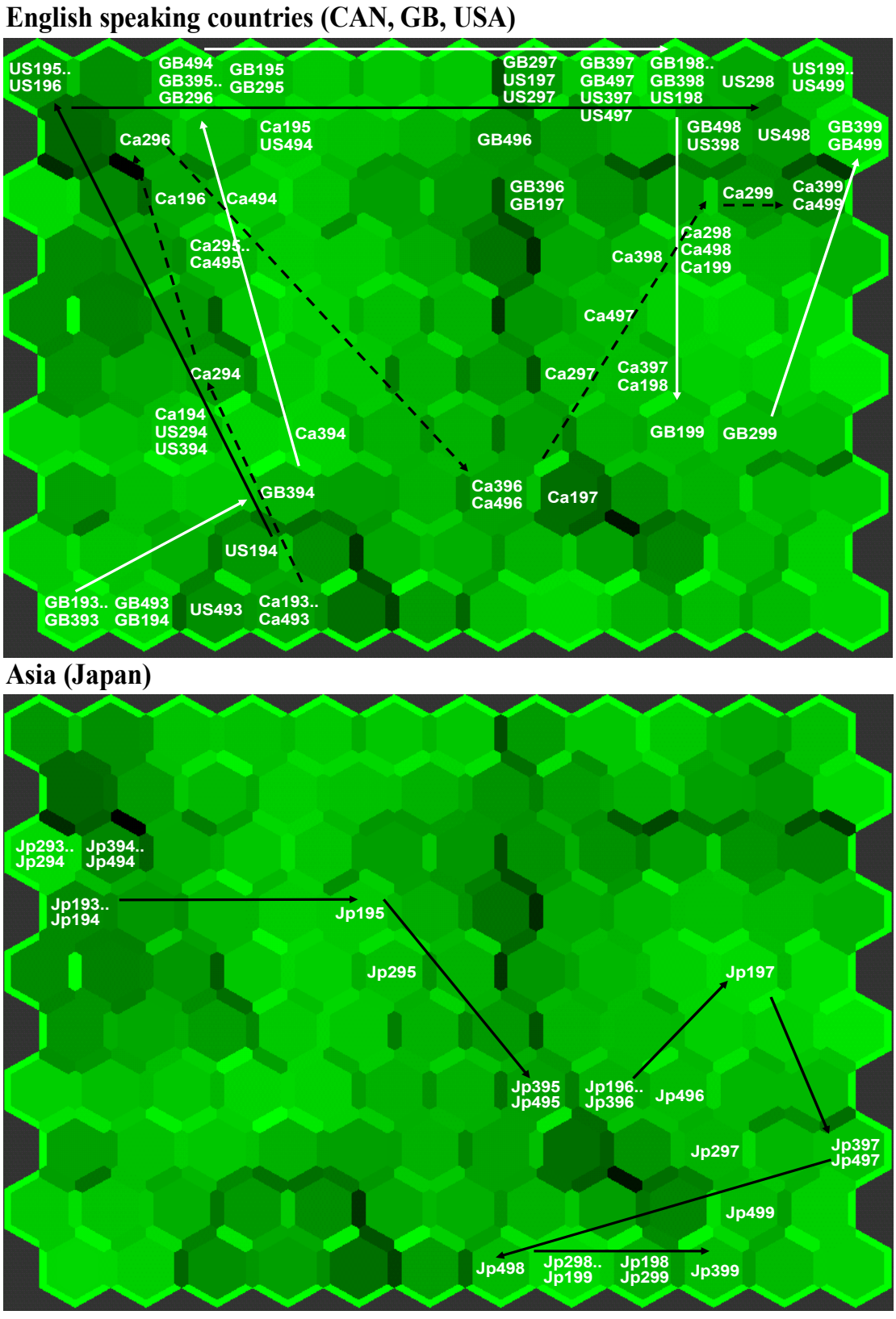


Figure 16b: English speaking and Asian trends by nine variables (Model 3)

All the English speaking countries (Canada, Great Britain and the USA) have had similar upward trends according to the upper part of Figure 16b. They have had a steady economic development without larger recessions in

the studied period. The English countries have, anyhow, some small differences between their trends. At the end of 1996 the Canadian (dashed black) interest rates dropped temporarily, which is a reason for the difference with the US trend. In Great Britain (white) import to GDP and exchange rates increased and interests dropped resulting in a difference compared with the American trend at the beginning of 1999. The English speaking countries have the greatest similarities with the simulations where all the variables are increasing linearly and with the simulation where all the variables increase linearly except decreasing exchange rates. Smaller similarities between these two simulations and the trend can be seen in Canada although the similarities are still strong. The Canadian trend follows the simulation with linearly increasing variables. The British and US trends follow the simulation where all the variables are increasing except linearly decreasing exchange rates.

The lower part of Figure 16b shows the Japanese macroeconomic trend. Japan has had an entirely different trend compared to the other countries, which is not very surprising after analyzing the earlier presented Models 1 and 2. Japan had an exceptional development because already in the beginning retail sales and stock market index were closer to the Japanese maximum level than corresponding levels in the other countries. The best period in Japan was at the beginning of 1997 when industrial production, retail sales, GDP and stock market indexes were at the highest level. Japan had some indication of a recession at the end of 1997 because all variables dropped from the beginning of the 1997 level. At the end of 1999 there were some signs of a better future; then leading indicator, industrial production, export to GDP, import to GDP and stock market indexes increased although retail sales still remained at the low level. To sum up, all Japanese economic variables had stayed at a very low level during the 90's. One problem in Japan was extremely low –almost zero- interest rates. Therefore, policymakers were not able to decrease interest rates to boost the economic growth. This extremely low interest rate was an exceptional feature in the Japanese economy compared to the other studied countries. The comparison between the simulations and the Japanese trend shows that the Japanese trend has some similarities with the simulation where all variables are increasing except linearly decreasing retail sales and interest rates.

The presented results support our research goal. The used technique enabled us to perform a multivariable business cycle comparison in different countries during the same time-period. By using the SOM-technique we could notice several interesting issues. First, neighboring countries have usually similarities in their business cycles (cf. Kaski & Kohonen 1996). Second, in the USA was the most balanced upward economic trend. Third, we noticed the effect of the Asian crisis on the Japanese economy.

5.1.3.2 Conclusions of the trends by nine variables

In this part of the study we have used neural networks in the form of SOM for a multinational macroeconomic environment analysis. Model 3 showed that, especially, the neighboring countries had similarities in their business cycles. This means that the largest movements have occurred almost at the same time in all the countries' trends (1995/6, 1997 and 1999) although the strength of the movements varies from country to country. This indicates that some kind of shocks (see Chapter 3.2, Prescott 1999, Temin 1998, 1-2, Ravn 1997 and Zarnowitz 1997, 3-4) have influenced the worldwide business cycle (see also Gregory et al. 1997, Kindleberger 1995, 97, Lumsdaine & Prasad 1999, 27 and Schaefer 1995, 27). Our study also revealed that the variation in the used variables (both monetary and production-oriented) caused movements. The economic growth was also an essential feature in all the countries' trends – except Japan after 1997.

Our study also brought up a large number of other interesting issues. The smaller countries (i.e. Finland and Sweden) except Japan (in recession in the latest studied period) had larger fluctuations than the bigger ones – especially the English speaking countries (see also Crucini 1997). We could also observe that countries' distance from one another affects business cycles (cf. Artis et al. 1997, Schaefer 1995, 27 and Zimmerman 1997), thus, countries with lower distance usually have more similar cycles than those with longer distance. Model 3 showed an upward and constant economic development in the English speaking countries. The study clearly revealed the Asian crisis and its effect on the Japanese economy that has not expanded after 1997. We could also find some similarities between the countries' trends and the illustrated simulations.

5.1.4 Comparison between macro level models

This last subchapter examines the differences and similarities between the three constructed macro level models. Therefore, we investigate if the trends are similar between the models and if any model reflects larger fluctuations in economic trends than the other models.

Generally, Model 1 shows the largest movements in the map whereas Model 2 does not show as large movements as Model 1. This means that the financial variables have had larger fluctuations than production-oriented variables. Model 2 reveals the important macroeconomic feature, macroeconomic growth, in almost all the countries. Therefore, Model 3 shows

movements but these movements are not as substantial as in Model 1 due to the inclusion of production oriented variables.

Despite the model, each model showed that the trends have been quite similar in each region. This means that Germany and France –as well as Finland and Sweden- have similarities in their trends. All the models showed that Canada and the USA have had quite similar trends and also Models 2 and 3 indicate a similarity between Great Britain and North American countries. All the models also showed the exceptional development of the Japanese economy and the most constant economic growth in the USA. Furthermore, all the models showed that the fluctuations in each country have occurred almost at the same time (1995, 1997 and 1999).

Model 1 highlights the huge movement in Central European and Scandinavian countries during the last quarter of 1999 because stock market indexes increased drastically. If we focus on Model 2 we can notice that this model does not show any huge movement in the last quarter of 1999. Therefore, Model 3 does not show this kind of larger movement because the stock market index is only one of the nine variables and thus this variable has less than 15 percent effect on the construction of the third model.

All the models show that the Italian development has been slightly different against other European countries before it joined the European Monetary Union. Models 1 and 3 show that the Italian interest rates are at the highest level at the beginning of the period. Model 2 shows that retail sales have been decreasing until 1997 and after that the Italian trend has followed the French trend. If we combine the financial and production-oriented variables in Model 3 we can observe the similarity of the Italian trend with that of other European countries (except Great Britain) during 1999.

We can clearly observe the movement in Finland during 1996 and 1997 in all the models. The growth of retail sales and the weakening of exchange rates have almost simultaneously occurred in Finland. All the three models show that all the variables have increased in Finland after 1997. The models show that the Swedish economic development has been slightly more stable than the Finnish one.

All the models show that strengthening currency, decreasing interest rates and increasing retail sales cause the movement in Germany during 1995-6. Models 1 and 2 show a larger movement than Model 3 in Germany in the first quarter of 1997. The weakening currency and decreasing retail sales cause the huge movement in Models 1 and 2 in the first quarter of 1997. This movement can be observed also from Model 3 although the movement is not as large as in the other models.

All the models show the huge deviation of the Japanese economic trends, if we compare them to the other countries' trends. Models 1 and 3 show that the

strengthening Yen against the US dollar causes the movement in Japan during the first and second quarter of 1995. Models 2 and 3 show that the best period in Japan was during 1997 although the stock market indexes were not at the highest level (cf. Model 1). Model 1 clearly shows that the Japanese general stock market index has not improved since 1993 although the variables – except retail sales - have improved according to Model 2.

5.2 Industry level models

In this subchapter we focus on the industry level analysis whereas we focused on the macro level analyses in the earlier subchapters. First, we conduct similar country specific analysis as before but the focus is on the forest industry in the pulp and paper sector. First, we investigate if the country specific trends are similar in the most important countries of forest product manufacturers. Second, we focus on the Finnish grocery industry. We use self-organizing maps to find out the possible price level differences between grocery retailers and try to explain some reasons for the possible differences. The last industry level model illustrates how self-organizing maps can be used to analyze the effect of changing pricing policies on the location of a grocery retailer's pricing position.

5.2.1 Model 4 – Cycles in the paper industry

In this subsection we present how self-organizing maps can be used for analyzing the industry level competitive environment. We have chosen global forest industry as our research area and we focus on the specific variables of the pulp and paper sector. This sector is chosen because it is the biggest sector of the forest industry and it is one of the most important industries for the Finnish economy. Moreover, the pulp and paper sector is a traditional industrial sector and subsequently international quality data is available.

The major purpose of this chapter is to explore how different countries' relative economic trends are in the pulp and paper sector. Therefore, we investigate if some countries have larger fluctuations than other countries or if the trends are similar between countries. Finally, we are interested if the viability of the trends differs between countries, i.e. some countries may have better trends than others due to decreasing cost and increasing productivity ratios.

5.2.1.1 Cluster identification and trend analysis

We identified ten clusters A-I with seventeen variables from the U- matrix, which is presented in Figure 18. These clusters can be identified and explained by using feature maps which are presented in Figure 17. White cells on the feature maps indicate high values whereas black cells indicate low values.

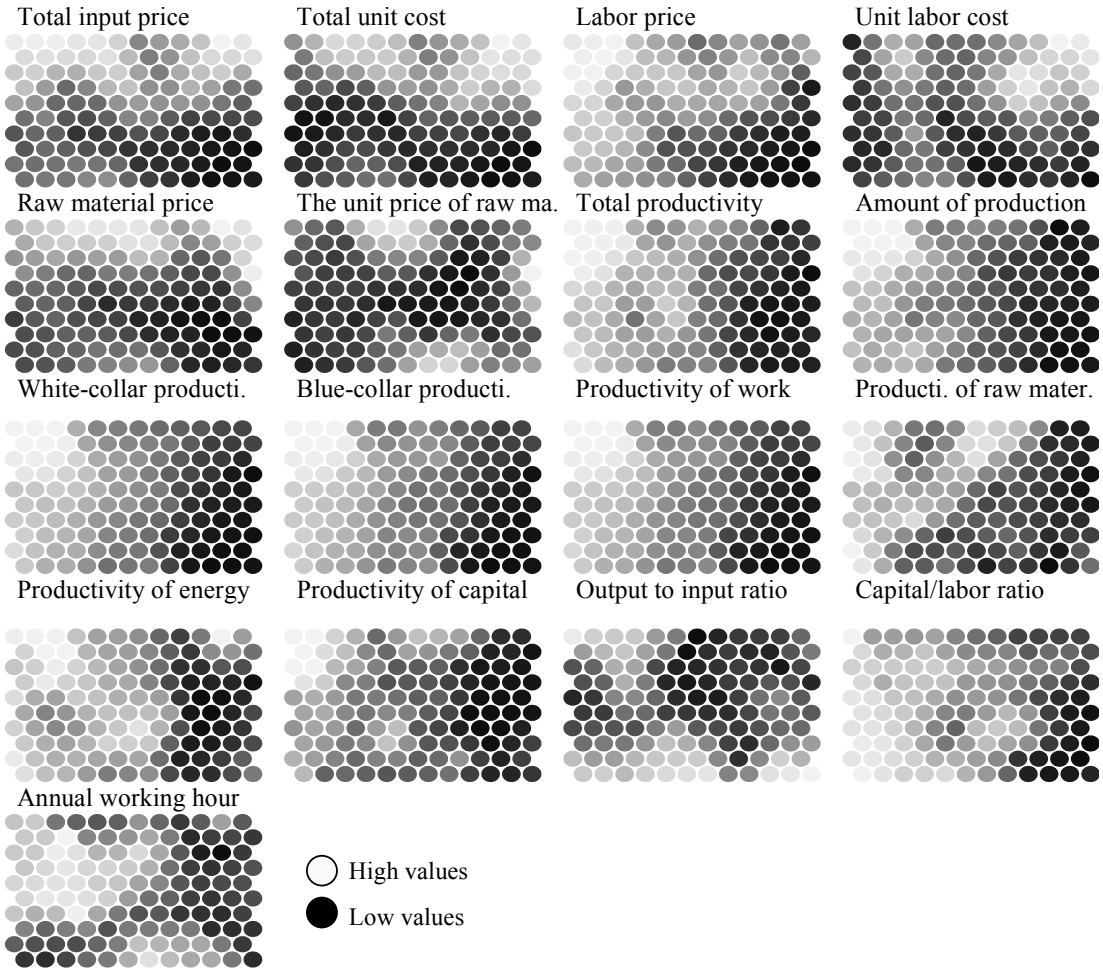


Figure 17: Feature maps of Model 4

Figure 18 present these ten clusters. Figures 17, 18 and Table 7 show that the majority of variables - especially the variables concerning production and productivity - are increasing from the right to the left side of the map. The price and cost variables are increasing from the bottom of the map upward.

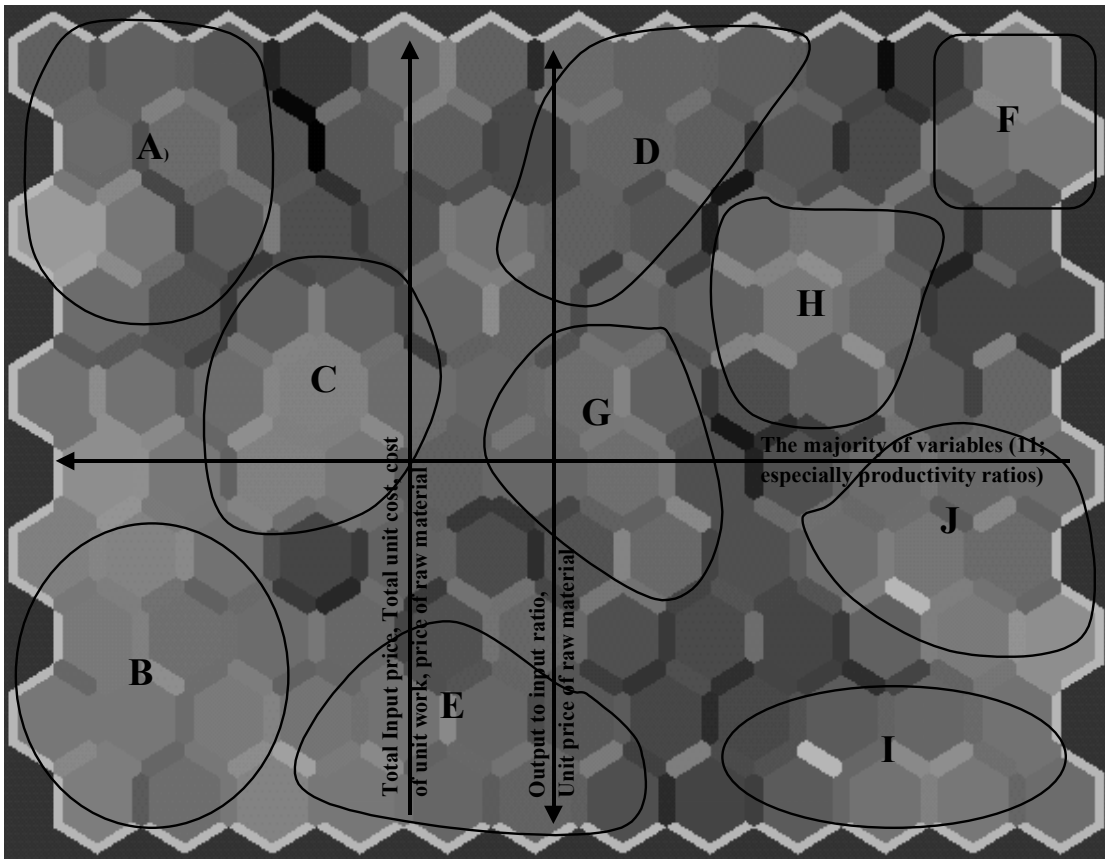


Figure 18: U-matrix of Model 4

Table 7 describes the properties of the different clusters. The properties of the clusters are described by seventeen variables and these variables have three different degrees (high, average, and low) with plus and minus signs (e.g. Aver- & Aver+). In this study, the high values of production variables are also good values (i.e. high productivity is better than low) whereas low values of cost variables are preferable to high values.

Table 7 (and also Figure 17) shows that cluster A includes the highest values and cluster J the lowest values. Therefore, the productivity and costs are at the highest level in cluster A. Clusters F and H are extremely bad clusters because the costs are high and the productivity ratios are low at the same time. Because we are analyzing the trends of a country's pulp and paper sector we have to consider our indexed data. Therefore, if one country remains in Cluster A all the time it would not be optimal because the country has not improved its performance during the period (i.e. its productivity and costs have remained at the same level).

Table 7: The specifications of different clusters

Variables/Clusters	*A*	*B*	*C*	*D*	*E*
Total input price in FIM	High-	Aver-	Low	Aver	Aver-
Total unit cost in FIM	Aver+	Low+	Low+	Aver	Aver-
Labor price in FIM	High	Aver+	Aver	Aver	Aver
Unit labor cost in FIM	Aver+	Low+	Aver-	Aver	Aver
Raw material price in FIM	Aver+	Low+	Aver-	Aver+	Aver
The unit price of raw mat.	Low+	Low+	Low+	Aver-	Aver-
Total productivity	High	High-	Aver+	Aver	Aver
The quantity of production	High	Aver+	Aver	Aver-	Aver-
Blue-collar productivity	High	High-	Aver+	Aver	Aver
White-collar productivity	High	High-	Aver+	Aver-	Aver-
The productive. of raw mat.	High-	High-	Aver	High-	Low+
The productivity of energy	High-	High-	Aver+	Aver-	Aver
The productivity of work	High	Aver+	Aver+	Aver	Aver
The productivity of capital	High	Aver+	Aver	Aver	Aver-
Output to input ratio	Aver+	Aver+	Aver-	Low+	High-
Capital/labor ratio	Aver+	High	High-	Aver	Aver+
Annual working time	High-	Low+	High	Aver	Aver-
Variables/Clusters	***F***	***G***	***H***	***I***	***J***
Total input price in FIM	High	Aver-	Aver	Low	Low
Total unit cost in FIM	High	Aver-	Aver+	Low	Low+
Labor price in FIM	Aver	Aver	Aver+	Low	Low+
Unit labor cost in FIM	High	Low+	High-	Low+	Low+
Raw material price in FIM	High	Low+	Aver-	Low	Low
The unit price of raw mat.	Aver	Low	Low	Aver	Low+
Total productivity	Aver-	Aver-	Low+	Low+	Low
The quantity of production	Low+	Aver-	Low+	Low	Low
Blue-collar productivity	Low+	Aver-	Low+	Low	Low
White-collar productivity	Low+	Aver-	Low+	Low	Low
The productive. of raw mat.	Low+	Aver-	Low+	Low	Low+
The productivity of energy	Aver	Aver	Low	Low+	Low
The productivity of work	Low+	Aver	Low+	Low	Low
The productivity of capital	Low+	Aver-	Low+	Low+	Low
Output to input ratio	Low+	Low	Low+	High	Aver-
Capital/labor ratio	Low+	Aver	Aver-	Low	Low+
Annual working time	Low+	Aver	Low+	Aver	Low

Next, we illustrate what-if analysis for the industry level analysis. We present two illustrations. The first illustration shows the trend for the situation where all the variables increase linearly (indicated by UpXX and black arrows). The second illustration indicates the trend (CostsXX and white arrows) with linearly decreasing costs and linearly increasing productivity ratios. We can conclude that the second illustration represents a more favourable situation to the country, since the country benefits then both improving productivity and cost ratios. Naturally, we have to remember the

starting level of the ratios because if the productivity ratios are very low in the beginning, they are more easily improved than the extremely good ratios. Two simulations are crossing in the year of 1995. The simulations are presented in Figure 19 and they will be analysed later.

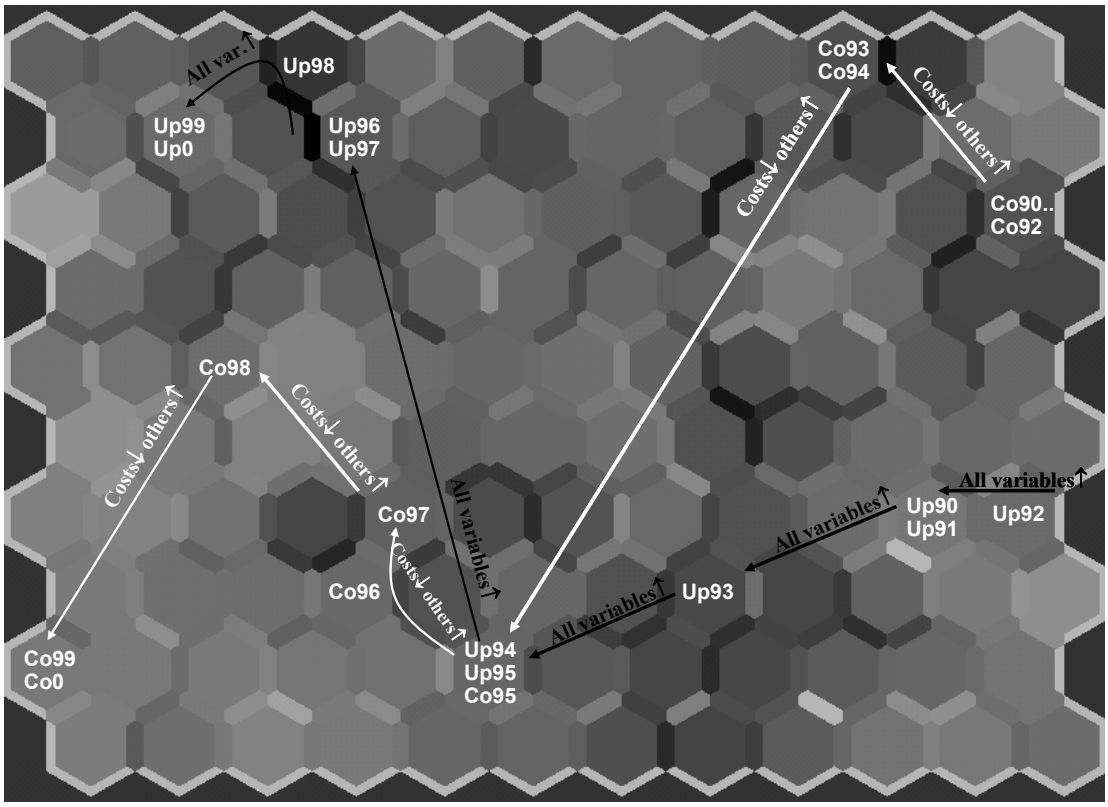


Figure 19: What-if analysis of Model 4

In Figure 20 we present countries' trends in the pulp and paper sector. We divide the countries into four areas as we already did with Model 3, i.e. Scandinavian countries (Finland and Sweden), Central Europe (Austria, Germany and France), North American countries (Canada and the United States) and Asia (Japan). The distance between the countries' trends on the map indicates a similarity of the economic situation, thus we can find similarities inside the four geographic areas (i.e. Finland and Sweden have similar trends, Austria and France have similarities, and also the USA and Canada). The movements can be vertical or horizontal in the map. Horizontal movements refer to change in productivity ratios whereas the changes in cost variables cause vertical movements.

Although the trends seem to be slightly different between geographic areas, they have similarities with each other. Therefore, all the trends are moving from the right-hand side of the map to the left-hand side thus showing enhanced productivity in all the countries. The trends are also moving from down to up in the map, which shows that the costs have also increased during

the period. Furthermore, the largest movements have occurred almost at the same time in all the countries (1992/3, 1995/6, 1999/00) although the strength of the movements varies from country to country (similar results with Schaefer 1995, 27 Kindleberger 1995, 97 and Lumsdaine and Prasad 1999, 27). This indicates that some kind of shocks (Prescott 1999, Temin 1998, 1-2 and Zarnowitz 1997, 3-4) have influenced the forest industry cycles in different countries (see also Gregory et al. 1997, Kindleberger 1995, 97, Lumsdaine and Prasad 1999, 27 and Schaefer 1995, 27).

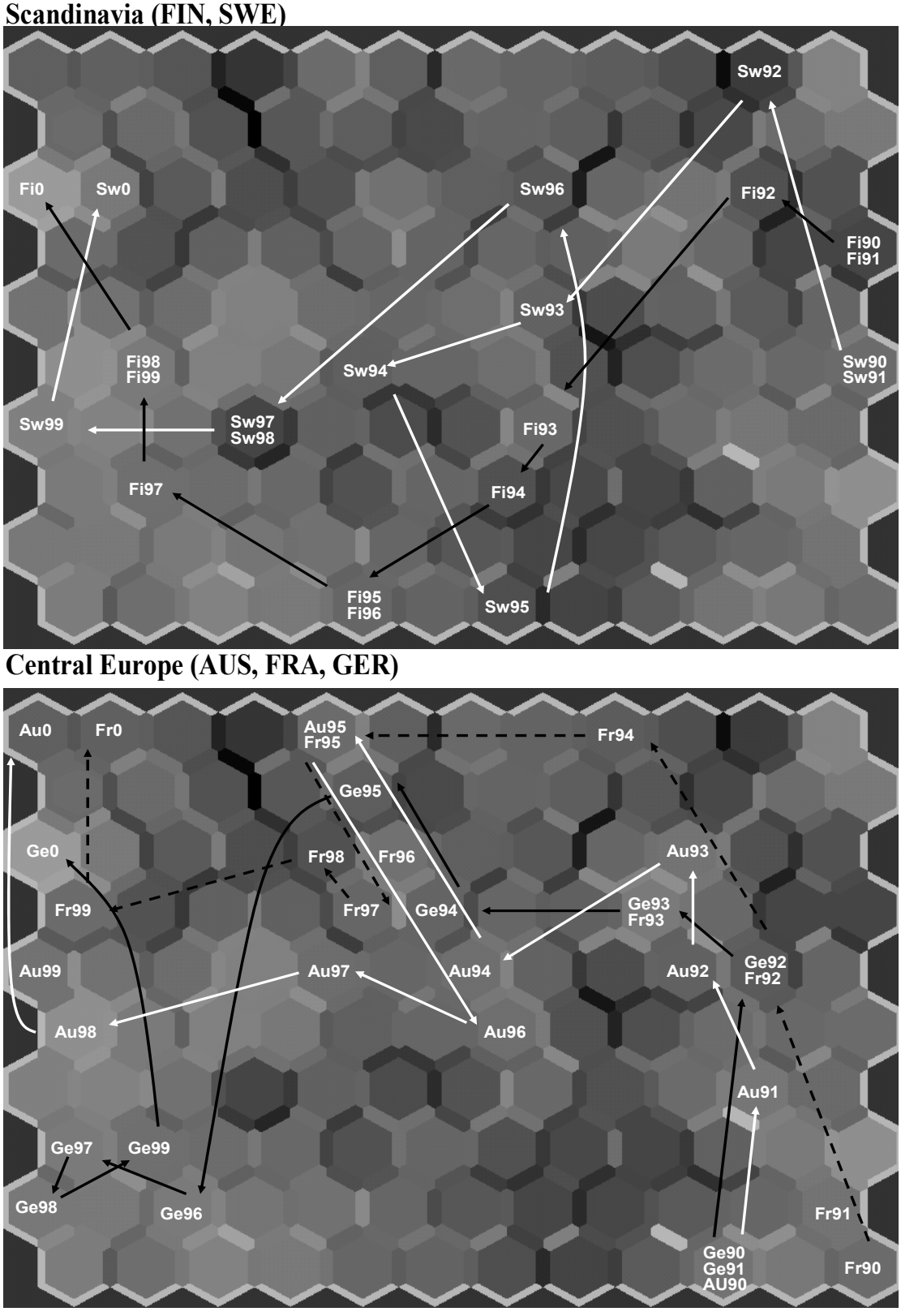


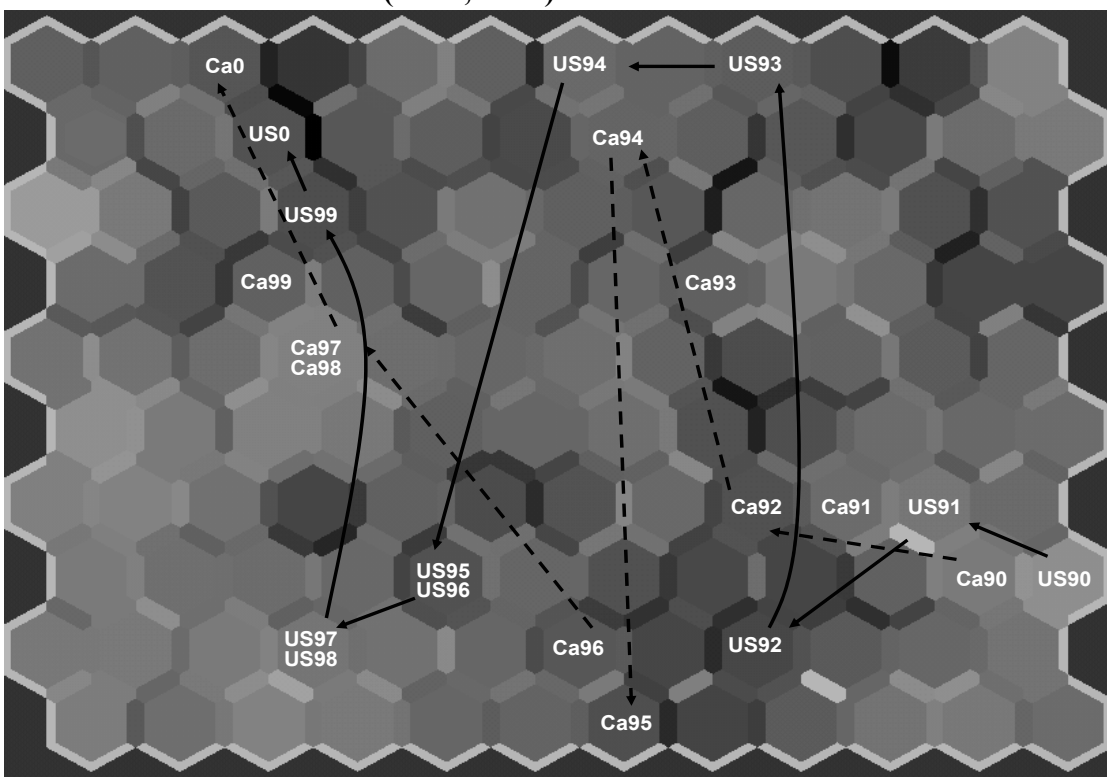
Figure 20a: Forest industry trends in Scandinavia and Central Europe (Model4)

The upper part of Figure 20a shows that the Scandinavian countries have a large number of similarities in their trends -except in the year of 1996. Scandinavian countries have one difference in their trends because the trends

were moving from the middle of the map downward at the beginning of the period (i.e. the map shows both vertical and horizontal movement). This means that the Finnish and Swedish pulp and paper sector had decreasing costs and faster increase of production than the other countries studied during 1993-1995 (although the costs actually increased from the level of 1994 in 1995). Furthermore increased output to input and capital to work input caused the movement in Finland during 1992-1996 and in Sweden 1992-1995. Working hours were higher in Sweden than in Finland in 1993 and 1994, which caused the small difference between these trends. Figure 20a clearly shows the difference between the Finnish and Swedish trends in 1996. The reason for the movement was a decreasing output to input relation and the increase of labor price that possibly weakened the competitive ability of the Swedish paper manufacturers compared to the Finnish manufacturers. Therefore, this movement probably appears in the financial statements of the Swedish paper companies. All cost variables -except labor price- decreased and productivity and working hours increased in Sweden during 1996-1999. The last movement occurred in Finland during 1997-2000 and in Sweden during 1999-2000 since all variables - except capital to work input- were increasing.

Figure 20a shows that Central European countries - except Germany during 1996-1999 - had similarities in their trends. In the Central European countries three larger movements can be spotted. The first movement occurred in the Central European countries during 1990-1992. The movement was caused by decrease of the output to input ratio, the price of raw material, the productivity of capital, raw material, and energy, and the increase of labor costs. We notice that the French trend differed from the other European countries in 1994 due to the higher unit costs. The second large movement occurred after 1995 in Central Europe because the costs dropped. Figure 20a shows that the German trend deviated from the French and Austrian trends during 1996. The cause for deviation was the decrease of costs (especially raw materials) and the increase of productivity ratios in Germany during 1996. German capital to work input ratio stayed at the highest level during 1996-1999. The third large movement occurred in France and Germany during 1999-2000 and in Austria during 1998-2000 because the costs and productivity increased. In Figure 20b we show the trends in Canada, the USA and Japan.

North American countries (CAN, USA)



Asia (Japan)

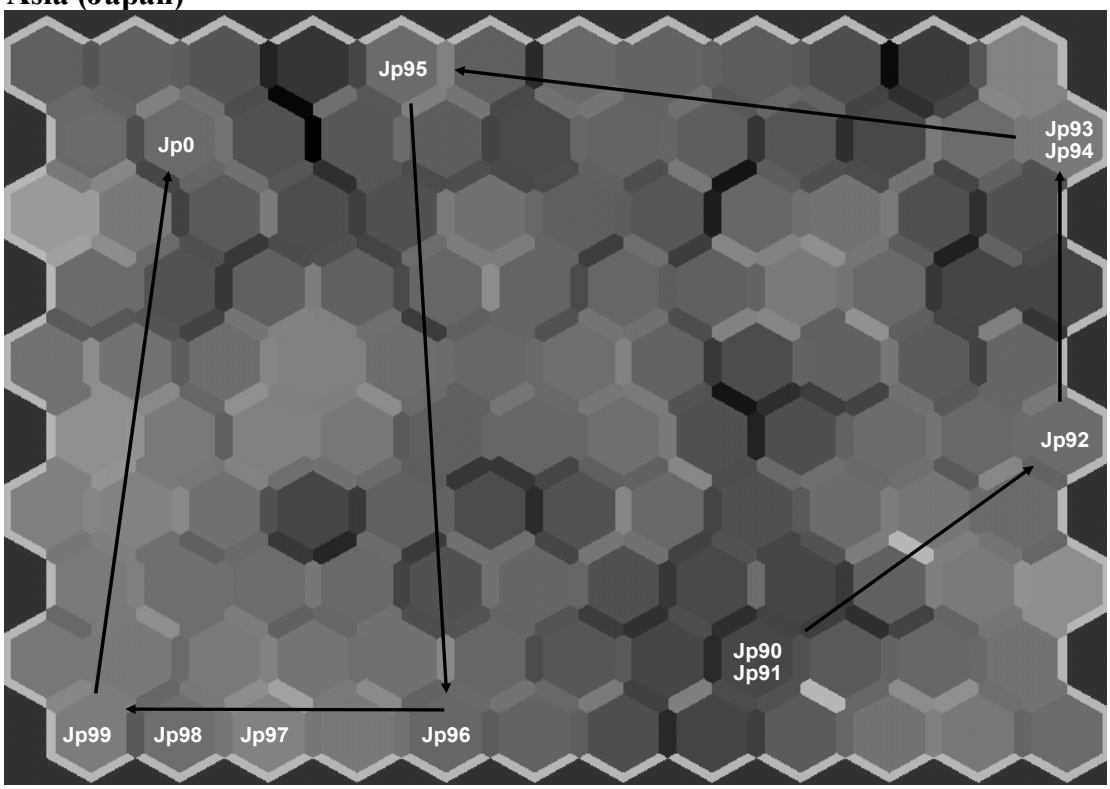


Figure 20b: Forest industry trends in North American countries and Asia (Model4)

From Figure 20b in the upper part we can conclude that North American countries have had quite similar trends with three larger movements. The heavily increased costs caused the first huge vertical movement in the USA in

1993 and in Canada in 1993-4. Both decreased costs and increased production and productivity ratios caused the other huge movement in the USA and Canada after 1994. All ratios had increased during 1998-2000 by causing the third substantial vertical and horizontal movement in the USA. All ratios - except capital to input and unit price of raw material - also increased in Canada during 1997-2000. North American countries (and Japan) had one difference compared to the other countries because their annual working hours were on the extremely high level during the examined period.

The lower part of Figure 20b shows the Japanese trend in the pulp and paper industrial sector. Despite some similarities Japan has had a different trend compared to all the other countries. Annual working hours and costs have been at an extremely high level in Japan all the time. The first movement occurred during 1992-1994 since costs increased although the productivity ratios did not improve, thus, this period was depressing for the Japanese paper manufacturers. Although cost variables stayed at a high level, Japan improved its situation during 1995 because the productivity ratios increased. The third larger movement occurred during 1996 since costs dropped heavily by possibly improving the competitive ability of the Japanese companies. During 1997-1999 the productivity ratios increased and costs stayed at the same level. The last movement occurred during 2000 because productivity ratios and costs increased.

If we compare the simulations in Figure 19 and the trends in Figures 20a and 20b we observe the Finnish trend to be the closest to the simulation with increasing productivity and decreasing cost ratios. This connection seems to be quite tight until 1998. The Swedish trend also has some connection with that simulated trend but it is not as strong as the Finnish connection. The second similarity with the simulations can be found from the North American trends because both the Canadian and the US trends are close to the simulation with all the variables increasing at the beginning of the studied period but after that the similarities with that simulation are not very substantial. Other similarities in trends and simulations cannot be found easily.

5.2.1.2 Conclusions of the trends in the industry level

This part of the study, i.e. industry level analysis, contributes to SMA literature in several different ways (cf. Chapter 1.4). First, the study focuses on companies' external environment. Second, the study investigates a longer period than only one year or quarter. Finally, the presented simulations are focused more on future than history.

Our study showed that, especially, the neighboring countries had similarities in their business cycles in the pulp and paper sector. This means that the largest movements have occurred almost at the same time in all the countries (1992/1993, 1995/1996, 1999/2000) although the strength of the movements varies from country to country. This indicates that some kind of shocks (Prescott 1999, Temin 1998, 1-2, Ravn 1997 and Zarnowitz 1997, 3-4) have influenced the worldwide business cycle (see also Gregory et al. 1997, Kindleberger 1995, 97, Lumsdaine and Prasad 1999, 27 and Schaefer 1995, 27) also in the pulp and paper sector. The improved productivity was also an essential feature in all the countries' trends. The study showed the high level costs during 1994-1995 in all the countries except the Finnish and Swedish pulp and paper sectors.

Our study also brought up a large number of other interesting issues. We could observe that countries' distance from one another affects business cycles (see also Artis et al. 1997, Schaefer 1995, 27 and Zimmerman 1997) i.e. countries with lower distance usually have more similar cycles than those with longer distance. The study clearly visualized the Asian crisis and its effect on the Japanese pulp and paper sector during 1990-1994 when productivity did not improve and the costs heavily increased. Furthermore, the study revealed that the fluctuations have been a typical character in this industrial sector.

We propose that results have several different possibilities for utilization. First, the results are utilizable for forecasting: if the trends in each area have been almost similar, these trends are probably similar also in future. Second, the result can be used for companies' performance analyses: the Finnish pulp and paper sector had possibly financial success during 1993-1995 because the costs were decreasing and productivity increasing which was a different trend compared to the other countries. Finally, the result can be used for investment decisions: if the costs are increasing in one country this can indicate that the National labor union is powerful and companies subsequently will loose their profitability in those countries. We can conclude that the introduced industry level analysis can be used in the strategy process when companies are comparing their strengths and weaknesses to emerging opportunities and threats at the industrial level (cf. Andrews 1999, Johnson & Scholes 1997).

5.2.2 Model 5 – Comparison of grocery retailers' pricing policies

The last two models relate to the industry level analysis because the focus is on the Finnish grocery industry instead of the forest industry. Model 5 illustrates how self-organizing maps can be used for the pricing purposes. The purpose of Model 5 is to illustrate and somehow explain the possible price

differences of the Finnish retailers. Unfortunately, we cannot explain the results in a way that the reader could specify retailers due to data confidentiality. However, we think that this anonymity policy does not diminish the interest of Model 5 notably because it is constructed only for the illustration purposes. Therefore, the main interest is to show how the SOM can be used so that customers would increase their knowledge about the price levels in different stores. The importance of this kind of knowledge increase is supported by Aalto-Setälä (2003), who explained the existence of price dispersion of grocery products by people's incomplete information. If this kind of price knowledge can be increased, the only possibility of retailers would be to balance their product prices.

5.2.2.1 Cluster identification and analysis of results

We identified eight clusters A-I with 237 variables from the U-matrix. Figure 22 presents these clusters. Dark cells on the map indicate a difference between two cells i.e. the border of a cluster. We derived the properties of the clusters manually from the feature maps as we did already in the earlier models. Some of these feature maps, in particular the unusual maps which have been referred to in Table 8, are presented in Figure 21.

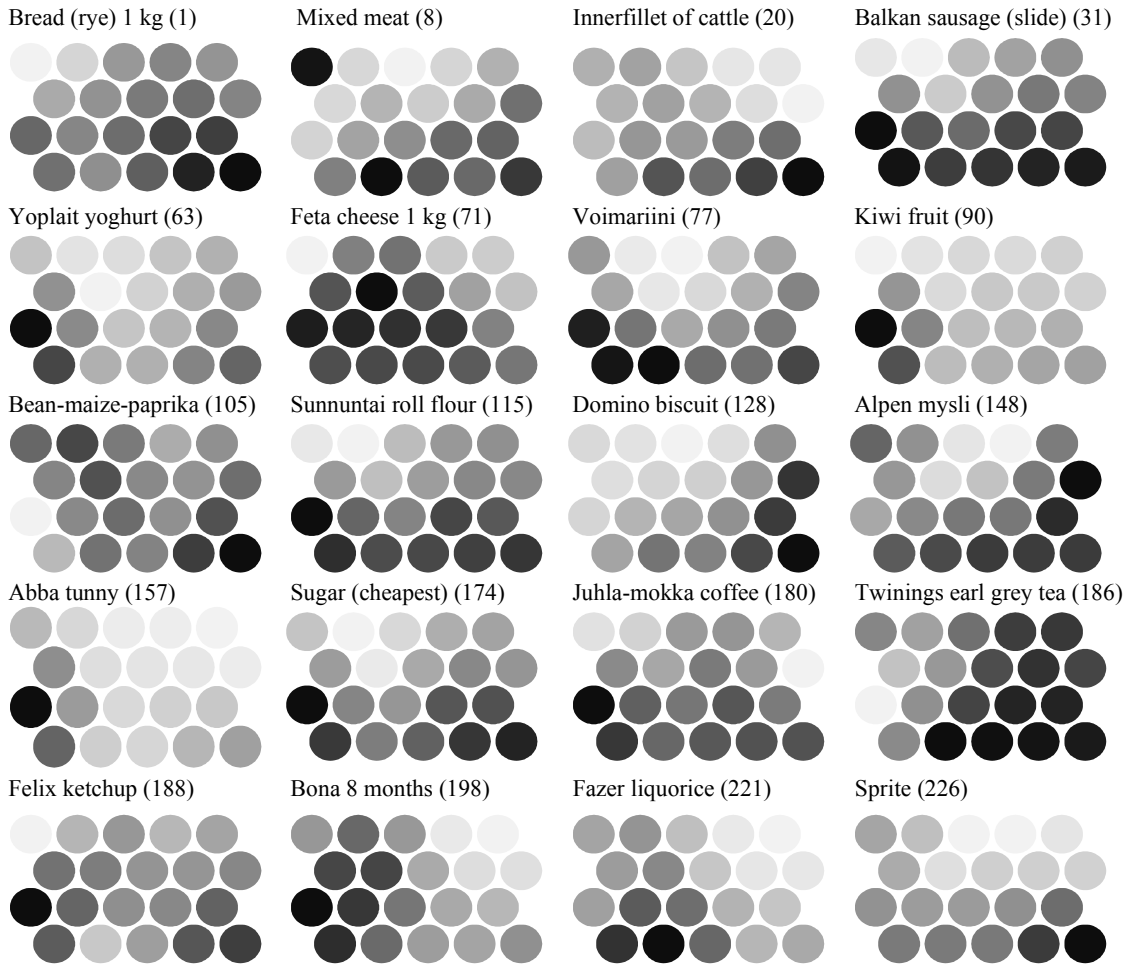


Figure 21: Selected feature maps for the Model 5

Figure 22 and Table 8 show that the variables are generally increasing from the right-hand (or down) to the left-hand (up) side of the map. Therefore, the most expensive retailers are locating in the left-up side of the map, i.e. in Cluster A_1.

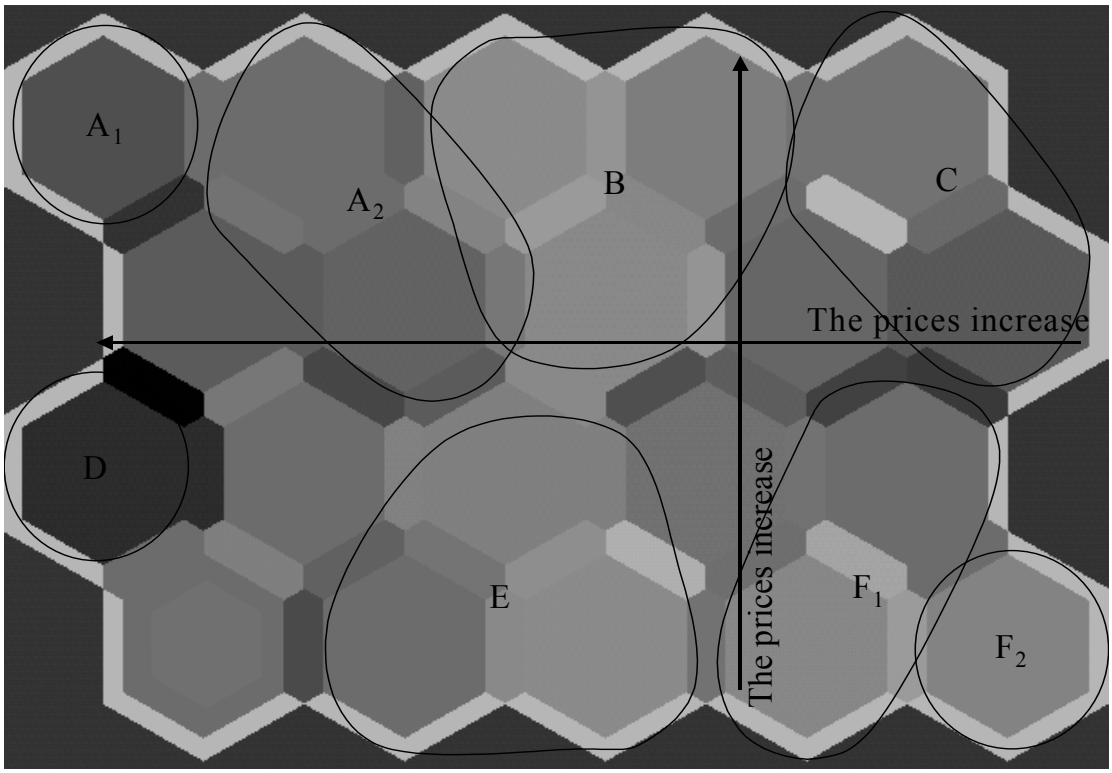


Figure 22: U-matrix of Model 5

Table 8 describes the price levels of the different clusters. Table 8 shows that the retailers with the most expensive products are in cluster A_1 whereas the retailers with the cheapest products are in cluster F_2 (cf. Porter 1985 proposes that the competitive advantage can be based on low cost or see Mintzberg 1988 that competitive advantage can be based on differentiation by price). Table 8 also shows that the most expensive retailers have some campaign products (e.g. mixed meat and strip beef of cattle) that try to increase the customer traffic and subsequently the profit to the retailer. On the other hand, the cheapest retailers (F_2) have also some products (e.g. jelly and bona) which are not the cheapest although they are still quite cheap compared to the other retailers.

Table 8: The specifications of different clusters

Cluster	***General price level***	***Exceptionally <u>cheap</u> products compared to the general price level of the cluster***	***Exceptionally <u>expensive</u> products compared to the general price level of the cluster***
A_1	1	Mixed meat of cattle and strip beef of cattle, meat paste casserole	-
A_2	2	Feta cheese	Yoghurts, plum, raisins and sugar
B	3	Cream cheese	Milk, yoplait yoghurt, butter, Voimariini, oil, Domino biscuits, mueslis, Abba tunny, pineapple, Koti mustard, Bona 5 months, Orbit xylitol and Sprite
C	4	-	Innerfillet of cattle, liver of cattle, Kellog's frosties, Abba tunny, Juhla- Mokka, Bona 8 months, Emmental and Fazer Liqourice
D	(4/) 5	Strip beef of cattle, shoulder of cattle, meat paste casserole, stock cube, satsumas, twining earl grey tea)	Balkan sausage, feta cheese, Becel margarine, kiwi, Anni helene wheat flour and Sunnuntai roll flour
E	6	-	Yoplait yoghurt, kiwi, Abba tunny, Felix ketchup, Bona 5 months, halva mixed candies
F_1	7	-	-
F_2	8	-	Some biscuits, jelly, bona and gum

In the most expensive cluster A_1, the retailers use sc. loss-leader[72] pricing to provide incentives to customers to shop in the store (Lal & Matutes 1994). These products with loss-leader pricing try to increase customer traffic and profits through the sale of other products (Lal & Matutes 1994). However, Walters and MacKenzie (1988) found that most loss-leaders had no ultimate effect on the store profit because they failed to stimulate either loss-leader sales or store traffic. The model of Lal and Matutes (1994) shows that companies do not restrict their product assortment even if they make a loss on one of the products.

Figure 23 shows how the prices differ between groups of retailers. The number before the acronym indicates the number of the retailers in a specified group in a neuron, i.e. 7D means that seven retailers of D-group are locating in the neuron. It is always interesting to analyze extremes, i.e. what retailers are in the most expensive or in the cheapest clusters and why they are in these

[72] This pricing technique means that (i) the price of products most often is at or below retailer's marginal cost, that is, the retailer incurs a loss on the sale of these items; and (ii) these items are heavily advertised in the local newspapers (Lal & Matutes 1994 and Walters & MacKenzie 1988).

clusters. Figure 23 shows that the largest number of the most expensive retailers belongs to D-group (black dashed lines) or C-group (dashed white). The most expensive cluster also includes two retailers of A-group (black). If we look at the cheapest cluster we can easily observe that most of the cheapest grocery retailers belong to B-group (white). On the other hand, we observe that the prices in A-group are generally more expensive than in B-group although the cheapest cluster includes also three retailers of A-group (cf. Aalto-Setälä 2000 and Aalto-Setälä 2002). Finally, similar prices inside the groups can be spotted although the prices between the groups vary, i.e. one neuron usually includes more than one retailer of a group. We were not able to specify the groups of all the retailers and subsequently they are marked by NA in Figure 23.

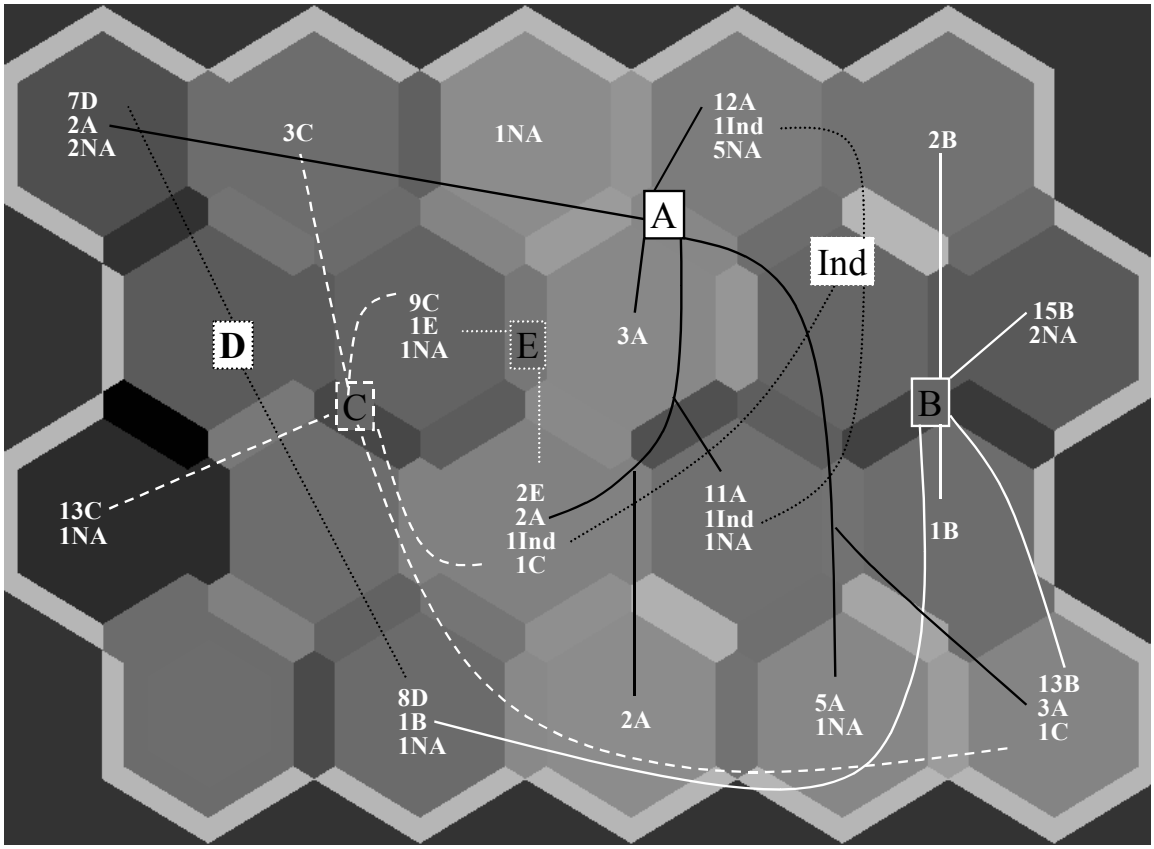
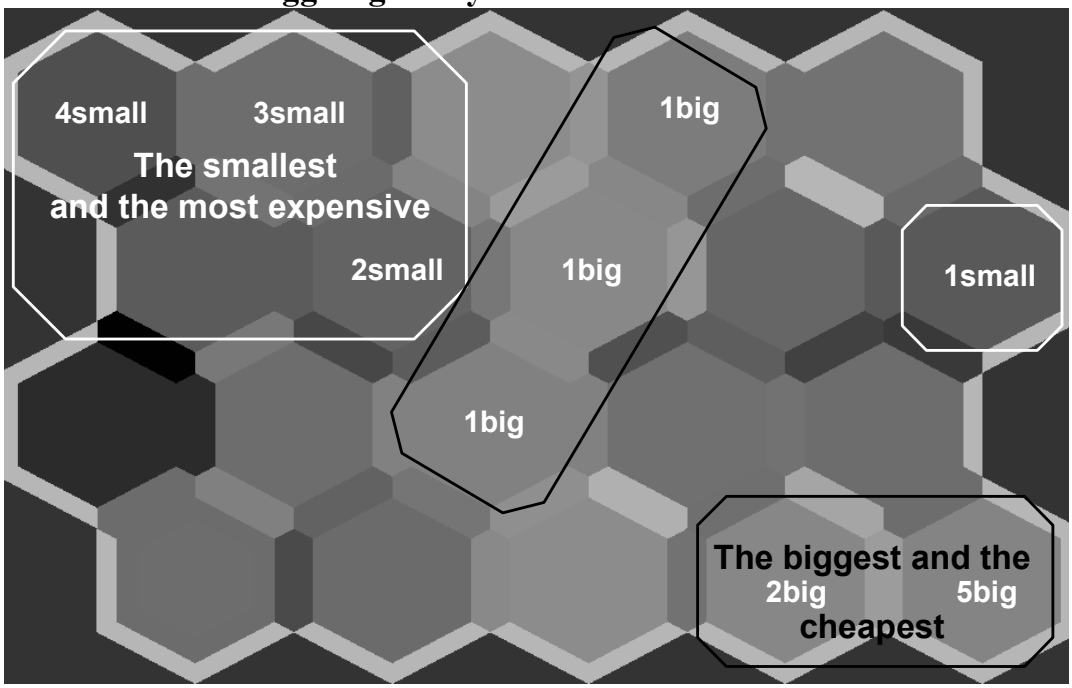


Figure 23: The price levels between the groups

From Figure 24 we can observe how the size of the retailer and geographic location impact on the price level.

The smallest vs. biggest grocery retailers



Helsinki and its neighboring cities vs. Tampere and Turku

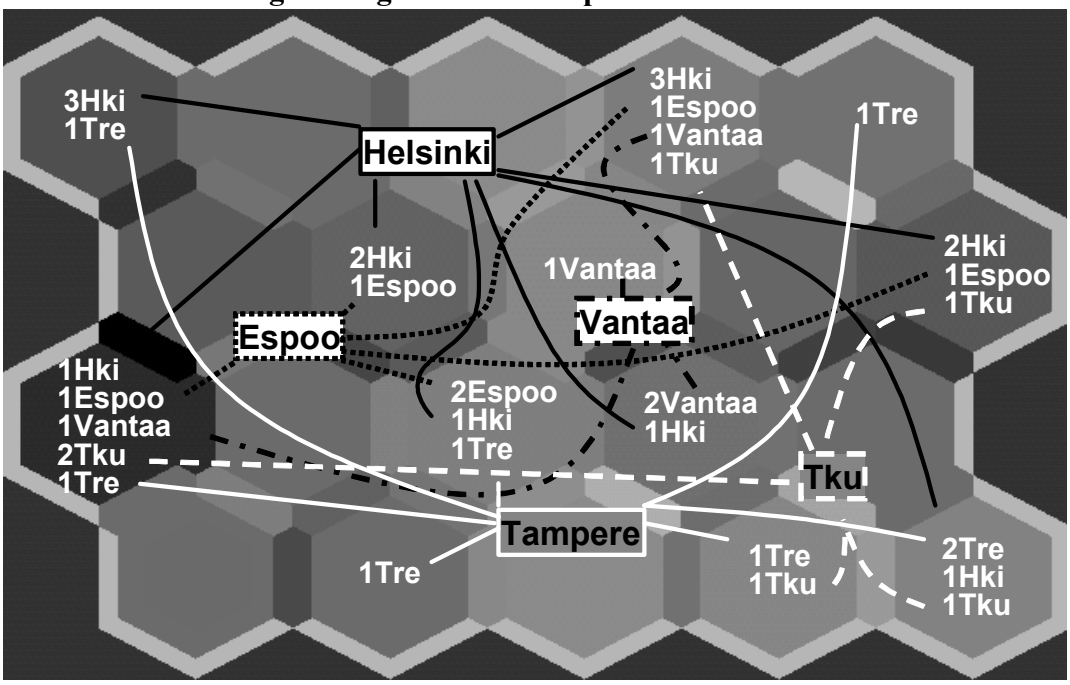


Figure 24: The impact of size and geographic location on retailer's price level

From Figure 24 in the upper part we can conclude how the size of the retailer[73] affects the price level of grocery products. The ten smallest retailers

[73] The size of a retailer is measured only by the turnover of grocery products although the retailer would have also other departments. We did not have information about the turnover of all the retailer's grocery products and it can be possible that some smallest and biggest retailers could be replaced with others. We included only the retailers with the turnover information to the list of ten biggest and smallest. These price positions of the listed retailers are illustrated in Figure 24.

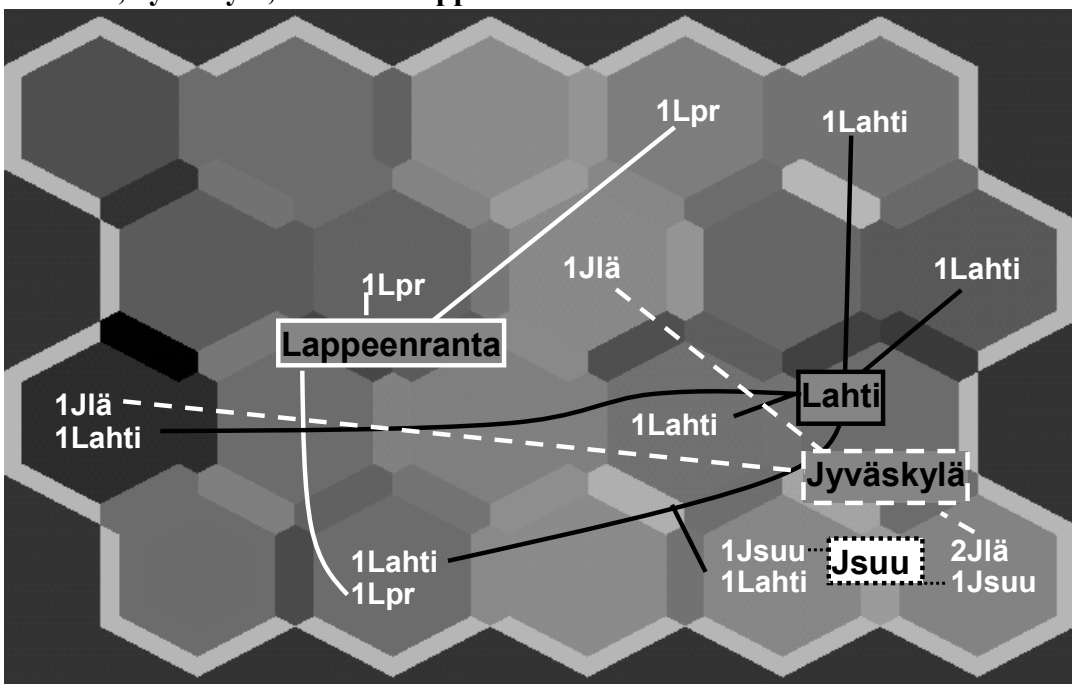
(turnover between EUR 1-2.2 million) are marked with a white line and the ten largest companies (EUR 20-30 million) are circled with black lines. Figure 24 clearly shows that the smallest retailers are the most expensive and vice versa (cf. Aalto-Setälä 2000 and Aalto-Setälä 2002). All the smallest retailers - except one retailer- are only grocery retailers. They are retailers of D, C-group or A-group. Figure 24 also shows that one of the smallest retailers is not in the most expensive cluster. It is a B-group retailer and outside of Helsinki and its neighboring cities.

The biggest retailers seem to be the cheapest. However, we can observe from Figure 24 that the three biggest retailers are not the cheapest. These retailers are in Helsinki or its neighboring towns (i.e. in Espoo or in Vantaa). Two of them are only grocery retailers of A-group and one of them is an independent retailer. The other seven of the tenth largest retailers are outside Helsinki and are in the cluster where the prices are the lowest. The retailers include A-group (two), B-group (four) or C-group (one). Two of the biggest and cheapest are only grocery retailers whereas the other retailers also have some other departments.

From the lower part of Figure 24, we observe that the prices in Helsinki (black lines) and its neighboring towns are higher than in other towns because only one retailer in Helsinki and its neighboring towns belongs to the cheapest cluster. It is a big retailer of B-group in Helsinki. All the three most expensive retailers are small D-retailers in Helsinki. In Vantaa (dashed black) the prices are quite high with two exceptions. However, in Tampere (white) and Turku (white dashed) all the retailers –except a small D-retailer- have quite low price levels compared to the retailers in Helsinki and its neighboring towns.

We continue our analysis by showing the price levels of grocery retailers outside the biggest Finnish towns in Figure 25.

Joensuu, Jyväskylä, Lahti & Lappeeenranta



Oulu, Rovaniemi, Seinäjoki & Vaasa

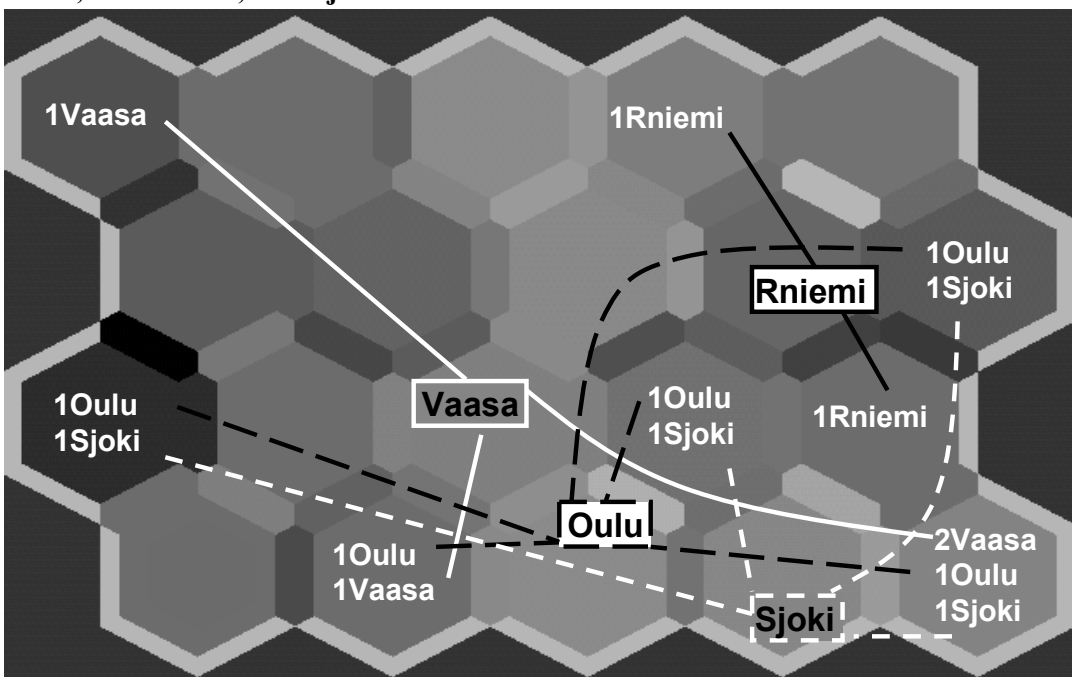


Figure 25: The impact geographic location on retailer's price level outside of the Finnish biggest towns

The upper part of Figure 25 shows the price levels of grocery retailers in central Finland. Joensuu (dot black) has two very cheap and large retailers. Jyväskylä (dashed white) has also cheap grocery retailers. The prices are also quite low in Lahti (black). On the contrary to the other earlier presented towns, the price level of retailers is average or above in Lappeenranta (white).

The lower part of Figure 25 includes grocery retailers from the north of Finland. In Vaasa (white), Oulu (black long dash) and Seinäjoki (white dash) the prices of the retailers are average or usually below the average. There is an exception in the price levels of Vaasa with one retailer in the most expensive cluster. One reason for the high prices of that retailer can be its quite small turnover of grocery products. Our database includes only two retailers from Rovaniemi (black). The more expensive retailer is a smaller than median size retailer and the cheaper is an above median retailer.

5.2.2.2 Conclusions of the comparisons of grocery retailers

This part of the study contributed to SMA literature by focusing on the competitors (Chapter 1.4) and especially on the strategic pricing issues (cf. Guilding et al. 2000). In the area of strategic pricing we focused on the analysis of economies of scale and scope (cf. Simmonds 1982). Model 5 has also connection to another used practice of SMA, i.e. the target costing where one step is to analyze competitors' product prices (Guilding et al. 2000).

Model 5 showed that the smallest retailers have the highest prices (and vice versa). This can be explained by the fact that the smaller retailers do not have economies of scale and scope, efficient distribution channels and delivering equipment; their service level may also be higher (i.e. turnover/number of employees ratio) and their central geographical location in downtown may increase the rent level (cf. Johnson & Scholes 1997, 254, Tellis 1989 and Lawton 1999). Therefore, our study confirms the proposition of Aalto-Setälä (2000 see also Aalto-Setälä 2002) and Tellis (1989) who found that the size of company and prices have negative correlation, i.e. the bigger retailers are cheaper. However, the more expensive retailers can also be profitable because the consumers may have incomplete information[74] about the price levels (cf. Aalto-Setälä 2003 and Tellis & Wernerfelt 1987) and consumers sometimes behave emotionally (Pitt et al. 2001) rather than rationally by not seeking the lowest prices of products. There are also other factors than only the product prices guiding the consumers' choice of retailer. These factors are, for instance, location of the retailers (household distance from retailer), transportation cost (car owner or not) and size of a household (the potential benefits about the low prices are larger if the number of people in the household increase) (Aalto-Setälä 2000).

[74] If the consumers have incomplete information about the prices of the products between different retailers as result of the incapability of the information processing (see the bounded rationality in Chapter 1.2), this kind of presented study would have a great value for consumers.

Our study also illustrated the prices of grocery retailers being higher in Helsinki and its neighboring towns. The higher costs (i.e. rents, salaries) as well as the higher incomes of buyers can partly explain this geographical price difference (cf. Aalto-Setälä 2002).

The study is important both for retailers and consumers because retailers want to benchmark their price level against their competitors. After benchmarking the retailers can consider if they should adjust their price level in order to improve their overall financial performance or their pricing position compared to that of competitors. On the other hand, consumers would be interested in our study because they want to find the cheapest grocery retailers and earn the highest value for their money in their geographic area.

5.2.3 Model 6 – Scenario analysis of retailers' pricing positions

Model 6 uses Model 5 for scenario analysis and thus cluster identification is already presented in Chapter 5.2.2.1. Model 6 uses six retailers from the same town for the scenario analysis. The presentation of Model 6 starts by describing the retailers. The analysis part starts by presenting the results in a case when all the product prices are changed. We also present an example where the retailer is able to change its pricing position by changing its the prices of milk products.

5.2.3.1 The description of selected retailers

Because the purpose of the study is to illustrate how changing pricing policy affects the position of a retailer, we will focus on some retailers. The illustrations focus on the retailers in one town[75] because our database includes several competitors from different retailer groups in that town. The chosen retailers also had close locations and were of quite the same size, which gave another reason to focus on these retailers.

The database contains six retailers in the selected town. Their grocery products turnover is between EUR 2 million and EUR 16 million. Four retailers of six, i.e. 53, 54, 55 and 56, are over median size retailers in the Finnish grocery industry and all of them belong to different groups of retailers. We do not know the size and group of 57 but we assume it is quite a small retailer because we can estimate the size of the retailer by the location of 57. 58 is a small retailer and it is in the same group with 56.

[75] We do not have possibility to mention the name of the town due to the data confidentiality

Retailers 53 and 55 belong to different groups and are geographically very close to each other. 53 and 55 also have the same turnover and can therefore be considered to be competitors. Retailer 54 is located at a distance of some kilometers from 53 and 55 but 54 is a competitor for 55 because they have almost an equal turnover of grocery products. The closest geographical competitor for 54 is 56 with a distance of less than three kilometers. On the other hand, retailers 57 and 58 are also close competitors since they have quite the same turnover and are located in the same area; the distance between the retailers is less than three kilometers. The closest competitors of 56 are 53, 54 and 55 within a distance of some kilometers.

We limited the maximum prices of the products in the analyses so that they could not exceed the maximum price of that product after the rise of the product price. Thus if the price of the product has been raised by some retailer by 10 percent in the analyses then a price can exceed the maximum price of that product and this exceeded price has been adjusted so that it does not rise over the maximum price of the product in the whole dataset. The same limitation method was applied to reduced prices.

5.2.3.2 Changing prices of all the products

In this subchapter, we illustrate the movements in price positions if the changing pricing policy affects all the products. This means that the prices of all the products have been raised or reduced in the illustration of Figure 26.

First we investigate what will happen to the original position (see cluster F_2) if the cheapest retailer 55 (white solid arrows in Figure 26) is planning to raise the prices of all its products. We can see that if all the prices of retailer 55 are raised only by three percent, retailer 55 will move to more expensive Cluster F_1. This is interesting because if 53 (black solid arrows; originally in cluster E), competitor of 55, is planning to reduce its prices at the same time by three percent they will end in the same cluster F_1. On the other hand, if retailer 53 is able to reduce its prices by seven percent, this will drive 53 to the same cluster with the original price position (F_2) of 55. Therefore, the situation of 55 seems to be quite safe because not until a seven percent reduction in the prices of 53 and 54 (ten percent decrease in 56; white dashed arrows) will make them close price competitors to 55.

Finally, we see the movement if retailer 58 (A_2) is able to reduce its prices by 10 percent. This 10 percent reduction moves 58 (white dashed arrows with the number 58) to be a price competitor to 54 (black dashed arrows, originally in cluster E) if it decides to raise its prices by five percent at the same time. We can also see that if 57 (black dashed arrows with the number 57, originally

in cluster B) reduces its prices by 5 percent it moves quite far away from its geographical competitor 58. This five percent drop moves 57 to the same cluster with 53 (E). If 57 is able to reduce its prices by 10 percent it will move to the cheapest cluster (F_2). Figure 26 clearly illustrates that the decrease in price level affects the position of 57 much more than that of 58. We also observe the unfavorable situation of 58 (originally in cluster A_2) because at least a 10 percent reduction in the prices would move 58 to the cheaper cluster but already a three percent rise of the prices moves it to the more expensive cell. Therefore, it seems that if 57 can reduce its prices, the effects would be more favorable than in the case of its close competitor 58.

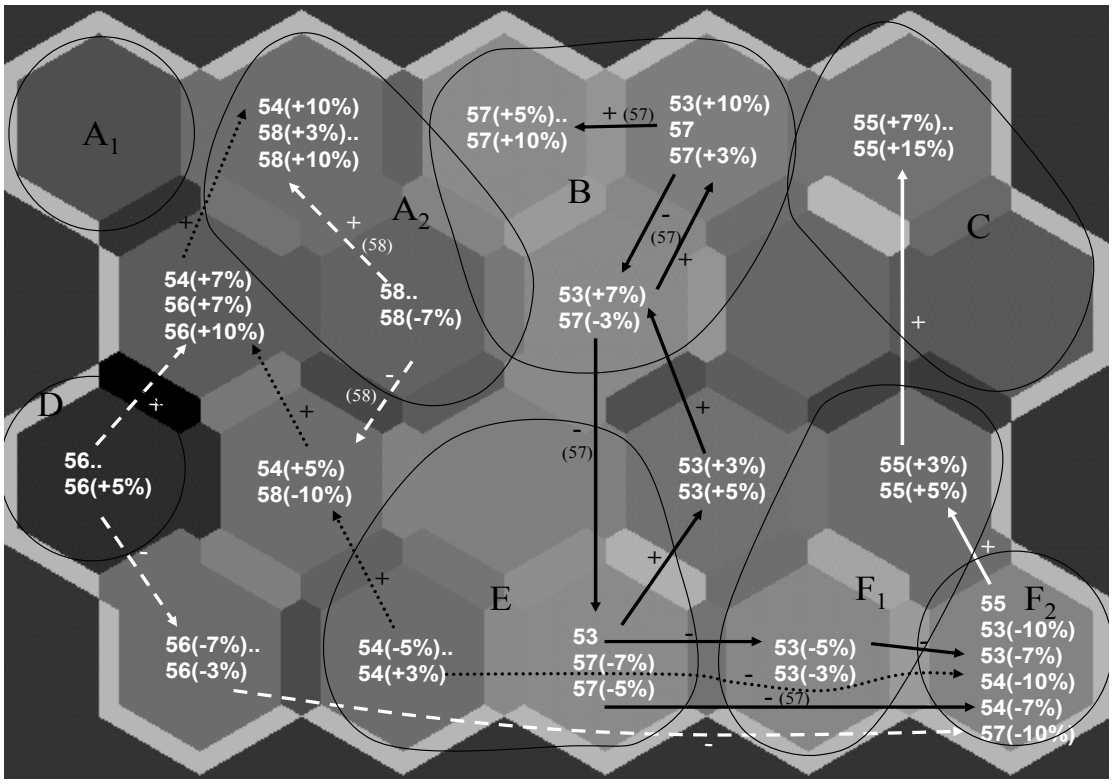


Figure 26: Retailer pricing position after changing all the prices

Figure 26 shows that a seven percent increase in the prices of 53 brings it to the same cluster with 57 (B). Their geographical distance is only a few kilometers and this possible rise in the prices may stimulate customers with high price sensitivity to change their grocery retailer. The situation of retailer 54 (originally in cluster E) is quite amazing and unfavorable because if it changes its prices between –5 and +3 percent its location does not change. Then only a seven percent reduction in prices will bring 54 to the cheapest cluster (F_2). On the other hand, a ten percent raise of prices brings 54 to the second most expensive cluster (A_2). Next subchapter focuses on the changes of milk product group and its effect on the price positions of the retailers.

5.2.3.3 Changing prices of milk products

Figure 27 illustrates a situation where the prices of milk products (i.e. products 55-65 in Appendix 1) have been changed and all the prices of other products have stayed on the original level. In general, we observe the changes on the map being smaller (although the product group specific price level changes are larger) in Figure 27 than in Figure 26 as a result of the changes in the smaller number of product prices.

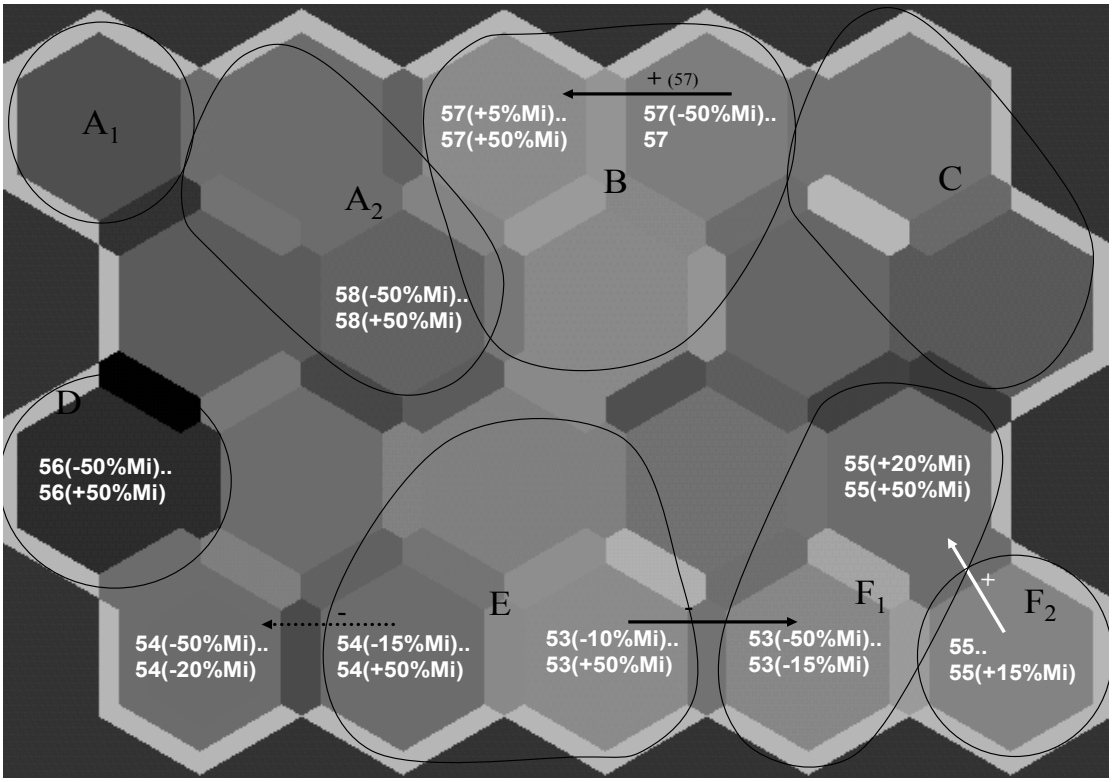


Figure 27: Pricing positions after changing the prices of milk products

Figure 27 shows that the cheapest retailer 55 (F_2) can raise milk product prices even 15 percent and still remain in the cheapest cluster. On the other hand, retailer 53 has to reduce its milk product prices by 15 percent to change its location closer to retailer 55. It is amazing in Figure 27 that if retailer 54 reduces the prices of milk products by 20 percent, its location changes to the opposite direction that would be expected by Figure 26. We verified this surprising movement from the feature planes of milk products (they are not presented in this study) and noticed the reliability of the movement. We can also see that if 57 raises the prices by only five percent it will achieve almost the price level of its competitor retailer 58 (A_2). Finally, Figure 27 shows that retailers 58 and 56 cannot change their positions by decreasing or increasing only their milk product prices.

5.2.3.4 Conclusions of pricing position scenarios

Model 6 illustrated some possibilities to change the strategic pricing position. The scenarios were performed with six Finnish grocery retailers which are located in the same town. As would be expected the greatest movements are achieved by changing the prices of all products. This kind of a total change can be very difficult to conduct in practice since the position can also be moved by doing minor changes in specific product groups. Therefore, we showed how the pricing position changes if the milk product prices are changed. The study also showed that not all the product pricing policy changes affected the price positions of retailers, which emphasizes the importance of individual analyses of each retailer. Some pricing policy changes did not affect the position at all and some larger changes did not affect the position any more than minor changes had already done. However, in some cases even minor pricing policy changes affected the position of the retailer. This shows clearly that some retailers have fewer possibilities to change their pricing position by reducing grocery product prices than others.

We also found that if a retailer is planning to raise the prices of one product group, it should consider the plans of the competitor retailers so that they do not move close to one another unexpectedly. This kind of assessment has connection to three forms of SMA, i.e. competitor accounting, strategic pricing and target costing. In the field of competitor accounting Model 6 focused on competitive position monitoring. On the other hand, Model 6 focused on competitor price reaction in the field of strategic pricing (cf. Guilding et al. 2000). In the field of target costing, Model 6 analyzed the the possibilities and needs of retailers to change their pricing policy. To conduct this kind of price reaction analysis, the accountants of retailers should analyze the cost structure of their competitors (Guilding et al. 2000 see also Grundy 1992), competitors' possibilities to reduce the prices or the competitors' pressures to raise the prices of their products as a result of unprofitable business. These kinds of assessments can be very difficult to conduct in practice.

We propose that accountants should produce earlier presented illustrations because they know the cost structure of the company. Therefore, accountants can estimate, first, how possible it is to improve the cost structure and, second, how much costs it is possible to cut to achieve the desired price position of the retailer. Accountants can also make action plans so that the desired price level could be achieved. On the other hand, we also think that if accountants provide the presented price sensitivity illustrations it will be valuable information to the marketing managers (cf. Foster & Gupta 1994) who have not been satisfied with the information produced by accountants.

5.3 Comparison between macro and industry environment

In this chapter, first we describe the motivation of the comparison. Second, we compare Models 3 and 4 and finally we draw conclusions of the comparison.

5.3.1 Introduction to the comparisons

This section shows how the SOM can be used to investigate if the industry level movements can be explained by the macro level movements. This comparison is partly based on the McGahan and Porter (1997) and Hawawini et al. (2003) findings that the macro level and industry level factors affect the performance of companies. Because we did not have firm level data we focus next only on the macro and industry level comparisons. The second motive for our comparisons is given by Hornstein (2000) and Cuadrado-Roura and Ortiz V.-Abarca (2001) studies. They found that industries move jointly with economy and with other industries. The weaknesses of Hornstein's (2000) and Cuadrado-Roura and Ortiz V.-Abarca's (2001) studies are the analyses of only one economy (former the US and latter Spain) and its industries. We avoid these weaknesses by focusing on several countries simultaneously although we focus only on the pulp and paper industry.

The comparisons are based on Models 3 (macro level) and 4 (industry level) and thus we do not present these models anymore and focus only on the comparisons of the movements. Feature planes are used to explain the causes for the movements. The feature planes can be found in the earlier analysis of this dissertation.

The movements of Models 1 and 2 were compared also against the movements of Model 4. The results concerning the comparison between Models 1 and 4 are presented in the Workshop on Self-Organization Maps (Länsiluoto et al. 2003a) and between Models 2 and 4 in PulPaper 2004 Conference (Länsiluoto et al. 2004). Next we compare the movements between Models 3 and 4. The last comparison can be found from Länsiluoto (2003b).

5.3.2 The comparison of movements between Models 3 and 4

This chapter investigates if the movements occur at the macro and industry levels simultaneously. We investigate the movements in Models 3 and 4. In Figures 28a and 28b we can observe simultaneous movements (solid lines and circles) both at the macro (Figure 28a) and industry (28b) levels although there

are also individual movements (dashed lines and circles) that can be seen only from the other map (e.g. the huge Finnish movement at the macro level in 1994 cannot be identified from the industry level). The black circles and arrows illustrate the European countries (FIN, GER, FRA & SWE) and white the North American (the USA & CAN) and the Japanese movements.

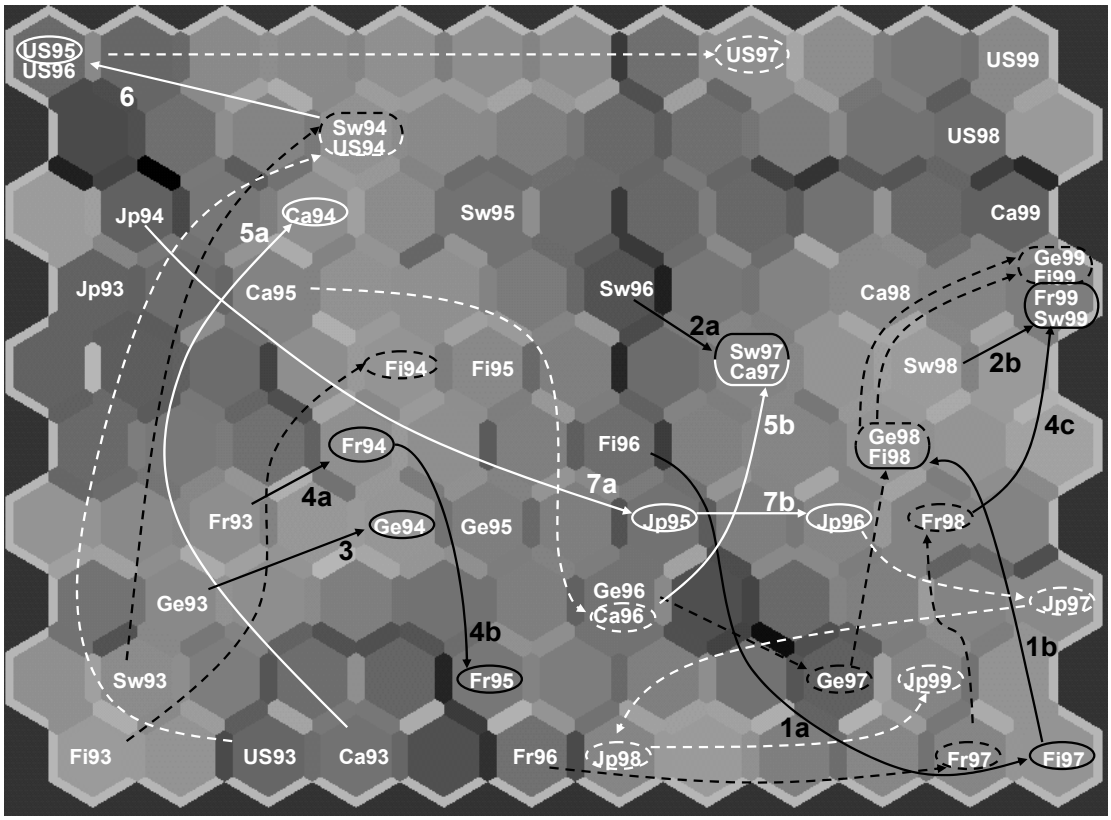


Figure 28a: The movements at the macro level in 1994-1999 (i.e. Model 3)

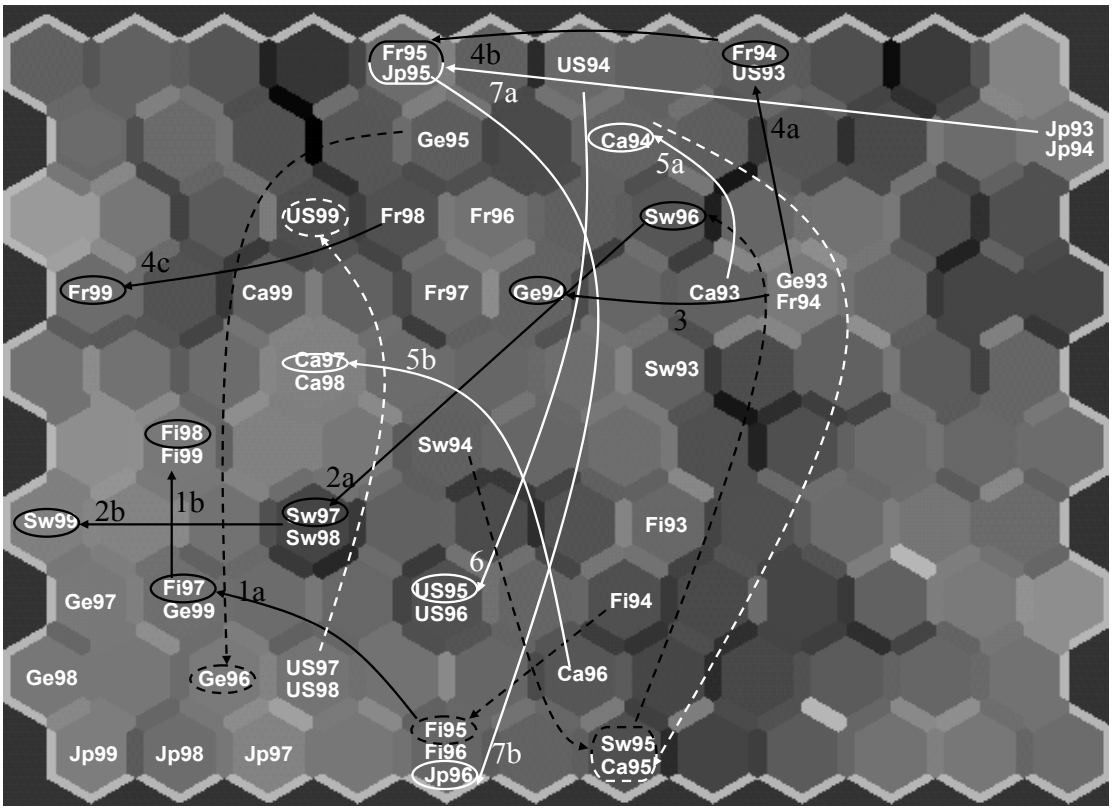


Figure 28b: Movements at the industry level in 1994-1999 (i.e. Model 4)

Figures 28a and 28b show four simultaneous and six individual movements in the Finnish (see the black 1 numbers in Figures 28a and 28b) and the Swedish (black 2) macro and industry level trends. The Finnish simultaneous movements occurred in 1997 and 1998. The reasons for the first Finnish simultaneous movement (black 1a) were the increase of all macro level variables (especially the drastically weakening Finnish mark against US dollar) and the decreased costs and increased productivity at the industry level. The last Finnish simultaneous movement occurred in 1998 (black 1b) when all the production oriented variables, except decreasing leading indicator, and stock market index increased at the macro level and the increase of annual working time by reaching the Finnish highest level at the industry level. There was also one huge individual macro movement in Finland in 1994 that cannot be seen from the industry level. The reason for this individual movement is the increasing of all variables and especially the strongly strengthening Finnish currency. Finally, there is one Finnish industry level movement in 1995 that cannot be observed at the macro level.

In Sweden we can see the first simultaneous movement in 1997 (black 2a) because all the variables increased and especially the Swedish currency strengthened drastically at the macro level. The industry level movement is caused by the decreased costs, increased productivity and annual working time in Sweden at the industry level in 1997. The first huge Swedish individual

movement occurred in 1994 when all the productivity ratios and interest rates increased slightly and the currency strengthened strongly. On the other hand, we can find two individual industry level movements in 1995 and 1996 although the macro level indicates also some minor movements in these years. The second simultaneous Swedish movement (black 2b) occurred in 1999 (cf. the Finnish individual macro movement at the same time) because all the production related variables increased, the currencies weakened drastically and stock market index increased rapidly at the macro level. Decreased working time, total and unit work costs and increasing production (except raw material) caused the simultaneous movement at the industry level in that year.

If we are looking at the German and French trends in Figure 28 we observe four simultaneous and six individual movements. The one and only German simultaneous movement occurred in 1994 (black 3) because the DEM strengthened against the USD, interest rates decreased and all the rest of the macro variables increased. The increased productivity ratios and the decreasing cost variables (excluding raw material) and output to input price ratio caused the industry level movement. Figure 28a shows three German individual movements at the macro level in 1997-1999. The last German individual movement occurred at the industry level during 1996 by Figure 28b. You can verify also a minor movement at the macro level at the same time.

The French trends show three simultaneous movements at the macro and industry levels. The first simultaneous movement occurred in 1994 (black 4a) due to the macro variables, especially the productivity variables increased and the Franc strengthened against the USD. The simultaneous movement at the industry level can be explained as well by the increase of raw material costs and productivity ratios as the decrease of labor costs. The second French simultaneous movement occurred in 1995 (black 4b) when interest rates, leading indicator and retail sales dropped, and the Franc against US dollar strengthened. The cause for the movement was the increase of all the other variables except the decreasing cost of unit work and productivity of raw material at the industry level. The last French simultaneous movement occurred in 1999 (black 4c) because all the macro variables increased drastically, except interest rates which remained on almost an equal level. This huge movement can be seen also at the industry level because productivity and output input price ratio increased and total unit cost and raw material unit price decreased. Finally, we are able to observe two French individual macro level movements in 1997 and 1998 from Figure 28a.

Figure 28 shows three simultaneous and five individual movements in the USA and Canada. The first Canadian simultaneous movement occurred in 1994 (white 5a) when the Canadian dollar weakened against the USD, interest

rates and all the other macro variables increased. The cause for the industrial level movement was the decrease of total input costs and unit work and the increasing productivity ratios and raw material prices. The second simultaneous movement occurred in 1997 (white 5b) since the Canadian dollar weakened against the US dollar and all the other macro variables increased. The reasons for the 1997 movement were the decrease of output input price ratio and unit price of raw material as well as the increase of work input price and all the productivity ratios at the industry level. The first individual Canadian macro level movement occurred in 1996 as the result of the decreasing interest rates. The secondary reason for the movement was the increase of other macro variables. The final individual Canadian industry level movement occurred in 1995 since the costs (except unit price of raw material) dropped heavily, both output/input price ratio and annual working time increased.

The US simultaneous movement occurred in 1995 (white 6). This movement occurred due to the increase of all the variables except the interest rates and the weakening US dollar against the euro. At the industry level a huge movement occurred also in 1995. The movement was caused by the increase of the productivity ratios and the decrease of cost ratios. The first US individual movement occurred in 1994 as a result of the increase of all the macro variables and especially interest rates. The movement of 1994 can be seen also at the industry level but it is not as huge as the macro level movement. The last two individual movements can be seen in the USA in 1997 (macro level) and 1999 (industry level). The US macro level movement occurred in 1997 because all the variables increased and the US dollar strengthened against the euro. The last individual movement occurred in 1999. This was due to the increase of all the variables at the industry level in the USA.

Finally, we analyze the Japanese macro and industry trends. Figure 28 shows two simultaneous and three individual movements in Japan in the studied period. The first simultaneous movement occurred in 1995 (white 7a) due to the drastically decreasing interest rates and increasing other macro variables. On the other hand, the industrial level movement is caused by the slightly decreasing costs (except raw material) and increasing productivity ratios. The second Japanese simultaneous movement occurred in 1996 (white 7b) as a result of the weakening Yen against the USD and the increase of all the other macro variables (except interest rates). The decreasing level of cost variables caused the Japanese industry level movement at the same time. Finally we can observe three individual macro level movements in the years of 1997-1999 which cannot be observed from the industry level clearly.

5.3.3 Conclusions of macro and industry level movements

In the above subchapter we illustrated how self-organizing maps can be used to analyze the competitive environment simultaneously at the macro and industry levels. The study contributes to the strategic management accounting literature (Guilding et al. 2000) by focusing also on the macro level analysis. The performed analysis is difficult to conduct without computational tools in today's information rich era where the problem is to get a fast and correct overview of the huge databases. It is important to conduct the illustrated competitive business environment analysis if we are, for instance, evaluating companies' financial performance, estimating the opportunities and threats of their environment or learning the complicated relations at the different levels of the competitive business environment. Therefore, the possible users of the analysis are people operating in the forest industries such as shareholders, managers, employees, suppliers, financial partners, stockbrokers and economists.

The results show the importance of multilevel analysis in the strategy process because we could observe simultaneous macro and industry level movements (cf. Hornstein 2000 and Cuadrado-Roura & Ortiz V.-Abarca 2001). On the other hand, we also found individual movements both at the macro and industry levels and this seems to indicate also other reasons for the industry level movements than only the macro level changes. The earlier analyses expanded Hornstein's (2000) and Cuadrado-Roura and Ortiz V.-Abarca's (2001) studies by including several nations and their pulp and paper industry comparisons.

6 EVALUATION OF THE SUITABILITY OF MODEL 3 FOR TREND ANALYSIS

The purpose of this chapter is to assess the suitability of self-organizing map (SOM) technique for trend analysis by surveying managers' opinions about the usefulness of Model 3 for strategic environment analysis. The survey is conducted in the Finnish publicly noted companies. We start by a brief theoretical introduction to the evaluation of Model 3. We present the results and draw conclusions of the evaluation at the end of the chapter.

6.1 Theoretical background of the user evaluation of Model 3

In this chapter we evaluate the viability of Model 3. Model 3 can be understood as a product of an information system, i.e. self-organizing map. The success of an information system is not easy to define and determine. Delone and McLean (1992) defined six categories of information system success after a huge literature review. These six categories are compared to the Shannon and Weaver's three hierarchical levels of communication problems: technical (how well the system transfers the symbols of communication), semantic (how the interpretation of meaning by the receiver correlates with the intended meaning of the sender) and effectiveness (how the meaning conveyed to the receiver affects actual behavior) (Rai et al. 2002). The six categories of Delone and McLean (1992) are system quality, information quality, information use, user satisfaction, individual impact and organizational impact. Seddon (1997) respecified the categorization of Delone and McLean (1992) with adding expectations, consequences of IS use, perceived usefulness and net benefits to society into the categorization. The categories of Delone and McLean (1992) are presented in Figure 29. Double lines emphasize our focus on the evaluation of Model 3, i.e. information quality and user satisfaction.

Shannon & Weaver (1949)	Technical Level	Semantic Level	Effectiveness or Influence Level			
Mason (1978)	Production	Product	Receipt	Influence on Recipient		Influence on System
Categories of I/S success	System Quality	Informat. Quality	Use →	User Satisfact.	Individ. Impact	Organiz. & Societal Impact

Figure 29: Categories of I/S success (adapted from Delone and McLean 1992)

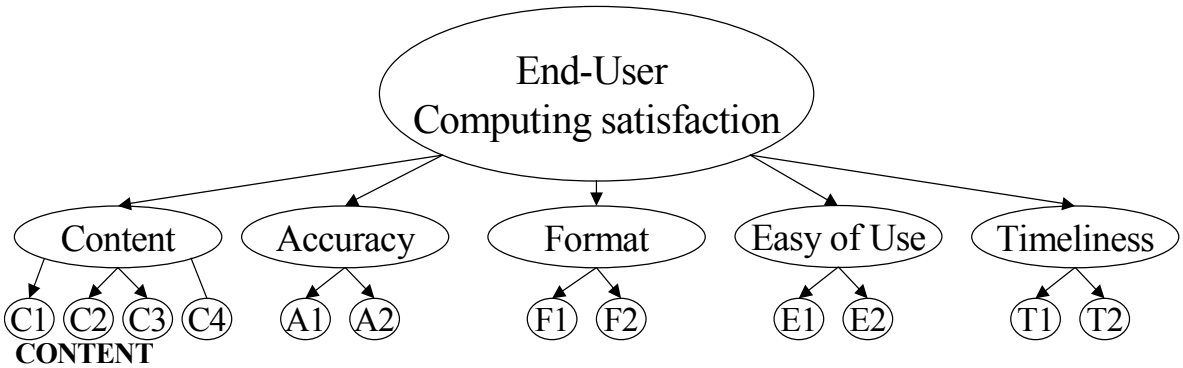
As Figure 29 shows, the current study focuses on the evaluation of information quality and user satisfaction. System quality issues are of minor interest to the current study because we have not developed the SOM technique. On the other hand, the constructed Model 3 is not currently used, which does not enable us to ask the frequency of the utilization or individual, organizational and societal impacts. However, drawing upon bounded rationality (see Chapter 1.3) we included some speculative questions concerning the possible impact of strategic decision making on the individual if Model 3 would be presented to a decision maker. Figure 29 shows information quality preceding user satisfaction, i.e. high information quality enables higher user satisfaction (Delone & McLean 1992) which is indicated by the bold arrow.

One focus of the evaluation is to measure user satisfaction concerning Model 3. It is measured because user satisfaction can indicate the utilization of Model 3 (Doll & Torkzadeh 1988 and Rai et al. 2002), especially if the utilization is voluntary. On the other hand, the concepts of user satisfaction or user information satisfaction are the most widely used measures for the success of an information system (Delone & McLean 1992).

Another evaluation focus is on information quality. It is important to be measured because information quality has a greater impact on the perceived usefulness than ease of use (Rai et al. 2002). Therefore, if the respondents perceive information quality good then the possibility to use the evaluated Model 3 would improve. Information quality means that information is understood as a product and subsequently this product is evaluated by the characteristics like accuracy, meaningfulness and timeliness (Delone & McLean 1992).

Doll and Torkzadeh (1988) have constructed a framework which focuses especially on the information quality issues. The framework includes only 12 questions which are divided into five dimensions. All these five dimensions affect end-user computing satisfaction. The dimensions are content (measured with four questions), accuracy (two questions), format (two questions), ease of use (two questions) and timeliness (two questions). The evaluation of Model 3

is based basically on the framework of Doll and Torkzadeh (1988) and, hence, their framework is presented in Figure 30.



CONTENT
C1: Does the system provide the precise information you need?
C2: Does the information content meet your needs?
C3: Does the system provide reports that seem to be just about exactly what you need?
C4: Does the system provide sufficient information?
ACCURACY
A1: Is the system accurate?
A2: Are you satisfied with the accuracy of the system?
FORMAT
F1: Do you think the output is presented in a useful format?
F2: Is the information clear?
EASE OF USE
E1: Is the system user friendly?
F2: Is the system easy of use?
TIMELINESS
T1: Do you get the information you need in time?
T2: Does the system provide up-to-date information?

Figure 30: End-user computing satisfaction (Doll & Torkzadeh 1988)

Also other frameworks for the measurement of user satisfaction have been developed (e.g. Bailey & Pearson 1983 and Ives et al. 1983). Bailey and Pearson (1983) developed a framework with 39 factors. Ives et al. (1983) revised this framework when they shortened Bailey's and Pearson's framework (1983). The framework of Ives et al. (1983) measures general aspects of user satisfaction such as relationship with EDP staff, processing of request for system changes or top management involvement. The framework of Ives et al. (1983) includes also some similar aspects with Doll & Torkzadeh (1988) such as accuracy and timeliness. The method of Ives et al. (1983) is not as good as Doll and Torkzadeh (1988) for the purposes of our study because we want to focus on the information product itself and Doll & Torkzadeh (1988) have more questions to measure user satisfaction concerning this product.

We had also other reasons to choose the framework of Doll and Torkzadeh (1988) for the user satisfaction evaluation of Model 3. First, the framework has been used also in several other studies (Adelakun 1999, Chen et al. 2000, Gelderman 1998, Gordon & Geiger 1999, Rai et al. 2002 and Seddon & Yip 1992). Second, Seddon and Yip (1992) concluded the framework of Doll and Torkzadeh (1988) being more useful than the framework of Ives et al. (1983) if the user satisfaction is measured in the context of general ledger systems. Finally, Doll and Torkzadeh's (1988) framework focuses on the produced information and its usefulness from the user point of view.

In the following subchapter we present the results of the Model 3 evaluation. The evaluation is primarily based on the framework of Doll and Torkzadeh (1988). However, we added some additional questions into five dimensions to improve the quality and specificity of the evaluation. The survey process of the current macroeconomic analysis methods is described in the beginning because participants of the evaluation of Model 3 were chosen by using the results of the survey.

6.2 Survey process of the current macroeconomic analysis methods

The state of the art survey concerning current macroeconomic analysis methods was conducted in the Finnish publicly noted companies. There were several reasons to focus on these companies. First, we wanted to select international companies because we considered these companies being the most affected by changing macro level factors. We assumed that international companies would posses the greatest interest to conduct the macro environment analysis. Second, we wanted to investigate larger companies because we thought that they have the largest resources to conduct environment analysis (cf. Aguilar 1967, 50-53 and Stoffels 1994, 15). Third, the Finnish publicly noted companies have legal responsibility to inform their shareholders of the estimation of business prospects in their financial statements. This causes the companies pressures to analyze the macro environment more specifically. Finally, we thought that it is easier to get contact information from the public companies because they have usually fairly good web pages.

The state of the art survey process was the following. First, we[76] called all the Finnish public companies that were noted at the main list of HEX. 103

[76] The survey was conducted together with Lic.Sc. (Econ) Tomas Eklund who was interested in the benchmarking of financial ratios. I called to the Finnish public companies together with Tomas Eklund. B.Sc. (Econ) Stefan Lindholm programmed a web-based survey at Åbo Akademi University.

public companies were on the list in the September 2003. We tried to contact the manager of business intelligence or the corporate development department. We assumed that they would have the best knowledge about the state of the art of the environment analysis at the company. If the company did not have these kinds of departments, we contacted the department of finance and business administration. During this call we briefly presented the purpose of the survey. We promised that all the respondents would have possibility to get a summary of the results. We also asked if the respondent would prefer web-based or traditional post-based survey. All the respondents requested the web-based survey. During the call ten companies said that they did not have time or interest to participate in the survey. Finally, 93 companies volunteered to participate in the survey.

In the second phase of the survey process, we sent the first e-mail to the contact person on the 23 October 2003. This e-mail included one link to a web page where a brief project description and a three-part questionnaire was available. The first part of the questionnaire handled financial benchmarking issues. The second part[77] was focused on the macroeconomic environment analysis. In the last part of questionnaire we asked the willingness of the respondent to take part in a demonstration and evaluation of the self-organizing map (SOM) in a financial benchmarking and macro environmental analysis application. This final part also included the possibility to give the contact information of the respondent, if the respondent was interested in the results of the survey or interested in taking part in the demonstration and evaluation of two SOM applications. After our first e-mail we received 18 answers to the macro environment part of the expert survey.

We sent the second e-mail to those respondents who did not reply to the first e-mail on 12 November 2003. After the second e-mail we received four more answers to the macro environment analysis. The second e-mail gave four more persons who said that they did not have time to take part in the survey. Furthermore, one person said that she had forwarded the e-mail again to the person who was responsible for business development. The forwarding person was afraid of that the business developer would not have time to take part in the survey. The third and final e-mail notification was sent on 3 December 2003 to those who had not participated. We received three more answers after that. We did not get any other information (such as e-mail reply) why the other persons had not answered the questionnaire. The final number of respondents in the macro environment part was 25 (24.3%).

[77] Appendix 2 includes the questionnaire concerning current macro environment analysis methods.

6.3 Evaluation process of Model 3 in the Finnish public noted companies

Subjects for the evaluation of Model 3 were selected in the expert survey of current macroeconomic environment analysis methods[78]. In this survey one question asked the willingness of the respondent to take part in the self-organizing demonstration and evaluation project. In this question also the contact information was asked so that we were able to send the summary of the results. We received contact information from 25 respondents and all the respondents were from different companies. 10 of 25 respondents did not want to take part in the project. 5 of 25 respondents wanted definitely to take part and 9 of 25 respondents wanted possibly to take part in the project. We contacted all the respondents who definitely or possibly wanted to take part in the project. There was still one respondent who did not answer if he wanted or not to take part in the project. We contacted also him. Therefore, the number of contacted respondents and companies was 15.

We managed to arrange a demonstration and evaluation with 13 (of 15) companies. The two companies not participating had answered possibly in the survey, whether to participate in the project or not. When we agreed about the day of the evaluation with a company, we informed them that all the people responsible for business intelligence or corporate development tasks were welcomed to the evaluation. 39 persons participated in the evaluation project, from one to seven respondents per company[79].

The evaluation process took about two hours and had the following outline. First, I presented the purpose of the evaluation and demonstration. Second, Lic. Sc. (Econ.) Tomas Eklund presented the basic idea of SOM and the application areas where it has been used before. Third, two of our SOM applications were presented, one for financial benchmarking of the Finnish forest industries companies (presented by Tomas Eklund) and the other for analyzing macroeconomic environment (Model 3 presented by Aapo Länsiluoto). Finally, the respondents evaluated the models with a questionnaire[80]. The filling of the questionnaire took about 20-30 minutes. We recommended respondents to fill the questionnaire immediately after the presentations. However, ten respondents asked for the possibility to return the questionnaire by mail after the evaluation because they did not have enough

[78] Länsiluoto (2004) reports these results.

[79] Five companies had only one participant (1 respondent did not mention the name of the company). The other companies had more participants.

[80] Appendix 3 presents the questionnaire concerning the evaluation of Model 3. This appendix does not include questions between 3 and 7 because the focus of the questions is on the financial benchmarking (Tomas Eklund's model). Questions 3-7 are exactly similar to questions 8-12 but the earlier questions are focused on the benchmarking model instead of macroeconomic model.

time to complete the questionnaire immediately after the demonstrations. We accepted the requests. Unfortunately, we did not manage to get three questionnaires although we requested these questionnaires several times by e-mail and telephone. Therefore, the final number of respondents in the evaluation was 36.

6.4 Respondents' background information

In the state of the art survey concerning the current methods for the macroeconomic environment analysis we asked if the respondent had heard about the technique of self-organizing maps. We gave two alternatives (yes and no). 10 of 25 (40%) respondents had heard about the SOM. Two were knowledgeable about the news map of Kohonen's laboratory (i.e. Honkela et al 1998 and Kaski et al 1998a), two knew an application concerning customer relationship management and one knew a dissertation. The rest of the respondents with the SOM knowledge did not specify the application. In brief, some respondents had some kind of knowledge about the SOM before the evaluation although the knowledge was not very detailed and professional.

Next we explain the background information of the respondents. The respondents' position and work experience and information technology experience are described. We also characterize the respondents' perception concerning the environment turbulence and frustration concerning the amount of information.

6.4.1 Position and work experience

Three of 36 respondents did not give any background information. 5 of 36 respondents did not describe their positions in the company. Thus, we had information about the positions from 31 respondents. 11 of 31 respondents were analysts, i.e. market, corporate development, business analyst. 15 of 31 respondents were managers, e.g. business development manager, CFO, head of department, or vice president.

Five of 36 respondents did not mention their department and subsequently we had the information from 31 respondents. 9 of 31 respondents were exactly from the business intelligence department. Still 5 of 31 respondents were from some kind of synonym department for the business intelligence, i.e. corporate analysis, business development. The people of business intelligence were also working in other departments such as marketing, various business divisions or corporate headquarters.

Three of 36 did not mention their education and thus we had 33 responses to the question. 29 of 33 respondents had university degree education, one out of which was a PhD degree. Two respondents had bachelor level education.

We also received information about the work experience from 32 respondents. The respondents' average number of years in the current company was 7.8 years. Because some respondents had been over 20 years in the same company, the standard deviation was high (8.6). The median of work experience was 4.

Also 32 respondents gave information about the years in their current position in the current company. The respondents had been in the current position in the current company 3.6 years on average. Median was 2 and standard deviation was again high (4.1). 29 respondents had been in a similar position in their entire career 5.8 years on average. Median was 4 years and standard deviation 6.6 years. We investigate the information technology experience of the respondents in the following chapter.

6.4.2 Information technology experience

13 of 36 respondents used information technology (IT) themselves. 2 of 36 respondents used reports which were generated by others, i.e. indirectly used. The majority of the respondents, 23 of 36, said that they use IT as a combination of the two earlier alternatives, i.e. indirectly and directly use IT. Because one respondent marked all the three alternatives, the number of the respondents for the question is higher than the total number of participating respondents.

Next, we investigate the frequency of usage of different IT tools. The scale[81] of the question was from 1 (Daily) to 6 (Never), i.e. the lower average indicates the more frequent usage of the tool. Table 9 reports the results.

[81] The scale was the following: 1=Daily, 2 = A few times per week, 3 = A few times per month, 4 = A few times per year, 5 = More rarely, 6 = Never

Table 9: The frequency of usage of IT tools

	Average	*Median*	*STD*[82]	*N*[83]	*Never*[84]	*Daily*[85]
Word processing	1.25	1	0.500	36	0	28
Spreadsheets	1.44	1	0.773	36	0	25
E-mail	1.00	1	0.000	36	0	36
Calendars	1.31	1	0.787	36	0	29
Databases	2.00	2	1.095	36	1	14
Internet	1.00	1	0.000	36	0	36
Decision support systems	3.73	4	1.645	33	6	3

Table 9 shows that e-mail and internet are the most frequently used IT tools because all the respondents used these tools daily. Also word processing, calendars and spreadsheets were used frequently, over 25 of 36 respondents used these IT tools daily. Databases and decision support systems were used less frequently compared to the other tools. One respondent never used databases and six respondents never used decision support systems. The respondents used decision support systems more infrequently in the evaluation survey of Model 3 compared to the earlier described macro environment survey.

The respondents had a possibility to specify an IT tool which was not included in our questionnaire. We received two answers to that question. Both two respondents said they use Power Point presentations daily.

We also examined the respondents' knowledge level concerning IT tools. The scale[86] of the question was from 1 (Beginner) to 5 (Expert), i.e. the higher average or median indicates the higher level of expertise. Table 10 summarizes these results.

82 STD = standard deviation
83 N = number of total answers for the question
84 Never column indicates the number respondents who do never use the IT-tool.
85 The number of respondents uses the IT-tool daily.
86 1=Beginner, 2 = Inexperienced, 3 = Average, 4 = Experienced, 5 = Expert

Table 10: Respondents' knowledge level concerning IT tools

	Average	*Median*	*STD*	*N*	*Expert*	*Beginner*
Word processing	3.80	4	0.531	35	2	0
Spreadsheets	3.89	4	0.583	35	4	0
E-mail	4.00	4	0.492	35	4	0
Calendars	3.57	4	0.608	35	1	0
Databases	3.09	3	1.011	35	3	2
Internet	3.97	4	0.618	35	6	0
Decision support systems	2.31	2	1.030	32	1	8

Table 10 shows that respondents have the highest knowledge concerning e-mail and Internet. The respondents are experienced users of these IT tools. 6 of 35 respondents are expert users of Internet and four are expert users of e-mail. The respondents are also experienced users with spreadsheets, word processing and calendars.

Databases and decision support systems had the lowest knowledge level and the highest standard deviation. Even 8 of 32 respondents said to be beginner users of decision support systems. It seems that the knowledge of the IT tool and the usage of that tool seem to have some kind of correlation.

The respondents were able to add an IT tool into our questionnaire if it was not included in the original questionnaire. The respondents gave two answers. Both the two respondents said they had an experienced knowledge level concerning Power Point.

In conclusion of this subchapter, the respondents were more familiar with and used more frequently the basic IT tools (e-mail, internet and word processing) than decision support systems and databases.

6.4.3 Information overload and macro environment complexity

In the last subchapter discussing the respondents' background information, we report the results concerning information frustration, complexity and turbulence of macro environment. The scales were from 1 (low) to 5 (high) in all three cases. We present the results in Table 11.

Table 11: Information frustration, complexity and turbulence of macro environment

	Average	*Median*	*STD*	*N*	*High*	*Low*
Frustration[87]	3.20	4	0.994	35	1	1
Complexity[88]	4.03	4	0.785	35	9	0
Turbulence[89]	3.63	4	0.877	35	3	0

According to Table 11, the respondents were somehow frustrated with the amount of information. This frustration gives some support for the bounded rationality (see Chapter 1.3) and the need for computational assistance in the macro environment handling. Frustration statement received average value 3.2 and median value 4. Value 4 means that respondents were often frustrated with the amount of information. Finally, we observe one respondent being constantly frustrated and one never frustrated with the amount of macro environment information. Frustration statement achieved the highest standard deviation compared to the other three statements. If we compare the frustration level between the respondents of Model 3 evaluation and state of the art survey, the respondents in the evaluation of Model 3 had slightly higher information frustration compared to the respondents of state of the art survey.

The respondents perceived the macro environment somewhat complex because the average value was 4.03 and median value 4. Even 9 of 35 respondents considered macro environment very complex. The standard deviation for the complexity was 0.78. Generally, the respondents of the evaluation perceived macro environment more complex compared to the participants of state of the art survey.

Finally, we measured the uncertainty of the macro environment from the respondents' point of view. The average of the responses was 3.6 and median 4. Thus we can say that the respondents perceived macro environment somewhat turbulent. Three respondents considered macro environment very turbulent. Respondents of the evaluation also perceived the macro environment more turbulent compared to the respondents of the state of the art survey.

In conclusion of this subchapter, we found the respondents being somewhat frustrated concerning the amount of macro environment information. The respondents also perceived the macro environment somewhat complex and

[87] Scale was the following concerning the frustration: 1 = Never frustrated, 2 = Rarely frustrated, 3 = Neither, 4 = Often frustrated, 5 = Constantly frustrated

[88] Scale was the following concerning the complexity: 1 = Not complex, 2 = Not very complex, 3 = Neither, 4 = Somewhat complex, 5 =Very complex

[89] Scale was the following concerning the turbulence: 1 = Not turbulent, 2= Not very turbulent, 3 = Neither, 4 = Somewhat turbulent, 5 = Very turbulent.

turbulent. These findings support the bounded rationality theory (cf. Chapter 1.3) and some kind of complexity and turbulence of macro environment (cf. Chapter 2.4.2).

6.5 Current methods for the environment analysis

This section presents the importance of different information factors. We also investigate the respondents' satisfaction with the current methods. This section is based on the five factors of Doll and Torkzadeh's (1988) framework.

6.5.1 Importance of factors of information

First, we measured the importance of the selected factors because we wanted to see if the importance differs between factors of information (cf. Bailey & Pearson 1983). The scale[90] was from 1 (very unimportant) to 5 (very important). These results are presented in Table 12.

Table 12: Importance of factors of information for macro environment analysis

	Average	***Median***	***STD***	***N***	***Very important***	***Very un-important***
Content	4.31	4	0.718	35	15	0
Accuracy	4.14	4	0.974	35	16	0
Format	3.69	4	0.631	35	1	0
Ease of Use	3.94	4	0.765	35	8	0
Timeliness	4.14	4	0.772	35	13	0

According to Table 12, content, accuracy and timeliness are the most important information factors when companies are analyzing their macro environment. According to the results of our survey all the three factors are important factors of information. At least 13 of 35 respondents perceived these three factors very important. Table 12 shows accuracy having the highest standard deviation compared to the other four factors.

Ease of use and format factors have the lowest information importance. We have to notice that both these factors are also important because the median is 4. We can see that only one respondent perceived format of information a very

[90] The scale was the following: 1 = Very unimportant, 2 = Unimportant, 3 = Neither, 4 = Important, 5 = Very important

important factor and subsequently format has the lowest level of standard deviation (0.6) among the five factors.

The questionnaire included also one question concerning information visualization capabilities of IT tool, which is one specific form of format. The responses indicate that the visualization capabilities of IT tool in macro environment analysis are important because the average value was 4.31. Even 17 of 36 respondents answered that visualization capability is very important. If we compare the results concerning visualization and format, we can observe visualization having much higher importance compared to the general format factor.

In summary, all the information factors were considered important. On the other hand, none of the factors received any response with the lowest level of importance. If we compare these results to the results of the state of the art survey, the order of importance between the factors is similar. However, content has lower importance and format higher importance in the evaluation than in the state of the art survey if these two factors are measured by average. Next, we investigate the satisfaction of the respondents concerning the current methods.

6.5.2 Satisfaction with current methods

We used the scale[91] from 1 (strongly disagree) to 5 (strongly agree) to measure the satisfaction of the respondents with the current macro analysis methods. We constructed the questions in the form of statements, e.g. I am satisfied with the content of the current macro analysis methods in my company. Therefore, higher average means higher satisfaction with the current methods. Table 13 reports the results concerning the satisfaction of the users of the current methods.

[91] The scale was the following: 1 = I strongly disagree, 2 = I somewhat disagree, 3 = Neutral, 4 = I somewhat agree, 5 = I strongly agree

Table 13: Satisfaction with current methods

	Average	*Median*	*STD*	*N*	*Highest*	*Lowest*
Content	3.26	3	1.067	35	4	1
Accuracy	3.11	3	1.022	35	3	1
Format	3.26	3	1.010	35	3	1
Ease of Use	2.97	3	0.954	35	1	2
Timeliness	3.17	3	1.014	35	3	2

Generally, Table 13 shows that the respondents were not very satisfied with any factor of information concerning their current methods. All the averages were rather low and all the factors received at least one response with very unsatisfied value. Furthermore, one and the same respondent gave the lowest value for all the five factors. We can conclude from this that the performance of current methods can be improved by all the factors. All the factors have higher standard deviation if Table 13 is compared to the importance of the factor in Table 12.

Content, format and timeliness show the highest satisfaction level. At least 3 of 35 respondents perceived these three factors very satisfactory. We can notice that the relational ranking of format is higher in Table 13 than in Table 12. The respondents seem to be more satisfied with the factor of information format than what could be concluded by the ranking of the importance of factor in Table 12.

The ease of use gained the lowest satisfaction level the average being 2.97. Ease of use has the lowest standard deviation (0.95) and it is the only factor with standard deviation under 1. Two respondents were very dissatisfied with the ease of use and timeliness factors.

If we compare these results of Model 3 evaluation and the results of state of the art survey, we find that the respondents of both surveys were the most satisfied with content factor. The greatest difference between the two surveys is in format factor. The respondents of Model 3 evaluation appreciated the format factor of their current methods higher than the respondents of state of the art survey. The ranking of format factor was second in the former survey whereas it was the last in the state of the art survey. On the other hand, three respondents of Model 3 evaluation were very satisfied with the format whereas none of state of the art survey respondents were very satisfied with the format factor. However, if we compare the averages of format factor they are close to each other. The respondents of Model 3 evaluation were on average 0.13 more satisfied with the format factor than respondents in the other survey. In the next chapter, we focus especially on Model 3 and its suitability for trend analysis.

6.6 Model 3 suitability for trend analysis

This subchapter presents the results concerning the suitability of Model 3 for trend analysis. Although we primarily used the framework of Doll and Torkzadeh (1988) for the evaluation, we also utilized the studies of Alter (2002, 163-166), Au et al. (2002), Ives et al. (1983), Jiang & Klein (1999) and Seddon & Yip (1992). These studies enabled us to design a more specific questionnaire to better respond to the purposes of the study.

6.6.1 Content

First, we focus on the content of Model 3. Five factors measured the content of Model. The scale[92] was from 1 (strongly disagree) to 5 (strongly agree), i.e. the higher value means better content. Table 14 presents the results.

Table 14: Evaluators' opinion about the content of Model 3

	Average	***Median***	***STD***	***N***	***Strongly agree***	***Strongly disagree***
Relevant	3.57	4	0.778	35	1	0
Informative	3.51	4	0.919	35	2	1
Important	3.66	4	0.725	35	3	0
Helpful	3.51	4	0.853	35	4	0
Sufficient	3.03	3	0.785	35	0	1

Generally, Table 14 shows respondents perceiving all the five factors of content rather good because all the averages are over 3. All the factors - except sufficient - have median 4. We can conclude that the respondents somewhat agreed Model 3 being relevant, informative, important and helpful.

Importance factor has the highest average (3.66) and the lowest standard deviation (0.725) compared to the other factors. 3 of 35 respondents strongly agreed on the importance of Model 3. Four of 35 respondents strongly agreed on Model 3 being helpful.

The informative factor has the highest standard deviation (0.92). One reason for the high standard deviation is that informative factor received answers from two extremes, i.e. two respondents strongly agreed and one strongly disagreed.

[92] 1 = I strongly disagree, 2 = I somewhat disagree, 3 = Neutral, 4 = I somewhat agree, 5 = I strongly agree

The last column of Table 14 shows that only one respondent strongly disagreed with both the informative and sufficient factors. Sufficient is the only factor with median 3 (neutral). All the rest of the factors of content have higher median.

If we compare the results between Table 13 and Table 14, we find that Model 3 has higher averages in all the factors of content, except sufficient, than the methods which are currently used in the companies. We also see that the factors of content of Model 3 have lower standard deviation compared to the content of the current methods. Therefore, we can conclude that if the respondents used Model 3 instead of the current methods the satisfaction of content would increase.

6.6.2 Accuracy

Table 15 presents the results concerning the accuracy of Model 3. The original framework of Doll and Torkzadeh (1988) has only two questions relating to accuracy. We wanted to measure accuracy more specifically and subsequently we used five different factors for measuring it. The scale of the five factors was from 1 (strongly disagree) to 5 (strongly agree).

Table 15: Evaluators' opinion about accuracy of Model 3

	Average	***Median***	***STD***	***N***	***Strongly agree***	***Strongly disagree***
Reliable	3.31	3	0.796	35	1	0
Precise	3.11	3	0.796	35	0	1
Valid	3.37	3	0.770	35	1	0
Complete	3.00	3	0.767	35	0	1
Overall	3.26	3	0.741	35	1	1

Table 15 gives some support for the accuracy of Model 3 because all the factors have average three or higher. In general, the accuracy is not very high because all the factors have median 3 (neutral). All the factors of accuracy have standard deviation under 0.8. Thus accuracy has lower standard deviation than content.

Reliability and validity factors have the highest averages of accuracy. Both factors also have one and same respondent who strongly agreed on the reliability and validity of the factors. We notice that one and the same respondent gave the lowest values for three factors, i.e. precise, complete and overall.

The respondents also measured the overall accuracy of Model 3. According to Table 15, the average of overall accuracy of Model 3 was 3.26. One of 35 respondents strongly agreed on the overall accuracy of Model 3. Thus we can conclude that Model 3 is overall accurate. This overall factor has the lowest standard deviation compared to the other four factors.

If we compare the accuracy of the current systems (Table 13) and Model 3 (Table 15), we see that all the factors of Model 3, except the complete, have higher averages and lower standard deviation of accuracy than the current systems. Therefore, we claim that the accuracy improves by using Model 3 instead of the current systems.

6.6.3 Timeliness

One evaluation factor of the framework of Doll and Torkzadeh (1988) is timeliness. They have two questions for the factor. We used only one question for timeliness because it is not interesting to know if the system provides up-to-date information as a result of the fact that the respondents are not able to use Model 3 currently. Scale was again from 1 (strongly disagree) to 2 (strongly agree). Table 16 reports the results concerning timeliness.

Table 16: Timeliness of Model 3

	Average	***Median***	***STD***	***N***	***Strongly agree***	***Strongly disagree***
Current methods	3.20	3	0.933	35	1	1
Model 3	3.11	3	0.718	35	0	0

Table 16 shows respondents being more happy than unhappy with the timeliness of the information with the current methods.

The current methods are more timely compared to Model 3 because the former average was 3,2 and Model 3 average was 3,11. This is not very surprising if we remember the research period of Model 3. On the other hand, Model 3 had a lower standard deviation compared to the current methods because the current methods had one answer from two extremes.

Both current methods and Model 3 had median 3 (neutral) concerning the timeliness of the information.

6.6.4 Format

Now we investigate how the respondents evaluated the format of SOM models. According to Figure 30, the original framework of Doll and Torkzadeh (1988) includes only two factors concerning the format of information. Our questionnaire included 5 factors for the format because we wanted to use more specific factors. The scale of the factors was again from 1 (strongly disagree) to 5 (strongly agree). Table 17 reports the results of the evaluators' opinions concerning the format.

Table 17: Respondents' opinions about the format of models

	Average	***Median***	***STD***	***N***	***Strongly agree***	***Strongly disagree***
Colors (satisfactory)	3.92	4	0.806	36	7	0
Shape of model (satisfactory)	3.83	4	0.655	36	4	0
Visual representation of information (clear)	3.56	4	0.998	36	6	0
Readability of map	3.47	4	0.774	36	2	0
Overall format	3.77	4	0.731	36	5	0

Generally, Table 17 shows that the format of presented information is satisfactory because all the factors have over 3.45 averages and none of the factors has the lowest values. On the other hand, all the factors have median 4 (somewhat agree). We also see that all the factors have standard deviation less than 1.

The colors factor has the highest average. Even 7 of 36 respondents strongly agreed on the colors used in the models being satisfactory. The shape of the model received the second highest average and 4 of 36 respondents perceived this very satisfactory. The questionnaire also included also one question concerning the visual representation of the models. 6 of 36 respondents strongly agreed on the visualization being clear. Although the readability factor received the lowest average of format, the average is still over 3. Furthermore, 2 of 36 respondents strongly agreed that the models are readable. The last format factor measured the overall satisfaction of respondents. We see the respondents being somewhat satisfied with the overall format because the average is 3.77. Five of 36 respondents strongly agreed on the overall format being satisfactory.

If we compare the evaluators' satisfaction of the current methods in Table 13 and the presented models in Table 17, we observe that all the format factors of the presented models have higher averages and median than the current

methods. Furthermore, the presented models have lower standard deviation compared to the currently used methods. In conclusion, the respondents would be more satisfied with format of information if the presented models were used.

6.6.5 Ease of use

We measured the ease of use because it affects positively the frequency of the system usage (Gelderman 1998). The used framework of Doll and Torkzadeh (1988) includes originally two factors to measure the ease of use but in our questionnaire we had seven factors to measure the ease of use. Because the respondents did not have possibility to use the system by themselves, the focus of the following factors is slightly different, i.e. the easy of interpretation of the models. The scale was from 1 (low) to 5 (high). Table 18 reports these results.

Table 18: Ease of use of models

	Average	***Median***	***STD***	***N***	***Highest***	***Lowest***
Transparency[93]	3.83	4	0.857	35	5	0
Easy to perceive and analyze[94]***;***						
Comparable data	4.08	4	0.604	36	8	0
Data trends	4.03	4	0.696	36	7	0
Correlations between variables	3.75	4	0.874	36	6	0
Data clusters	4.31	4	0.577	36	13	0
Differences between data	3.39	3	0.803	36	2	0
Data values	3.08	3	0.770	36	0	0
The SOM can be conveniently used by;						
Expert user	4.43	5	0.698	35	18	0
End/business user	2.86	3	0.867	36	0	1

Generally, all the factors of ease of use have the average over 3 and standard deviation under 0.9. All the factors have median 4, except differences between data and data values. Table 18 shows that none of the respondents disagreed strongly on any of the factors of ease of use of the models.

[93] The scale of the question was the following: 1 = Very non-transparent, 2 = Somewhat non-transparent, 3 = Neither, 4 = Somewhat transparent, 5 = Very transparent

[94] The scale of the questions was the following: 1 = I strongly disagree, 2 = I somewhat disagree, 3 = Neutral, 4 = I somewhat agree, 5 = I strongly agree

The first row of Table 18 shows how well the respondents understood Model 3, i.e. transparency of Model 3. Respondents perceived Model 3 somewhat transparent the average being 3.8 and median 4. Five of 35 respondents considered Model 3 very transparent.

Our questionnaire also contained factors to measure the interpretation of the models. Table 18 shows that the averages of three factors are over 4. This indicates that the respondents somewhat agreed with the statement that by using the SOM it is easy to perceive and analyze comparable data, data trends and clusters. Even 13 of 36 respondents strongly agreed on the easiness to perceive and analyze data clusters.

Data values and differences between data have the lowest averages concerning the ease of use. These two factors are the only factors with median 3. The other factors have median 4. The data value is the only factor where none of the respondents strongly agreed with the statement of easiness to perceive and analyze.

The last two rows of Table 18 show the respondents' opinions concerning the possible user of SOM. The first row measured an expert as a possible user of SOM. The average of that factor was over 4 and median was 5. Eighteen of 35 respondents agreed strongly with the statement that the SOM can be used conveniently by the expert. The respondents somewhat disagreed with the statement that an end or business user could use the SOM because the average is 2.9. One respondent strongly disagreed that the SOM can be used by a business user. These results show clearly that an expert user is the preferable user of SOM.

If we compare Table 13 and Table 18, we observe the SOM performing better compared to the respondents' current methods. Some of the values of the factors are much higher than the respondents' satisfaction concerning the current methods. However, we have to be careful in the conclusions because the respondents did not have possibility to use the models by themselves. Therefore, it can be misleading to compare the ease of use of the current methods and ease of interpretation of the models directly.

6.6.6 Use of results

The framework of Doll and Torkzadeh (1988) has been criticized due to the exclusion of performance-oriented variables (Etezadi-Amoli & Farhoomand 1996). We solved this criticism by measuring the performance of Model 3. Performance oriented variables measure especially the decision quality (cf. Jiang and Klein 1999) and possible improvement of decision quality if Model 3 is used.

In the theoretical introduction of Chapter 6.1 we presented the framework of Delone and McLean (1992). According to Delone and McLean (1992), one possible focus of the IS research is on the individual impact. The model has individual impact if it gives better understanding of the decision context, improves decision-making productivity or produces a change in user activity (Delone & McLean 1992). This individual impact is measured in this chapter by evaluating the perceived usefulness of Model 3 (cf. Rai et al. 2002). The current chapter examines this individual impact especially from the point of view of the understanding of decision context in a case when Model 3 is used.

The importance of the evaluation of the improved understanding of decision context is supported by the findings of Jiang and Klein (1999). Jiang and Klein (1999) showed that users place more weight on the ability of a decision support system to improve the decision process than on system performance. Table 19 presents the results concerning the perceived usefulness of Model 3 for the process of decision-making. The scale[95] of this question was again from 1 (strongly disagree) to 5 (strongly agree).

Table 19: Use of results

	Average	***Median***	***STD***	***N***	***Strongly agree***
Improve the quality of a strategic decision	3.60	4	0.847	36	3
Improve the confidence of a strategic decision	3.54	4	0.780	35	3
Affect or stimulate discussion during the strategic process	4.09	4	0.818	35	12
Use of Model 3 in the strategic process	3.69	4	0.900	35	7

Generally, all the factors have average over 3.5 and median 4. Therefore, we can say that the respondents somewhat agreed on the use of Model 3. None of the respondents strongly disagreed as to the utilization of Model 3 and subsequently Table 19 does not include the column for the strongly disagree responses.

The results show that the quality of a strategic decision would improve if Model 3 was used. 3 of 36 respondents strongly agreed with the statement concerning the improvement of quality. The respondents were able to explain

[95] The scale was the following: 1 = I strongly disagree, 2 = I somewhat disagree, 3 = Neutral, 4 = I somewhat agree, 5 = I strongly agree

their answers[96]. 18 of 36 respondents explained their opinion somehow. Most comments were positive;

> "Strategic decision making in acquisitions."
> "Asiayhteyksien hallinta."
> "To create a common mindset in the mgmt teams."
> "Lack of information concerning firm level in our case on macro level. Macro economy affects overall demand."
> "Identification of patterns and benchmarks are easier."
> "Very visual presentation is very good background for discussion. More dimensions can be used simultaneously from 2.g. in graphs and tables."
> "Information in this form probably opens up new views into problems/situations."
> "It could give some information of the future if the input is correct chosen."
> "A strategic decision should be based on a balanced assessment of many criteria. A tool like SOM's could improve gaining such understanding."
> "The visualization of certain interdependencies could generate new insight into decision making."

And some comments were negative. Some respondents criticized the lack of forecasting capabilities;

> "The model seems to visualize historic development, whereas in investment planning forecasting future, and in particular stochastic, development is of essence."
> "Too complex to help or to forecast."
> "In the model there should be possibility to filter out non-recurring events. And some prediction of the future would be important."
> "Firm level strategic decisions are not necessarily a function of variables as they often reflect qualitative parameters and the wish to go for a different structure -> more complex than having just variables!"
> "The quality of strategic decision making involves a lot more than data analysis, which is a necessary ingredient but alone not sufficient."

Table 19 shows that according to the respondents the confidence of a strategic decision would improve if Model 3 was used. This is justifiable because the average is 3.5 and 3 of 35 respondents strongly agreed with the proposition. Also in this question the respondents have possibility to explain their answer. 12 respondents explained their answer. Again most comments were positive;

> "Could be easy to create a common understanding of multi-indicator environment."
> "…In macro it is easy to see trends"
> "If results from multiple analysis and methods have similarities, confidence increases."
> "Using the tool as a complementary method would surely be helpful."
> "Visual presentation takes more dimensions into account than industrial methods, and in one glance."
> "Through a deeper understanding of the situation comes confidence."
> "It could give some information of the future if the input is correct chosen."

[96] The explanation can also be related to the model of Tomas Eklund.

> “I can't think of the variables that would be suitable… maybe yes, depending on the company's operating environment.”
> “The use of SOM could provide the additional angle needed to be confident with the tools backing up the decision making.”

Respondents gave two negative comments concerning relationship between the models and confidence of the strategic decision:

> “Lack of background info. It tells you what, but not why.”
> “The choice of parameters drives the conclusions. SOM's are not meant to verify this selection of specific decision criteria.”

We wanted to know if the utilization of Model 3 would affect or stimulate discussion during the strategic process. The respondents seemed to have quite common understanding that the utilization of Model 3 would stimulate the discussion because the average was 4.1 and median 4. Table 19 shows that even 12 of 35 respondents strongly agreed with the statement concerning stimulation of discussion. On the basis of the results we can propose that one frustration of macro environment analysis (Ginter & Duncan 1990 discussed in Chapter 2.4.3.1) could be decreased if Model 3 was used in the strategy process. The respondent had possibility to explain their opinions also concerning this factor. 11 respondents wrote a comment. Most comments were positive;

> ”Varmasti, koska tilaa jää tulkinnalle.”
> ”This kind of models always raise questions and starts discussion.”
> “Presentation modes are very important, so is visualization.”
> “Results might question some things that have been considered as self-evident.”
> “Especially good for taking different viewpoints into the data.”
> “The models are very visual, so they could well stimulate discussion.”
> “It indicates and input are correct when it comes to the purpose then the same results can affect the strat. disc.”
> “New approaches force decision-makers think!”
> “Good visualization often raises new questions!”
> “Good visualization & comparison estimator.”

One respondent gave a neutral explanation, i.e. not positive or negative;

> “Depends very much on the capabilities of decision makers if they can really understand what is behind the factors.”

Finally, we measured if the respondents would utilize Model 3 in the strategy process. We received support for the utilization because the average was 3.7 and median 4. Seven of 35 respondents strongly agreed to utilize Model 3 if it would be presented in the strategy process. The respondents were able to explain their opinions also in this question. 14 respondents gave some kind of explanation. Some comments were positive:

> "Information visualised is extremely important."
> "Startingpoint to analysis."
> "These go deeper than normal analyzing, but this would take more time too."
> "They would of course be of value in any decision making process."
> "I can't think of the variables that would be used, but if relevant variables are found, then the answer is yes."
> "Definitely, if the skills needed for operating the tool are fairly easy to obtain. Should not require more than 2-3 hours of time."

Some respondents were neutral. These comments requested especially more learning before the usage of Model 3;

> "Further learning and deeper understanding would be a prerequisite."
> "Probably the models could add value to the preparatory work of strategic decision-making. The required learning time, post and general acquaintance of the methods would influence the true use."

And some negative:

> "The key question is that in our environment key issues are qualitative, no quantitative. For instance, how do you measure Microsoft, IBM or Nokia roles in ICT industry."
> "The firm level model was clearer to me than the macro level model."

In conclusion, this chapter showed the capability of Model 3 for the strategic process because all the factors of the use of results had average over 3 and median 4. The written comments emphasized, for instance, the visualization capability of SOM and the fact that the models could be used at the beginning of the strategy process. Some respondents emphasized the use of a broader set of variables when the strategic decisions are made, i.e. also qualitative variables should be used. Some respondents also requested better forecasting capabilities.

6.6.7 Summary questions

The first summary question investigated the opinions of the respondents about the question: why the presented models are good. All the open questions were common for both the presented models and subsequently some of the comments may be focused more on the financial benchmarking model than specifically on Model 3. We received positive comments from 31 respondents. Almost all of these positive comments mentioned the visualization capability of SOM.

> "Visualising the interdependencies."

“Good visualizations”
“Visualization very good.”
“Trends and benchmarking can easily be seen. Visualization aspect is fine.”
“Visuaalinen”
“Visualization, simplification”
“Visualization”
“The obvious: visualization & clustering”
“Visualization, multiple dimensions, trends”
“Illustration“
“They structure a lot of into and views in a very conveyed and "simple" format.”
“Fairly easy to read and understand.”
“Somewhat clear and perhaps reliable.”
“Simplified ways of visualizing a complex world, without losing the relevant information, is valuable and thus good.”
“Additional way of visualizing market conditions.”
“Many variables without predetermined values can be visualized and used for comparison.”
“Ability to visualize.”
“New findings, more visual”
“Easy to understand, shows the trends, visuable”
“Visualization of clusters”
“Visual and logical”
“Quite clear visual outcome of the situation and development (time series).”
“To cluster information and to find correlation between parameters.”

Some respondents appreciated the SOM capability to cluster and the capability of the models to stimulate discussion.

“The models give a summarized picture of many variables in own graph. They are rather easy to understand with colours.”
“Helposti ymmärrettäviä.”
”Startingpoint.”
“In decision making and analysing they give a fast board picture that can be deepened later.“
”Fokusoivat ajatukset ja keskustelua -herättävät kysymyksiä -osoittavat uusiakin asiayhteyksiä”
“They stimulate thoughts and force the user to look at the issues from a neutral/new angle.”
“Fresh, thought-provoking.”
“You can analyze and make a summary when having a lot of data. Classify enterprises.”
”Create good basis for debate”
“Explaining environment, bringing new ideas, understanding”

The respondents had also possibility to improve and give critique against the models. 29 respondents gave comments on the question. Some respondents were worried about the possible long time to learn the method and models:

“New & unfamiliar to decision makers.“
“Too complex for executive presentations”
“Takes some time to adapt the logic.”
”Vaativat tulkin kartan ja käyttäjät väliin (ainakin aluksi!)”
“Cannot be used in daily work. Need some expertise to analyze the results.”
”Voi olla vaikea esittää päätöksentekijöille. Herkkä väärälle datalle.”

> “Takes some time to really understand them because of many dimensions on the map simultaneously.”
> “They need some expertise to understand. Need text along the graphs.”
> “May be complex to learn. May also prove to be complex to present results with to the decision making audience (a la strategy board) as time is always limited.”
> “Need some training to understand & data iteration needs deep expertise.”
> “Complexity, difference from current/existing models.”
> “The models are not poor. However, a further analysis would bring more info and ideas of using them.”
> “Requires a lot of training to use…(effectively)”

Some respondents were worried about data and its reliability and validity.

> “Should key ratios be eliminated by extraordinary component.”
> “Data input needs to be specified (es. Extraordinary items)”
> “Easy to make wrong conclusions if variables are chosen poorly.”
> “Uncertain about the source of data. Selection of attributes in some cases. Irrelevant examples (not own industry)”
> “Data feed probably difficult.”
> “There was correlation among variables -> they contain the same information (autocorrelation) finding right variables can be very time consuming.”
> “The connections of variables need to be explained to the audience. (a bit complicated)”
> “Leaves open to the "garbage-in, garbage-out" possibility.”
> “Can be hard to get hold of the most important information. Visualization improvements needed.”

Some respondents wanted even better visualization and the capability to forecast future development.

> “Visualisation in some cases.”
> “To predict the future and see trends more clearly.”
> “Transparency was questionable. "why things are how they were". Next steps could focus more on forecasting; How are floating node to node, are there clear streams and internal logic. Are there clear "suvanto", where companies often stay for longer time.”
> “In depth- analysis (drilling-down to more detailed info) or time-series analysis features were undiscovered!?
> “The differences within clusters remain fuzzy, so a detailed analysis would need another map.”
> “Not very transparent. Do not differentiate between "good" and "poor", e.g. incorrelated, factors”
> “Just presenting trends of numeric data is not enough. Text analysis could be an improvement. Why a company/country performance follows a certain path or what actions affect a company's path.”
> “Maps need more clear presentation (changes)”
> “The conclusions of macro economics analysis somewhat vague”
> “Value difficult to see.”

In conclusion the respondents appreciated the visualization capability of the models and the capability to stimulate discussion. Respondents were worried about the learning time of the method, data reliability and validity and the lack of the forecasting capability.

Summary questions also measured if Model 3 provides any new information about the competitive environment. 35 respondents answered that question. The same number of respondents (13 of 35) said that Model 3 gave or did not give any new information. The rest of the respondents (9 of 35) were not sure if Model 3 gave or did not give new information.

Respondents had possibility to comment their answer, i.e. what kind of new information they received from the models. Twelve commented but two respondents did not give any valuable information. Most respondents get new information about the trends and correlations;

> "Trends, visualization, but our company is not in P&P"
> "Trends."
> "On the characteristics of the paper and pulp market as well as on GDP development trends. "
> "Correlations very clear."
> "Comparisons"
> "I was not that well informed about how the pulp & paper companies and countries correlate in their behavior."
> "How this model could be used in practise. Macroeconomy (what affects what) is interesting."
> "I have a new view about the performance of pulp & paper industry."
> "Not familiar with the P&P industry beforehand."

Model 3 is helpful in the handling of the economic environment because 21 of 36 respondents agreed with this statement. Still 14 of 36 respondents were not sure if Model 3 helps in the handling of the environment. Only one respondent said that Model 3 does not help in the handling of the economic environment. 12 respondents gave some kind of explanation for their answer. One explanation related clearly to the financial benchmarking model and two were not usable. Some were interested to use the new tool itself or to make market analysis. Still two respondents appreciated the visualization capability.

> "New approach to analyze and understand."
> "It would be a different kind of analysis."
> "It could be used as one tool among others"
> "Helping us selecting right markets where to enter."
> "Understanding marketplayers, positions and trend performance."
> "On macro level, probably the visualization could be helpful, but parameters would need to be received (Researcher is not sure about the last word)."
> "Visualization again."
> "Comparisons"
> "Data sources and timelines important. Relationship to predicting futures and building scenarios vs. illustrating past?"

In the end we evaluate the practical usability of Model 3. We measured perceived usefulness and expectations of the net benefits (cf. Seddon 1997) because they can affect the use of Model 3 later. The last summary questions

were in the form of statements and had the scale from 1 (bad) to 5 (good). Table 20 reports the results concerning the last questions.

Table 20: Summary questions concerning Model 3

	Average	*Median*	*STD*	*N*	*Highest*	*Lowest*
Quick overview[97]	3.81	4	0.577	36	3	0
Similarity with preliminary assumptions[98]	3.75	4	0.732	36	6	0
Correlation with reality	4.03	4	0.521	35	5	0
Illustration of problems and new moves[99]	3.66	4	0.765	35	3	0
Benefits over current methods[100]	3.74	4	0.701	35	3	0
Overall satisfaction[101]	3.63	4	0.690	35	3	0
Complementary tool[102]	3.60	4	0.812	35	3	0
Replacement of currently used tool(s)	3.09	3	0.830	35	0	1
Importance of simulation capability[103]	3.91	4	1.011	35	11	1
Recommendation to colleagues[104]	3.80	4	0.759	35	7	0

Generally, we can say that Table 20 indicates the viability of Model 3 for macro environment analysis because all the averages are over 3 and all the medians, except replacement, are 4. Furthermore, all the questions have at least 3 respondents with the best values, except the replacement question.

The first row shows that Model 3 somewhat helps to obtain a quick overview of the environment because the average was 3.8 and median 4. Three of 36 respondents answered that Model 3 was very helpful in obtaining a

[97] The scale of overview question was the following: 1 = Not helpful at all, 2 = Somewhat unhelpful, 3 = Neither, 4 = Somewhat helpful, 5 = Very helpful

[98] Preliminary assumption and reality correlation question had scales: 1 = Very conflicting, 2 = Somewhat conflicting, 3 = Neither, 4 = Somewhat similar, 5 = Very similar

[99] The scale of new moves question was the following: 1 = Very poorly, 2 = Somewhat poorly, 3 = Neither, 4 = Somewhat well, 5 = Very well

[100] The scale of benefits question was the following: 1 = No additional benefits, 2 = Few additional benefits, 3 = Neutral, 4 = Some additional benefits, 5 = Many additional benefits.

[101] The scale of satisfaction question was the following: 1 = Very dissatisfied, 2 = Somewhat dissatisfied, 3 = Neutral, 4 = Somewhat satisfied, 5 = Very satisfied

[102] The scales of complement and replacement questions were the following: 1 = Absolutely not, 2 = Probably not, 3 = Undecided, 4 = Probably, 5 = Absolutely

[103] The scale of simulation capability question was the following: 1 = Not important, 2 = Somewhat unimportant, 3 = Neutral, 4 = Somewhat important, 5 = Very important

[104] Recommendation question had the following scale: 1 = Absolutely not, 2 = Probably not, 3 = Undecided, 4 = Probably, 5 = Absolutely

quick overview. The overview question has standard error 0.6 which is quite low.

We wanted to know if Model 3 is similar with the preliminary assumptions of the respondents concerning the environment. The average 3.8 indicates that the respondents considered Model 3 somewhat similar to their preliminary assumption. Even 6 of 36 respondents regarded Model 3 as very similar to their preliminary assumptions.

The third row of Table 20 analyzes if Model 3 correlates with the perceived reality of the respondents. Model 3 seems to have somewhat similar correlation with reality because the average is 4.0. Five respondents said that the correlation between Model 3 and reality is very similar. The reality question has the lowest standard error (0.5) of the summary questions.

One question measured how well Model 3 illustrates investments, turnarounds, problems, and new moves. The average 3.7 and median 4 indicate that Model 3 shows the problems and new moves somewhat well. 3 of 35 respondents perceived Model 3 showing the movements very well.

Table 20 shows Model 3 providing some additional benefits over the currently used analysis methods because the average is 3.7 and median 4. Three of 35 respondents considered Model 3 having many additional benefits compared to the current analysis methods.

We measured also the respondents' overall satisfaction concerning Model 3. The evaluation of user satisfaction is a vital task because it affects the performance of a company (Gelderman 1998). On the other hand, if users are satisfied with the system, they are also probably more willing to use the system. Table 20 shows respondents being somewhat satisfied with Model 3 because the average is 3.6 and median 4. Three of 35 respondents were very satisfied with Model 3.

According to Table 20, respondents are probably willing to use the SOM as a complement to other tools in the macro environment analysis because average is 3.6 and median 4. Three of 35 respondents said they are absolutely willing to use the SOM as a complementary tool in the macroeconomic analysis.

The lowest average of the summary questions (3.1) was gained by the question if the SOM could replace one or more of the tools currently used in the macro environment analysis. The replacement question was the only question where no respondent gave the highest values. One respondent said that the SOM could absolutely not replace one or more of the tools currently used in the macro environment analysis.

The summary questions also included a question concerning the simulation capability of Model 3. The average 3.9 and median 4 indicate that simulation capability is somewhat important. Even 11 of 35 respondents answered this

simulation capability being very important. One respondent did not think the simulation capability being important at all. The simulation question had the highest standard deviation (1.0) of the summary questions.

The final summary question investigates if the respondent would be willing to recommend the SOM to colleagues. The respondents probably are willing to recommend the SOM to colleagues because the average is 3.8 and median 4. Seven of 35 respondents gave the highest vale, i.e. they would absolutely recommend the SOM to colleagues.

In conclusion, the summary questions showed that the respondents perceived Model 3 viable for macro environment analysis. First, Model 3 is somewhat helpful in obtaining a quick overview. Second, Model 3 illustrates problems and new moves somewhat well. Third, the respondents are somewhat overall satisfied with Model 3. The summary questions also showed the viability of the SOM method for macro environment analysis. First, the SOM had some additional benefits compared to the current tools. Second, according to the respondents, the SOM can be used as a complementary tool.

6.6.8 General comments on SOM and the demonstration

At the end of the survey we asked if the respondents' had general comments on the SOM and the demonstration. We received 13 comments. Some comments were positive;

> "Illustrative demonstration, and an interesting tool."
> "Excellent job you have done. Focus on ease of use and simulation."
> "It brought a lot of ideas on how to use it in everyday BI (business intelligence. This is added by researcher) work… especially in benchmarking."
> "The presentation was very interesting and informative."
> "Seems to be an interesting method that "has" to be loaded into if it could be used for our purpose."

One positive comment emphasized specifically that the models could be used in the strategy process but not in daily work (cf. Chapter 2.3).

> "The models seemed to work in practise also. By them you can analyze the past, but how about the analyzing the future? In corporate level it is important that software/tool is fast and easy to use and visualization is clear. This model couldn't be used in daily work, but for example once a year during strategy processes this could be useful."

One comment thought of the uncertainty of environment and the usability of the models (cf. Chapter 2.4.2).

> "I think this approach is more useful for more stable industries such as paper. I have difficulties in imaging how to use it in IT as things are difficult to quantify."

A few respondents did not want to determine their opinions before testing the tool. Some gave suggestions for improving the questionnaire and presentations.

> "The framework and the possibilities of SOM seem very interesting. However, it is impossible to state anything certain before testing the application on my current industry and field of work."
> "This is a good tool for macro analysis (e.g. macro firm or environmental analysis), but I can't immediately see how it would/could be used for a single company's decision making."
> "The question were a little vague, as in the final analysis, it all comes down to the point of view, which was not specified in this survey clearly -> our company or in general."
> "The macro level data & firm data should be from the same time period to show the correlation."
> "Kartat on ihan hauskoja katsella, mutta missä on johtopäätökset? Voisitte itsekin miettiä miten tämmöisiä karttoja voisi käyttää yksittäisessä yrityksessä. Esim. Firmakohtainen tarkastelu kilpailijoitten finanssitunnuslukujen kehityksestä tarvitsee todellisen toiminnan analyysin sekä kansantalous + paperimarkkinakehityksen seurakseen ja varmaan hyvinkin yksityiskohtaista analyysiä ennen kuin mitään uutta irtoaa (uutta = ei "perinteisillä" menetelmillä saatavissa). Strateginen päätöksenteko ei välttämättä tarvitse paljon tietoa, vaan ymmärtämystä ja rohkeutta."
> "No common understanding at the tool yet."

To sum up the comments, some respondents were satisfied with the presentation and visualization capabilities of SOM. Some did not want to determine their opinion before more extensive training and testing.

6.7 Conclusions of Model 3 evaluation

Although the respondents of the evaluation of Model 3 were highly educated, had long working experience and high knowledge about the basic IT tools, the respondents were somehow frustrated concerning the amount of macro environment information. The respondents also perceived the macro environment somewhat complex and turbulent. These results show the need for computational assistance in the macro environment analysis.

We measured the different factors of information by using the framework of Doll and Torkzadeh (1988). All the information factors of Doll and Torkzadeh's (1988) framework were important from the respondents' point of view. The content of information gained the highest importance and format received the lowest. However, visualization which is one form of format received the same importance as content although the format itself was given lower importance. Even 17 of 36 respondents answered that visualization capability is a very important factor. The survey showed that all the five

factors should be improved because the users were not very satisfied with any of the factors.

We used primarily the framework of Doll and Torkzadeh (1988) for evaluating the suitability of the Model 3. We found that the respondents were somewhat satisfied with the content, accuracy, timeliness, format and ease of use of Model 3. All the factors were from the framework of Doll and Torkzadeh (1988). Model 3 performed better than the current systems with all these five factors, except timeliness, which proved the viability of Model 3. Furthermore, the viability of Model 3 was proved in several different places in the analysis of the questionnaire's results. First, the respondents somewhat agreed that they would use Model 3 in the strategy process (see Chapters 2.3 and 2.4) if it was introduced. Even 7 of 35 respondents strongly agreed with the usability of the models for strategy process. Second, the respondents were somewhat satisfied with the overall of Model 3. Third, the respondents said that Model 3 was somewhat helpful to obtain a quick overview of the macro environment. The results also indicate that the SOM method itself seems to work. First, the respondents perceived the SOM having some additional benefits compared to the current tools. Second, the respondents said they would probably use the SOM as a complementary tool in the macro environment analysis.

The possible use of Model 3 seems to have some kind of individual impact (cf. Delone & McLean 1992). This is proved by the results of the survey. The respondents somewhat agreed that the quality and confidence of a strategic decision would increase if Model 3 was introduced. On the other hand, Model 3 also seems to have some kind of organizational impact (cf. Delone & McLean 1992) because the respondents somewhat agreed that the use of Model 3 would affect or stimulate discussion during the strategic process. Even 12 of 35 respondents strongly agreed with this stimulation statement.

The respondents appreciated the visualization capability of the models and the possible use specifically as discussion stimulators. The respondents were worried about the time required for the learning of the method and data reliability and validity. Some respondents also wanted some kind of forecasting capabilities.

7 CONCLUSIONS AND DISCUSSION

The primary purpose of this study was to illustrate how companies can utilize the technique of self-organizing maps in the strategy formulation by focusing on economic and competitive environment analyses at the macro and industry levels. This kind of analysis is difficult nowadays, because the bounded rational people are frustrated with the amount of information (see Chapter 1.3 and Chapter 6) and the environment is perceived both complex and turbulent (see Chapter 6). We presented the background for the research in Figure 1. Figure 31 shows how we responded to the primary idea. The italics show our emphasis in the current study.

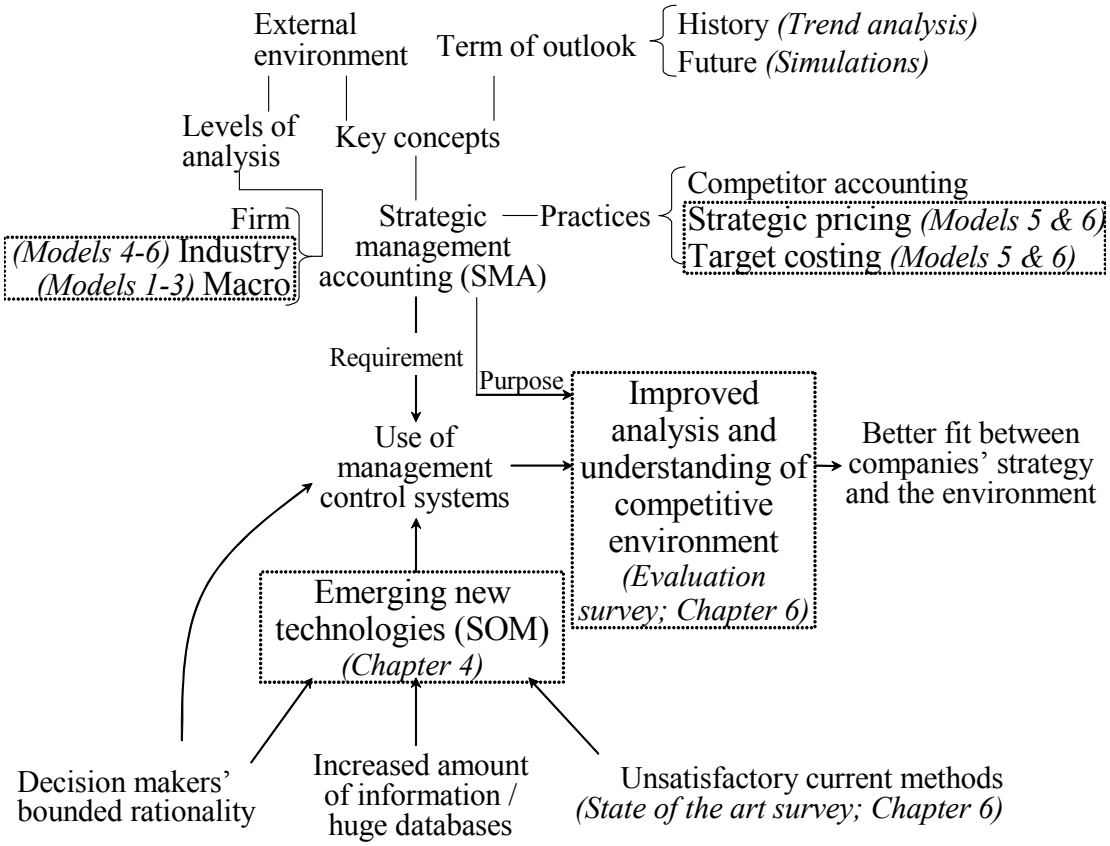


Figure 31: The response to the background for the research

To respond to the purpose of the research (see the upper left box in Figure 31), we constructed Models 1-3 to examine the deviations between economic trends in Canada, Finland, France, Germany, Great Britain, Italy, Japan,

Sweden and the United States at the macro level. To analyze the competitive environment at the industry level we built Models 4-6. The first industry level model (Model 4) examined the pulp and paper trends in Austria, Canada, Finland, France, Germany, Japan, Sweden and the United States. The second industry level model (5) illustrated how the SOM can be used for the pricing position analysis of the Finnish grocery retailers. In the last model (Model 6) we used model 5 to illustrate how the SOM can be used for the analysis of the changing pricing policy on retailers.

A large number of studies highlighting the importance of environment analysis when companies are planning their strategies can be found (cf. Ahola 1995, 188, Andrews 1999, Fahey & Narayanan 1986, 188, Johnson & Scholes 1997, 5, Larsen et al. 1998, Marsden 1998, Mintzberg 1999, Porter 1999b, Quinn 1999 and Rumelt 1999). The environment analysis could be used in the analysis of potential future threats and opportunities, the assessments of the market growth rates, the determination of the location of production and the setting and monitoring of the goals and action plans of an organization.

According to Figure 31, the environment analysis could be conducted at the levels of macro environment, industry and firm. We decided to focus on the macro environment analysis, which is the broadest level of analysis although the scanning of all the levels is vital (Garg et al. 2003). We had four reasons to focus on the macro environment analysis. First, the discussion concerning strategic management accounting has finished in the industry level analysis and concentrated on the competitor analysis (See Chapter 1.4 more about strategic management accounting. Figure 31 presents the key concepts and practices of SMA). Second, changes in the macro environment have an influence on companies' financial performance (cf. Brealey et al. 2001, 280 Hawawini et al. 2003 and McGahan & Porter 1997). Third, the consideration of changes in the macro environment is important nowadays since companies are operating more and more in global markets. Finally, we were able to get reliable data from the macro level, which gave one more reason to focus on the macro environment analysis.

We found that macro environment analysis should cover political, economic, social and technological areas (cf. Johnson & Scholes 1997, 93-96). We had several reasons to focus on the economic area. First, our state of the art survey concerning the current macroenvironment methods illustrated the economic environment possessing the greatest effect on the companies' success. Second, the survey proved economic environment analysis being the most often used analysis compared to the other three areas, i.e. political, social or technological. Third, our technique processes quantitative data better than qualitative data although the technique makes possible to use also qualitative data after encoding (cf. Honkela et al. 1998 and Kaski et al. 1998a). Fourth,

objective data is available from that area. Finally, we thought that accountants would prefer economic analysis in the beginning if they are moving from industry level analysis to macro level because they are historically more familiar with numbers and figures than qualitative data such as political, social or legal analysis.

We also wanted to include the industry level analysis in the study because earlier studies have shown that the industry level factors affect companies' financial success (Hawawini et al. 2003 and McGahan & Porter 1997). We focused on the pulp and paper industry as a result of its importance for the Finnish economy. Furthermore, we wanted to compare these macro and industry specific trends and we found that some of the industry specific movements can be explained by the changing levels of macroeconomic factors.

The second industry level model illustrated how self-organizing maps can be used in the field of strategic management accounting. Figure 31 shows that two practices of SMA are strategic pricing and target costing. According to the upper-right box of Figure 31, Models 5 and 6 focused on the strategic pricing and target costing. Model 5 showed how the pricing position of a retailer can be illustrated with the SOM. Model 5 also gave some reasons for the different pricing positions, i.e. the location, size and group of a retailer. Model 6 presented how Model 5 can be used for the scenario analysis. Moreover, Model 6 illustrated how much the prices should change so that the position of a retailer would change. However, we have to remember that a single SOM might be interpreted differently by two people if they possess distinct domain knowledge (Wang & Wang 2002) and subsequently the analysis of the results may be partly different depending on the analyzer.

Our study showed the importance of the consideration of countries' economic situation before operating on new continents although there were interdependencies and similarities between countries. The results supported Crucini's (1997) conclusion that smaller countries (exception was Japan which was in recession during the studied period) have had larger cyclical fluctuations than bigger ones – especially English speaking countries. Our study also supported the research of Artis et al. (1997) that the USA and Canada have had similar trends. We could also observe that countries' distance from each other affects business cycles (see also Artis et al. 1997, Schaefer 1995, 27 and Zimmerman 1997) i.e. countries with lower distance have usually more similar cycles than countries with longer distance. Trend similarities were discovered in Central European, English speaking and Scandinavian countries. The easier trade and cooperation with foreign countries is surely one attribute which makes countries more dependent on foreign countries and therefore to some degree equalize their business cycles

(cf. Zimmerman 1997). Our study also revealed that the Japanese trend did not have any substantial similarities with the other studied countries' trends. The study revealed clearly the Asian crisis and its effect on the Japanese economy, which has not expanded after 1997.

However, the largest movements have occurred almost at the same time in all the countries' trends (1995, 1997 and 1999) although the strength of the movements has varied from country to country. This indicates that some kind of shocks (cf. Chapter 3.2, Prescott 1999, Temin 1998, 1-2, Ravn 1997 and Zarnowitz 1997, 3-4) have influenced the worldwide business cycle (cf. Gregory et al. 1997, Kindleberger 1995, 97, Lumsdaine & Prasad 1999, 27 and Schaefer 1995, 27). In general our results clearly proposed that the economies (except Japan) expanded during the research period because all the trends were moving from lower values (i.e. left-hand side in Model 3) to higher values (right-hand side in Model 3). We can see that our results are generally congruent with earlier studies, and thus the third purpose of the research is fulfilled. Although we found similarity between this and earlier studies we think after the evaluation of Model 3 that the explanation of the different movements can be more easily and visually conducted by using feature maps than with statistical methods, i.e. correlation matrices (cf. Chyi 1998, Crucini 1997 and Martin & Rogers 2000), standard deviation calculations (cf. Ravn 1997), or regression analyses (cf. Paci 1997). Thus, we did not have to determine the dependent (cf. Paci 1997) and independent variables or consider the causality of the variables when using the SOM method. We can also easily observe the cumulative effect of variables on the trend or retailers pricing position in the SOM. If we want to analyze these trends or pricing positions more specifically, we can use feature maps. This means that we can find the possible exceptions in the trends or the positions and analyze these exceptions by using feature maps. Therefore, the SOM is a theoretically viable technique in this kind of multivariable analysis.

As can be seen from the lower-right corner of Figure 31, our state of the art survey concerning the macroenvironment analysis methods gave support for the need of improved techniques because the respondents were not extremely satisfied with the current techniques. The respondents were the most unsatisfied with the presented information format. State of the art survey revealed a requirement for a technique with better visualization capabilities so that the format could be improved.

Although the used technique, SOM, is more suitable in the assessing and monitoring (cf. Ahola 1995, 192-193, 216-217 and Fahey & Narayanan 1986, 36-44) of the changes of the environment, the results are also somehow utilizable for forecasting (cf. Kaski & Kohonen 1996) and scenario analysis (e.g. if European trends have been almost similar, these trends are probably

similar also in future). The results can also be used in companies' performance analyses (Japanese disadvantageous financial situation has probably weakened the Japanese companies' –as well as companies which are operating in Japan - financial ratios), investment and production decisions and export/import analysis (e.g. investments and foreign trade are possibly more secure in English countries because the fluctuations were not substantial) to mention only a few utilizable possibilities. The SOM technique seems to have theoretical viability in this kind of complex multivariable analyses because we observed similarities between our results and earlier studies. However, we consider the visualization capability to be better in our study than in the earlier studies. The evaluation survey gives support to this claim; according to the results the respondents appreciated the visualization capability of SOM.

The practical viability of Model 3 was evaluated in thirteen Finnish publicly noted companies. We primarily used the framework of Doll and Torkzadeh (1988) for the evaluation. We used this framework because it focuses on information quality issues and it is used in several other studies (e.g. Adelakun 1999, Chen et al. 2000 and Rai et al. 2002). The results of the evaluation proved the usability of Model 3. First, Model 3 received a higher satisfaction level than the currently used methods in four of the five measured factors of Doll and Torkzadeh's (1988) framework, i.e. the current methods were perceived better only in timeliness. Second, the respondents somewhat agreed with the willingness of use of Model 3 in the strategy process (see Chapters 2.3 and 6.6.6) if it was introduced. Third, respondents were somewhat satisfied with Model 3 in overall. Finally, the evaluation showed that Model 3 was somewhat helpful to obtain a quick overview of the macro environment. Therefore, the evaluation responded to the final purpose of the study because Model 3 seems to be useful for the purposes of strategic environment analysis and the SOM method itself is viable for the trend analysis as can be seen from the center of Figure 31. This viability conclusion was proved by the empiric evaluation and theoretic comparison between our result and earlier studies.

The evaluation of Model 3 showed the viability of the SOM method for macro environment analysis. First, the respondents perceived the SOM having some additional benefits compared to the current tools. One of the most appreciated benefits was related to the visualization capabilities. Second, the respondents said they would probably use the SOM as a complementary tool in the macro environment analysis.

This study has its limitations. First, the studied period is quite short and the number of investigated countries is also quite small. The examination of different countries and different time period may naturally affect the results. The second limitation relates to the nations' average level of variables because averages may sometimes explain differences between industrial sectors

insufficiently. Fluctuations in different variables between industries can sometimes be substantial (cf. Berman & Pfleeger 1997). Thirdly, a different size of the map may slightly affect the interpretation of results i.e. the fluctuations and differences can be introduced larger or smaller depending on the map shape. Thus, our results could be difficult to generalize to other periods and nations. Fourth, the participants of the evaluation were not able to test the SOM method themselves before the demonstration because Model 3 was presented only by the author of Model 3. Therefore, the results of the evaluation could be different if the participants were able to test the SOM method before the evaluation. Fifth, the number of the participating companies compared to all the Finnish public companies is not very high and a greater number of companies surveyed may affect the results of Model 3 evaluation. Finally, if the environmental complexity increases, the intuition and scenario analysis may complete or even replace the proposed models of environmental analysis (cf. Johnson & Scholes 1997, 92-93 and Ansoff & McDonnell 1990, 31-34). However, we suggest that this kind of formal analyses can precede the intuition and scenario analysis because history is alive in the present and may shape the emerging future (Fahey & Narayanan 1986, 3, 53, 114, Joyce & Woods 1996, 79 and Pettigrew 1992). On the other hand, the evaluation of Model 3 showed the usability of Model 3 for stimulating purposes of discussion during the strategy process, even though some respondents wanted better forecasting capabilities. As Figure 31 shows we illustrated how the SOM can be used for forecasting in different simulations, i.e. trend simulations in Models 3-4 and the movements of pricing positions in Model 6. Forecasting is one factor which makes a difference between traditional MA and SMA.

We propose that the illustrated models are important because they help to understand the general principles and laws that govern the behavior of the trends in the competitive environment (cf. Simon 1970). This kind of understanding is important because according to Simon (1970) this kind of information changes relatively slowly (e.g. some industry level movements are affected by changing macro level or larger grocery retailers are cheaper than smaller ones).

This study left and raised some interesting issues, which have research potential in future. Firstly, we could analyze how the financial ratios of companies reflect the changes in the macro environment. This relates to the consideration concerning the relation between the changes in financial ratios and changes in the variables of the macro environment. Therefore, the main interest would be if the (good or bad) financial success could be explained by a different (advantageous or disadvantageous) macroeconomic situation. Another interesting issue could be to research the differences between the

trends of industries and the macro environment. Then, we could investigate whether the different industries follow changes similarly in the macro environment. Finally, we could investigate whether the profitability of the customers of one company is affected by a different (advantageous or disadvantageous) economic development.

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APPENDIX 1. GROCERY PRODUCTS

1. bread (rye) 1 kg	32. balkansausage 1 kg
2. bread (rye with hole) 1 kg	33. gouter sausage 1 kg
3. pieces of bread (rye) 1 kg	34. jahti sausage (slide) 1 kg
4. bread (wheat) 1 kg	35. jahti sausage 1 kg
5. mixed bread 1 kg	36. lauantai sausage of Saarioinen (slide) 300 g
6. toast 1 kg	37. lauantai sausage 1 kg (cheapest)
7. mixed meat of cattle 1 kg	38. HK:n sininen sausage 1 kg
8. mixed meat of cattle (beef) 1 kg	39. owen sausage of Atria 1 kg
9. mixed meat of pork-cattle 1 kg	40. sausage 1 kg (cheapest)
10. chop of pork 1 kg	41. grill sausage 1 kg (cheapest)
11. fillet of pork (outer) 1 kg	42. HK:n small sausage 1 kg
12. shoulder of pork (with bones) 1 kg	43. small sausage of Atria 300 g
13. back of pork 1 kg	44. small sausage 1 kg (cheapest)
14. side of pork (without bones) 1 kg	45. liver casserole 400 g
15. strip beef of pork 1 kg	46. meat-paste casserole 400 g
16. pork kassler 1 kg	47. meat balls 400 g
17. outerbeef of cattle 1 kg	48. pizza 400 g
18. strip beef of cattle 1 kg	49. canned cattle-pork 400 g
19. innerbeef of cattle 1 kg	50. canned bean soup 450 g
20. innerfillet of cattle 1 kg	51. stock cube 12 psc.
21. outerfillet of cattle 1 kg	52. chicken balls 1 kg
22. shoulder of cattle (without bones) 1 kg	53. meat pie 1 kg
23. liver of cattle 1 kg	54. karjala pie 1 kg
24. breast of chicken 1 kg	55. 1.5 % milk 1 l
25. quarterpieces of chicken 1 kg	56. 3 % milk 1 l
26. frozen chicken 1 kg	57. 0 % milk 1 l
27. boiled ham (slide) 1 kg	58. 0 % sour milk 1 l
28. smoked ham (slide) 1 kg	59. asidofilus sour milk 1 l
29. metwursti sausage (slide) 1 kg	60. processed sour whole milk 200 g
30. wursti sausage (slide) 1 kg	61. light processed sour whole milk 200 g
31. balkan sausage (slide) 1 kg	62. yoghurt 200 g

63. yoplait yoghurt 4 * 125 g	94. paprika 1 kg
64 pudding 120 g	95. tomato 1 kg
65. tutteli milk 2 dl	96. cucumber 1 kg
66. edam cheese 1 kg	97. chinese cabbege 1 kg
67. emmental cheese 1 kg	98. cabbage 1 kg
68. olterman cheese 1 kg	99. carrot 1 kg
69. bla castello cheese	100. onion 1 kg
70. brie cheese 1 kg	101. garlic 1 kg
71. feta cheese 1 kg	102. leek 1 kg
72. cream cheese 200 g	103. cauliflower 1 kg
73. fresh cheese 100 g	104. salad 1 kg
74. rae cheese 200 g	105. kesäpöytä bean-maize-paprika 200 g
75. eggs 1 kg	106. kesäpöytä vegetables mix 250 g
76. butter 500 g	107. potato 1 kg
77. voimariini 400 g	108. frenc fries, frozen 1 kg
78. voilevi 400 g	109. potato-onion mix, frozen 1 kg
79. voimix 400 g	110. vegetable fat ice-cream 1 l
80. flora margarine 400 g	111. ice-cream 1 l
81. keiju margarine 400 g	112. ice cream 2 dl
82. kultarypsi margarine 400 g	113. sunnuntai wheat flour 2 kg
83. becel margarine 400 g	114. anni helene wheat flour 2 kg
84. kevyt linja margarine 400 g	115. sunnuntai roll flour 2 kg
85. sunnuntai margarine 500 g	116. uncle ben's rice 1 kg
86. milda margarine 500 g	117. risella porrage rice 1 kg
87. kultasula oil 0.5 l	118. elovena oat flakes 1 kg
88. kultaryosi oil 0.5 l	119. nalle 4-corn flakes 700 g
89. orange 1 kg	120. vaasan maukas 500 g
90. kiwi 1 kg	121. koulunäkki 360 g
91. satsumas 1 kg	122. pieni pyöreä 250 g
92. golden delicious apple 1 kg	123. vaasan voima 430 g
93. apple 1 kg (cheapest)	124. maitonäkki 460 g

125. vaasan rapeat crispbread 400g	157. abba tunny 150 g
126. crispbread of oululainen 350 g	158. tunny (cheapest) 185 g
127. ryvita crispbread 400 g	159. pineapple 227 g
128. domino biscuit 350 g	160. peach 850 g
129. jaffa biscuit 300 g	161. tropic orange juice 1 l
130. lu pims biscuit 300 g	162. valio orange juice 1 l
131. jyväshyvä suklaapisara 500 g	163. dole juice 1 l
132. fafer kaunis veera biscuit 350 g	164. apple juice (cheapest) 1 l
133. fazer cream cracker 400 g	165. tropic orange drink 1,5 l
134. jyväshyvä oat biscuit 500 g	166. black currant drink (cheapest) 0,5 l
135. tuc biscuit 300 g	167. drink (cheapest) 2 dl
136. Mc Vities Digestive 400 g	168. dronningholm straw-/raspberry jelly 1 kg
137. marie biscuit (cheapest) 1 kg	169. saarioinen jelly 720 g
138. waffle 1 kg	170. orange marmelad (cheapest) 1 kg
139. torino macaroni 400 g	171. plum marmelad (cheaoest) 1 kg
140. myllyn paras rakettispagetti 350 g	172. plum (cheapest) 227 g
141. milano spagetti 500 g	173. raisins 250 g
142. barilla spagetti 500 g	174. sugar (cheapest) 1 kg
143. kellogg's rce crispies 375 g	175. lumps of suger 1 kg
144. kellogg's frosties 375 g	176. felix mashed potatoes 214 g
145. kellogg's corn flakes 500g	177. mummon mashed potatoes 210 g
146. weetabix 430 g	178. estrella chips 200 g
147. finax perhemysli 1 kg	179. taffel chips 250 g
148. alpen mysli 375 g	180. juhla-mokka 500 g
149. mysli (cheapest) 1 kg	181. presidentti 500 g
150. salmon (whole) 1 kg	182. gevalia 500 g
151. salmon fillet 1 kg	183. o'boy cocoa 500 g
152. herring 1 kg	184. paulig tea 50 ps
153. fish sticks 250 g	185. lipton tea 50 ps
154. ahti herring 250 g	186. twinings earl grey tea 25 ps
155. boy herring 640 g	187. heinz ketchup 570 g
156. abba mustard herring 260 g	188. felix ketchup 500 g

189. turun mustard 125 g	214. maxi salmiakki/hedelmäaakkoset 100 g
190. koti mustard 300 g	215. pantteri salmiakki 100 g
191. felix pickles 380 g	216. marianne 90 g
192. piltti 3 months 125 g	217. halva mixed candies 200 g
193. piltti 5 months 125 g	218. fazer best 95 g
194. piltti 8 months 190 g	219. halva lakritsimatto 60 g
195. piltti 1-3 year 190 g	220. panda iso pepe 38 g
196. bona 3 months 125 g	221. fazer liquorice 10 g
197. bona 5 months 125 g	222. xylitol-jenkki 6,5 g
198. bona 8 months 190 g	223. xylitol-jenkki 32 g
199. bona 1-3 years 190 g	224. orbit xylitol chewing-gum 13 g
200. fazer chocolate 170 g	225. coca-cola 1 l
201. marabou chocolate 170 g	226. sprite 1 l
202. royal chocolate 150 g	227. hartwall jaffa 1 l
203. panda chocolate 200 g	228. aurinko jaffa 1 l
204. chymos rice chocolate 80 g	229. pepsi 1 l
205. mars chocolate bar 58 g	230. frisco 1 l
206. maxi-tupla 57 g	231. seven up 1 l
207. royal 45 g	232. koff aqua 1 l
208. dajm duppel 57 g	233. hartwall vichy 1 l
209. geisha chocolate ber 38 g	234. koff I-bier 0,33 l
210. fazer chocolate bar 40 g	235. lapin kulta I-bier 0,33 l
211. big cat 40 g	236. spice cucumber 1 kg
212. lauantaipussi 90 g	237. mushrooms 115 g
213. hyvää makumaasta 160 g	

APPENDIX 2. EXPERT SURVEY OF MACROECONOMIC ENVIRONMENT ANALYSIS

BACKGROUND QUESTIONS (optional)

Company _____

Position _____

Education _____

Business unit _____

Number of years in the company _____

Number of years in the current position in the current company _____

Number of years in a similar position in entire career _____

1. FAMILIARITY WITH INFORMATION TECHNOLOGY

The purpose of these questions is to determine the respondent's degree of daily IT use and familiarity.

1.1. How do you use information technology in your daily work? (Please choose one alternative)

Direct use, i.e. I use IT myself	_____
Indirect use, i.e. I use reports generated by others	_____
Combination of the two above	_____

1.2. How often do you use the following IT tools?

	Daily	A few times per week	A few times per month	A few times per year	More rarely	Never
Word processing	1	2	3	4	5	6
Spreadsheets	1	2	3	4	5	6
E-mail	1	2	3	4	5	6
Calendars	1	2	3	4	5	6
Databases	1	2	3	4	5	6
Internet	1	2	3	4	5	6
Decision support systems	1	2	3	4	5	6
Others (please specify) _____	1	2	3	4	5	6
_____	1	2	3	4	5	6
_____	1	2	3	4	5	6

1.3. How knowledgeable are you of the following software tools:

	Beginner	Inexperienced	Average	Experienced	Expert
Word processing	1	2	3	4	5
Spreadsheets	1	2	3	4	5
E-mail	1	2	3	4	5
Calendars	1	2	3	4	5
Databases	1	2	3	4	5
Internet	1	2	3	4	5
Decision support systems	1	2	3	4	5
Others (please specify) _____	1	2	3	4	5
_____	1	2	3	4	5

2. ENVIRONMENTAL ANALYSIS

The purpose of these questions is to determine the state of the art of macro environment analysis in the Finnish publicly noted companies.

2.1. How important are the following aspects of the macro environment for the success of your company?

Aspects / Importance	Very unimportant	Unimportant	Neutral	Important	Very important
Political	1	2	3	4	5
Economic	1	2	3	4	5
Social	1	2	3	4	5
Technological	1	2	3	4	5

2.2. How often do you analyze the different aspects of macro environment for your strategic business decisions;

Aspects / frequency	Once per week or more	Once to several times per month	Once to several times per quarter	Once to several times per year	More rarely	Never
Political	1	2	3	4	5	6
Economic	1	2	3	4	5	6
Social	1	2	3	4	5	6
Technological	1	2	3	4	5	6

If you answered that you never analyze the macroeconomic environment go directly to question 3.7.

2.3. How often do you use the following tools for analysis of the macroeconomic environment?

	Once per week or more	Once to several times per month	Once to several times per quarter	Once to several times per year	More rarely	Never
Time series, trend analysis	1	2	3	4	5	6
Regression analysis	1	2	3	4	5	6
Correlation analysis	1	2	3	4	5	6
Power point	1	2	3	4	5	6
Excel	1	2	3	4	5	6
Data mining (Neural networks, rule-based systems etc.)	1	2	3	4	5	6
Something else, what?						
_____	1	2	3	4	5	6
_____	1	2	3	4	5	6

2.4. How often do you seek the following information for analysis of the macroeconomic environment?

	Once per week or more	Once to several times per month	Once to several times per quarter	Once to several times per year	More rarely	Never
General trends and patterns	1	2	3	4	5	6
The changes in the external environment taking place currently, and potentially in the future, and how they will affect the organization and its activities	1	2	3	4	5	6
For explaining the extent to which unanticipated environmental events contributed to deviations from your company's expected (budgeted) results	1	2	3	4	5	6
For forecasting future directions of environmental changes, and assessing how current and future trends create new opportunities and threats	1	2	3	4	5	6
For searching for potential growth areas in a company's current businesses or in potential new businesses	1	2	3	4	5	6
What else (please specify)?:						
_____	1	2	3	4	5	6
_____	1	2	3	4	5	6

2.5. How often do you use the following information sources for analysis of the macroeconomic environment?

	Once per week or more	Once to several times per month	Once to several times per quarter	Once to several times per year	More rarely	Never
External consultants	1	2	3	4	5	6
Colleagues	1	2	3	4	5	6
Media (newspapers, TV, internet)	1	2	3	4	5	6
Internal reports	1	2	3	4	5	6
Seminars and conferences	1	2	3	4	5	6
Something else, what? _____	1	2	3	4	5	6
_____	1	2	3	4	5	6
_____	1	2	3	4	5	6

2.6. How often do you use the following models and constructions for analysis of the competitive environment?

	Once per week or more	Once to several times per month	Once to several times per quarter	Once to several times per year	More rarely	Never
Porter's diamond of national advantage (i.e. analysis concerning factor conditions; labor, capital, infrastructure, demand conditions; buyer needs, related and supporting industries and finally firm strategy, structure and rivalry)	1	2	3	4	5	6
PEST-analysis (i.e. analyses concerning political, economic, social & technological environment)	1	2	3	4	5	6
SWOT-analysis (companies strength & weaknesses, environment opportunities & threats)	1	2	3	4	5	6
Different matrices (e.g. BCG; includes dimension such as market share and growth of the product)	1	2	3	4	5	6
Porter's analysis of five forces (i.e. analysis concerning the bargaining power of existing suppliers and buyers, the threat of substitutes and new entrants, and the intensity of competitive rivalry)	1	2	3	4	5	6
What else (please specify) _____	1	2	3	4	5	6
_____ _____	1	2	3	4	5	6

2.7. From the perspective of macroeconomic environment analysis, please rate the importance of the following factors of information:

	Very unimportant	Unimportant	Neutral	Important	Very important
Content	1	2	3	4	5
Accuracy	1	2	3	4	5
Format	1	2	3	4	5
Ease of Use	1	2	3	4	5
Timeliness	1	2	3	4	5

3. HOW SATISFIED ARE YOU WITH YOUR CURRENT METHODS FOR MACRO-ECONOMIC ENVIRONMENT ANALYSIS ACCORDING TO THE FOLLOWING FACTORS:

3.1. Content (relevancy, informativeness, importance, and sufficiency of current methods)

	Very dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied
I am	1	2	3	4	5

3.2. Accuracy (reliability, validity, completeness, and credibility of current methods)

	Very dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied
I am	1	2	3	4	5

3.3. Format (clarity, format, visualization capabilities, etc.)

	Very dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied
I am	1	2	3	4	5

3.4. Ease of use

	Very dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied
I am	1	2	3	4	5

3.5. Timeliness (Do you get the information that you need in time using current methods?)

	Very dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied
I am	1	2	3	4	5

3.6. Overall, how satisfied are you with current methods for processing macroeconomic data in your organization?

	Very dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied
I am	1	2	3	4	5

In what way are they good / useful?

_____

_____

_____

In what way are they poor / unusable?

_____

_____

_____

3.7. My organization does not analyze the macroeconomic environment because:

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
there is too much data available about the environment and we cannot find suitable variables for analysis	1	2	3	4	5
we do not have useful and suitable tools for analyzing	1	2	3	4	5
the environment is not considered dynamic / fast changing	1	2	3	4	5
we think that these macroeconomic factors do not affect our company's success enough that the factors should be monitored.	1	2	3	4	5
we think that firm and industry specific factors are more important for the success of our company than macroeconomic factors are. Therefore, we focus on the analysis of firm and industry specific factors.	1	2	3	4	5
Other reasons (please specify? _____ _____ _____	1	2	3	4	5
_____ _____ _____	1	2	3	4	5

4. INFORMATION OVERLOAD AND THE COMPLEXITY OF MACROECONOMIC ENVIRONMENT

4.1. Are you frustrated with the amount of information you are facing daily?

Never frustrated	Rarely frustrated	Neutral	Often frustrated	Constantly frustrated
1	2	3	4	5

What kind of information is causing you frustration?

_____

_____

_____

4.2. How turbulent do you currently perceive the macro environment in which you are operating?

Aspects / turbulence	Very unstable	Unstable	Neutral	Stable	Very stable
Political	1	2	3	4	5
Economic	1	2	3	4	5
Social	1	2	3	4	5
Technological	1	2	3	4	5

4.3. How do you perceive the macro level turbulence currently compared to in the past?

Much less turbulent	Less turbulent	No difference	More turbulent	Much more turbulent
1	2	3	4	5

4.4. How complex do you currently feel the macro environment in which you are operating?

Aspects / turbulence	Not complex	Not very complex	Neutral	Some what complex	Very complex
Political	1	2	3	4	5
Economic	1	2	3	4	5
Social	1	2	3	4	5
Technological	1	2	3	4	5

5. HAVE YOU HEARD OF THE SELF-ORGANIZING MAP (SOM)

1 Yes 2 No

If yes, where and in what application?

_____
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APPENDIX 3. SOM EVALUATION SURVEY

BACKGROUND QUESTIONS *(optional)*

Company _____

Title/Position _____

Education _____

Business unit _____

Number of years in the present company _____

Number of years in the current position in the current company _____

Number of years in a similar position in entire career _____

1. FAMILIARITY WITH INFORMATION TECHNOLOGY

The purpose of these questions is to determine the respondent's degree of daily IT use and familiarity.

1.1. How do you use information technology in your daily work? (Please choose one alternative)

Direct use, i.e. I use IT myself	_____
Indirect use, i.e. I use reports generated by others	_____
Combination of the two above	_____

1.2. How often do you use the following IT tools?

	Daily	A few times per week	A few times per month	A few times per year	More rarely	Never
Word processing	1	2	3	4	5	6
Spreadsheets	1	2	3	4	5	6
E-mail	1	2	3	4	5	6
Calendars	1	2	3	4	5	6
Databases	1	2	3	4	5	6
Internet	1	2	3	4	5	6
Decision support systems	1	2	3	4	5	6
Others (please specify)						
_____	1	2	3	4	5	6
_____	1	2	3	4	5	6
_____	1	2	3	4	5	6

1.3. How knowledgeable are you of the following software tools?

	Beginner	Inexperienced	Average	Experienced	Expert
Word processing	1	2	3	4	5
Spreadsheets	1	2	3	4	5
E-mail	1	2	3	4	5
Calendars	1	2	3	4	5
Databases	1	2	3	4	5
Internet	1	2	3	4	5
Decision support systems	1	2	3	4	5
Others (please specify) _____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5

2. INFORMATION OVERLOAD AND COMPLEXITY

2.1. Are you frustrated with the amount of information you are facing daily?

	Never frustrated	Rarely frustrated	Neither	Often frustrated	Constantly frustrated
Firm level information	1	2	3	4	5
Macro level information	1	2	3	4	5

2.2. How complex do you feel that the competitive environment is?

	Not complex	Not very complex	Neither	Somewhat complex	Very complex
Firm level	1	2	3	4	5
Macro level	1	2	3	4	5

2.3. How turbulent do you currently feel that the competitive environment in which you are operating is?

	Not turbulent	Not very turbulent	Neither	Somewhat turbulent	Very turbulent
Firm level	1	2	3	4	5
Macro level	1	2	3	4	5

EVALUATION OF THE MACRO ENVIRONMENT MODEL

The questions in this section deal with the macro environment model.

8. IMPORTANCE OF FACTORS OF INFORMATION

From the perspective of macro environment analysis, please rate the importance of the following factors of information:

	Very unimportant	Unimportant	Neither	Important	Very important
Content	1	2	3	4	5
Accuracy	1	2	3	4	5
Format	1	2	3	4	5
Ease of use	1	2	3	4	5
Timeliness	1	2	3	4	5

9. SATISFACTION WITH CURRENT METHODS

How satisfied are you with currently used methods for macro environment analysis in your company?

	I strongly disagree	I somewhat disagree	Neutral	I somewhat agree	I strongly agree
I am satisfied with content of current macro analysis methods in my company	1	2	3	4	5
I am satisfied with accuracy of current macro analysis methods in my company	1	2	3	4	5
I am satisfied with format of information presented by current macro analysis methods in my company	1	2	3	4	5
I am satisfied with ease of use of current macro analysis methods in my company	1	2	3	4	5
I am satisfied with timeliness of current macro analysis methods in my company	1	2	3	4	5

10. CONTENT

Rate the information presented in the macro environment model according to the following factors.

	I strongly disagree	I somewhat disagree	Neutral	I somewhat agree	I strongly agree
The macro environment model is relevant	1	2	3	4	5
The macro environment model is informative	1	2	3	4	5

	I strongly disagree	I somewhat disagree	Neutral	I somewhat agree	I strongly agree
The macro environment model is important	1	2	3	4	5
The macro environment model is helpful	1	2	3	4	5
The macro environment model is sufficient	1	2	3	4	5

11. ACCURACY

How satisfied are you with the following aspects of overall accuracy?

	I strongly disagree	I somewhat disagree	Neutral	I somewhat agree	I strongly agree
The macro environment model is reliable	1	2	3	4	5
The macro environment model is precise, i.e. the fineness of detail is high	1	2	3	4	5
The macro environment model is valid, i.e. the model represents what it is supposed to	1	2	3	4	5
The macro environment model is complete, i.e. the information presented is adequate for the task	1	2	3	4	5
Overall, the macro environment model is accurate	1	2	3	4	5

12. TIMELINESS

12.1. Do you get the information that you need in time using current methods?

	I strongly disagree	I somewhat disagree	Neutral	I somewhat agree	I strongly agree
I get the information I need in time using current methods	1	2	3	4	5

12.2. How satisfied are you with the timeliness of the macro environment model, i.e. the extent to which the age of information is appropriate for the task?

	I strongly disagree	I somewhat disagree	Neutral	I somewhat agree	I strongly agree
The macro environment model is timely	1	2	3	4	5

VISUALIZATION QUESTIONS

The questions in this section concern the visualization properties of the SOM.

13. VISUALIZATION CAPABILITIES

13.1. Please select the tasks in which visualization technology could support decision makers

	I strongly disagree	I somewhat disagree	Neutral	I somewhat agree	I strongly agree
Data prediction	1	2	3	4	5
Data clustering	1	2	3	4	5
Data classification	1	2	3	4	5
Time series analysis	1	2	3	4	5
Benchmarking	1	2	3	4	5
Others (please specify)					
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5

13.2. In which of the following business activities could visualization techniques provide increased understanding of business problems?

	I strongly disagree	I somewhat disagree	Neutral	I somewhat agree	I strongly agree
Strategic management	1	2	3	4	5
Marketing and sales	1	2	3	4	5
Operations	1	2	3	4	5
Purchasing and procurement	1	2	3	4	5
Distribution and logistics	1	2	3	4	5
Finance and accounting	1	2	3	4	5
Customer service	1	2	3	4	5
Human resources management	1	2	3	4	5
Others (please specify)					
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5

13.3. What software do you use that supports visual exploration or visual presentation (communication)?

	Daily	A few times per week	A few times per month	More rarely	Never
Spreadsheet graphs	1	2	3	4	5
PowerPoint presentations	1	2	3	4	5
Other (please specify) _____	1	2	3	4	5
_____	1	2	3	4	5

13.4. How important are information visualization capabilities in financial competitor and macro environment analysis?

	Very unimportant	Unimportant	Neither	Important	Very important
Financial Benchmarking	1	2	3	4	5
Macro environment analysis	1	2	3	4	5

GENERAL QUESTIONS CONCERNING THE SOM MODELS

The questions in this section concern the overall use of the SOM.

14. FORMAT

	I strongly disagree	I somewhat disagree	Neutral	I somewhat agree	I strongly agree
The colors used in the models are satisfactory	1	2	3	4	5
The shapes of the models are satisfactory	1	2	3	4	5
The visual representation of the information presented in the models is clear	1	2	3	4	5
The maps are readable	1	2	3	4	5
Overall, the format of the information presented in the models is satisfactory	1	2	3	4	5

15. EASE OF USE

15.1. How transparent is the model? (i.e. how well did you understand the model)

	Very non-transparent	Somewhat non-transparent	Neither	Somewhat transparent	Very transparent
Firm level	1	2	3	4	5
Macro level	1	2	3	4	5

15.2. When using the SOM, it is easy to perceive and analyze:

	I strongly disagree	I somewhat disagree	Neutral	I somewhat agree	I strongly agree
a) comparable data	1	2	3	4	5
b) data trends	1	2	3	4	5
c) correlations between variables	1	2	3	4	5
d) data clusters	1	2	3	4	5
e) differences between data	1	2	3	4	5
f) data values	1	2	3	4	5

15.3. The SOM can be conveniently used by:

	I strongly disagree	I somewhat disagree	Neutral	I somewhat agree	I strongly agree
a) an expert user	1	2	3	4	5
b) an end / business user	1	2	3	4	5

16. USE OF RESULTS

16.1. Information in the form of the models presented could improve the quality of a strategic decision (e.g. investment planning)

	I strongly disagree	I somewhat disagree	Neutral	I somewhat agree	I strongly agree
Firm level	1	2	3	4	5
Macro level	1	2	3	4	5

Why and how, or why not?

_____

_____

_____

_____

16.2. Information in the form of the models presented could improve confidence in a strategic decision (e.g. investment planning).

	I strongly disagree	I somewhat disagree	Neutral	I somewhat agree	I strongly agree
Firm level	1	2	3	4	5
Macro level	1	2	3	4	5

Why and how, or why not?

_____

_____

_____

_____

16.3. Information in the form of the models presented could affect or stimulate discussion during the strategic process.

	I strongly disagree	I somewhat disagree	Neutral	I somewhat agree	I strongly agree
Firm level	1	2	3	4	5
Macro level	1	2	3	4	5

Why and how, or why not?

_____

_____

_____

_____

16.4. I would use the models if they were presented to me in the strategy process.

	I strongly disagree	I somewhat disagree	Neutral	I somewhat agree	I strongly agree
Firm level	1	2	3	4	5
Macro level	1	2	3	4	5

Why and how, or why not?

_____

_____

_____

_____

17. SUMMARY QUESTIONS

17.1. In what ways are the presented models good?

_____

_____

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_____

17.2. In what ways are the presented models poor?

_____

_____

_____

_____

17.3. Did our models provide any new information about the competitive environment?

Firm level 1 Yes 2 No 3 Not sure
Macro Level 1 Yes 2 No 3 Not sure

If so, what kind of new information?

_____
_____
_____
_____

17.4. Could our models be helpful in the handling of the competitive environment?

Firm level 1 Yes 2 No 3 Not sure
Macro Level 1 Yes 2 No 3 Not sure

If so, what kind of new information?

_____
_____
_____
_____

17.5. Did the models help you to obtain a quick overview of the competitive environment?

	Not helpful at all	Somewhat unhelpful	Neither	Somewhat helpful	Very helpful
The firm level model was	1	2	3	4	5
The macro level model was	1	2	3	4	5

17.6. Did the models support or conflict your preliminary assumptions concerning the competitive environment?

	Very conflicting	Somewhat conflicting	Neither	Somewhat similar	Very similar
Firm level	1	2	3	4	5
Macro level	1	2	3	4	5

17.7. Did the models correlate with reality?

	Very conflicting	Somewhat conflicting	Neither	Somewhat similar	Very similar
Firm level	1	2	3	4	5
Macro level	1	2	3	4	5

17.8. Did the SOM show investments, turnarounds, problems, and new moves well?

	Very poorly	Somewhat poorly	Neither	Somewhat well	Very well
Firm level	1	2	3	4	5
Macro level	1	2	3	4	5

17.9. Does the SOM provide additional benefits over currently used analysis methods?

	No additional benefits	Few additional benefits	Neutral	Some additional benefits	Many additional benefits
Firm level	1	2	3	4	5
Macro level	1	2	3	4	5

17.10. How would you rate your overall satisfaction with the SOM models?

	Very dissatisfied	Somewhat dissatisfied	Neutral	Somewhat satisfied	Very satisfied
Firm level	1	2	3	4	5
Macro level	1	2	3	4	5

17.11. Would you use the SOM as a complement to other tools in analysis cases such as those demonstrated?

	Absolutely not	Probably not	Undecided	Probably	Absolutely
Firm level	1	2	3	4	5
Macro level	1	2	3	4	5

17.12. Could the SOM replace one or more of the tools currently used in analysis cases such as those demonstrated?

	Absolutely not	Probably not	Undecided	Probably	Absolutely
Firm level	1	2	3	4	5
Macro level	1	2	3	4	5

17.13. How important would simulation capability be for the SOM in these applications?

	Not important	Somewhat unimportant	Neutral	Somewhat important	Very important
Firm level	1	2	3	4	5
Macro level	1	2	3	4	5

17.14. Would you recommend the SOM to your colleagues?

	Absolutely not	Probably not	Undecided	Probably	Absolutely
I would	1	2	3	4	5

recommend the SOM to my colleagues.

Please provide us with any general comments you would like to make about the SOM or about the demonstration.

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THANK YOU FOR TAKING THE TIME TO ANSWER OUR SURVEY!

APPENDIX 4. ROLE OF AAPO LÄNSILUOTO IN THE PAPERS

This thesis has been written partly, i.e. Models 1-4, within the GILTA-project financed by Tekes (number of application form 40943/99). The GILTA-project was led by Professor Ari Visa, Professor Barbro Back and Professor Hannu Vanharanta. The Finnish Forest Industries Federation provided the databases of Models 1-4 and it was an industrial partner of the group. National Consumer Research Centre (Finland) provided the data for Model 5. Part of the thesis has been joint work and presented at international conferences and published in conference proceedings.

Model 3, except the what-if simulations, described in Chapter 5.1.3 in the thesis was presented at the European Conference on Accounting Information Systems (ECAIS) in 2002 (Länsiluoto et al. 2002). Model 4, except the what-if simulations, in Chapter 5.2.1 in the thesis is included in the Journal of Pulp and Timber in 2002 (Länsiluoto et al. 2002b). The topics for the papers of Models 1-4 were discussed in our Gilta project meetings and the research aims were outlined. I wrote the underlying manuscripts for the papers. The manuscripts were then discussed at the project meetings and checked and corrected by the other authors. I was responsible for training the maps and for analyzing the results. I also presented the papers at the conferences.

The comparison between Models 3 and 4, described in Chapter 5.3.2 in the thesis were included in the proceedings of AI/ET 2003 workshop (Länsiluoto et al. 2003b). Model 5 was presented at the conference of eleventh Annual Research Workshop on: Artificial Intelligence and Emerging Technologies (AI/ET) in Accounting, Auditing and Tax in 2002 (Länsiluoto et al. 2002c). I wrote the underlying manuscripts for the papers. The manuscripts were then checked and corrected by the other authors. I was responsible for training the maps and for analyzing the results. I presented Model 5 at the conference.

Looking specifically at each chapter in the thesis co-authors state the following: Chapters 1.1 (purpose of research) and 1.4. (neural networks) are partly based on the papers presented at the AI/ET and ECAIS conferences. Chapter 3 (background of economic trends) is based mostly on the ECAIS paper. Chapter 4.4.1 (choice of variables) is partly based on the ECAIS paper. Chapters 4.4.2 (data normalization) and 4.5 (constructing of SOM) have minor similarities with the conference papers. Chapter 5.1.1 (the results of Model 1) is based on the results of the AI/ET 2001 paper (Länsiluoto et al. 2001).

Chapter 5.1.2 (the results of Model 2) is based on the results of the SMS paper (Länsiluoto et al. 2002d). Chapter 5.1.3 (the results of Model 3) is based on the results of the ECAIS paper, excluding the what-if simulations (Länsiluoto et al. 2002a). Chapter 5.2.1 is based on the results of Pulp and Timber paper, excluding the what-if simulations (Länsiluoto et al. 2002b). Chapter 5.2.2 is based on the AI/ET 2002 paper (Länsiluoto et al. 2002c). Chapter 5.3.2 is based on AI/ET 2003 paper (Länsiluoto et al. 2003b). All other parts of the thesis are written solely by Aapo Länsiluoto under normal supervision.