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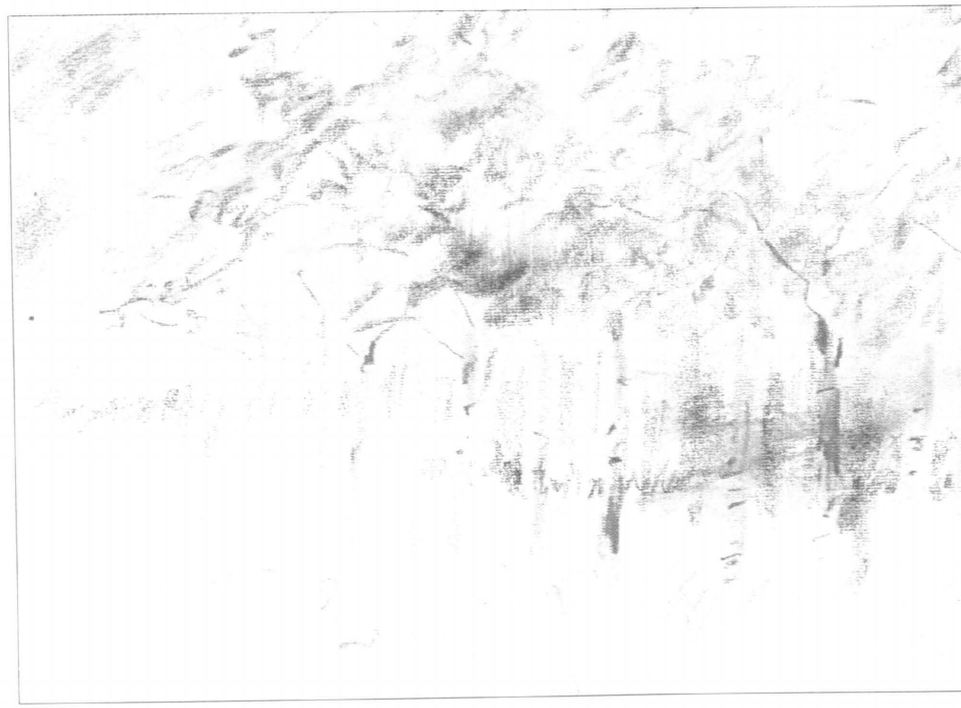

Timo Hartikainen

Late-Industrial Sawmill Customers. The Concept of Industrial Operating Mode and Its Testing in Secondary Wood Processing Industry

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The Finnish Society of Forest Science — The Finnish Forest Research Institute

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The methods of secondary wood processing are assumed to evolve over time and to affect the requirements set for the wood material and its suppliers. The study aimed at analysing the industrial operating modes applied by joinery and furniture manufacturers as sawnwood users. Industrial operating mode was defined as a pattern of important decisions and actions taken by a company which describes the company's level of adjustment in the late-industrial transition.

A non-probabilistic sample of 127 companies was interviewed, including companies from Denmark, Germany, the Netherlands, and Finland. Fifty-two of the firms were furniture manufacturers and the other 75 were producing windows and doors. Variables related to business philosophy, production operations, and supplier choice criteria were measured and used as a basis for a customer typology; variables related to wood usage and perceived sawmill performance were measured to be used to profile the customer types.

Factor analysis was used to determine the latent dimensions of industrial operating mode. Canonical correlations analysis was applied in developing the final base for classifying the observations. Non-hierarchical cluster analysis was employed to build a five-group typology of secondary wood processing firms; these ranged from traditional mass producers to late-industrial flexible manufacturers.

There is a clear connection between the amount of late-industrial elements in a company and the share of special and customised sawnwood it uses. Those joinery or furniture manufacturers that are more late-industrial also are likely to use more component-type wood material and to appreciate customer-oriented technical precision. The results show that the change is towards the use of late-industrial sawnwood materials and late-industrial supplier relationships.

Keywords industrial operating mode, late-industrial, post-industrial, joinery, furniture, sawmills
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Preface

This study is result of my graduate studies in Forest Products Marketing and Futures Research. The area of the study and the empirical application are related to the former, and the theoretical background with the formulation of basic research assumptions have their roots in the latter. The research has been conducted at the Department of Forest Economics, University of Helsinki. I would like to thank the Academy of Finland and the Finnish Cultural Foundation for their financial support. Thanks are due to my supervisor Prof. Heikki Juslin for his support, as well as Prof. Pentti Malaska of the Turku School of Economics and Business Administration and Associate Prof. Robert Bush of the Virginia Polytechnic Institute and State University for their valuable suggestions. Many thanks to my colleagues for their comments during the process. I would like to thank Mr. Kimmo Vehkalahti for his advice on data analysis and Ms. Laura Cottle for revising my English. The responsibility for any remaining flaws in both of these aspects is naturally mine alone.

Helsinki, July 1997

Timo Hartikainen

1 Introduction

1.1 Area of the Study

This study analyses the role of the industrial operating modes applied by joinery and furniture manufacturers using sawnwood, and profiles the differences between the manufacturers as sawmill customers. The study builds on the premise that the ways of secondary wood processing business evolve over time and affect the requirements set for the wood material and its suppliers.

The industrial operating modes are particular kinds of technologically and culturally determined ways of wood processing, which will be defined in the study. As technology develops by innovations it makes possible that the industrial operating modes of the joinery and furniture manufacturing change. This in turn triggers changes in the quality and quantity requirements to the wood material and parts purchased and sets new requirements to the suppliers and contractors of these inputs. The main suppliers of the joinery and wood furniture business are the sawmills. This chain of changes and effects between the secondary and primary wood processing industries forms the problem area of the study.

Industrial change has been central topic in social and management sciences since the beginnings of the industrial revolution in the eighteenth century. At present several economic and social discontinuities are interpreted as signs of a broader societal transition ongoing. The question of what is going to follow in the business environment is being tackled from several directions in many studies. In this study, the concept of *late-industrial* is used to describe the incremental change of the business environment. The term copes with the notions of information-intensive, de-massified production and non-adversary business relationships.

A mixture of scientific curiosity and expectations for practical business potential justifies the study. The construct of late-industrial economy is used as the theoretical background. Premises derived therefrom are operationalised in an empirical study on secondary wood processing firms. In addition to the inherent change in the industrial operating modes of sawmilling, a change in strategies may become necessary due to emerging operating modes and potential new customer types within the sawmill customers.

There is plenty of general literature on the industrial change, but it is diffuse and widely scattered, and weakly related to the wood processing industries. This study summarises core ideas especially from the wood processing industries' point of view. On the other hand, studies on how to observe the overall industrial change process in factual industrial enterprises within that process are scarce.

Specific practical interests for this study are many. In the Finnish sawmilling industry ideas of advanced sawmilling systems have been under scrutiny for the past thirty years, but experiments in component sawmilling have not always been successful. The late-industrial approach of this study might provide better understanding of the possible nature of problems. This study takes the component sawmilling as a demonstration of late-industrialism in the primary wood processing, for which the secondary wood industries constitute the customer base. The empirical part of the study is focused on two branches of the secondary wood processing setting new requirements to the primary wood industry. Window and door manufacturers are the traditional customers for high and medium quality wood, and furniture manufacturers are seen as potential customers for a broader quality spectrum. The late-industrial framework leads to fresh ideas for sawmill customer segmentation, and a step forward in the segmentation may well enhance the competitive edge of a market-oriented sawmill. Success of the primary wood industries plays a significant role in increasing employment and forestry-based regional income in Finland. Furthermore, the perspective of soci-

etal change also emphasises the need for continuous renewal and acculturation of the strategies applied for retaining the competitive edge; this in turn calls for a better understanding of the change.

1.2 Challenges for Sawmill Industry

Potential with obstacles. Sawmilling has the advantage of a renewable raw material base, and it produces material that is highly flexible, easy to handle and has a multitude of end-uses. One cannot resist the idea that the late-industrial society just might find a special place and status for new style sawmilling. The problems most regularly discussed in the Finnish sawmill industry are the raw material markets and procurement, roundwood as a cost factor, and quality of saw logs available (Niemelä 1993). As a sawmill has only a limited leverage to its main cost factors (cost of roundwood, employees, and capital), it feels obliged to concentrate on increasing productivity in order to maintain its price competitiveness (Simula 1995). From the industrial change viewpoint, the traditional volume-based concept of productivity will probably need to be re-defined as productivity measured by the value-added per customer.

The starting points of business in the sawmill industry have been quite cautious. The beliefs held by managers in 1991, as studied by Uotila (1994), show that the driving forces have been mainly external to the companies. Further processing of sawnwood has not been profitable because of difficult situation with the prices of logs, fibre wood and by-products. The imperative of production volume has inhibited effective product development in the bigger companies. Sawmilling has been a way to process large diameter logs but to produce chips as well, as a by-product – often the only reason for the pulp and paper corporations to remain engaged in sawmilling. Some argue even that the internal pricing of fibrewood and chip at the integrated sawmills has caused the profitability problems that the independent sawmills face regularly. Ownership structures have been one obstacle to development of the business as the enterpreneurship and efficacy of smaller business units are largely missing (Uotila 1994).

From commodities to customer products. Beauregard et al. (1994) still emphasise the traditional view of sawnwood as a commodity. A particular product mix manufactured from a given stock of raw material, using a particular technology and organisation, must be sold on a highly volatile commodity market. Validity of this business view is questioned in general and Narver and Slater (1996) argue that there need not be such a thing as a commodity within the forest products, and that every business is fundamentally a service business. Their arguments are supported by examples of US forest products companies that have successfully changed their bases of market understanding.

Sawmilling is one of the few production areas where the level of further processing has remained relatively stable since its industrialisation, while the substitutes for sawnwood are delivered to the same customers as semi-components and components (NUTEK 1992). Although the products themselves have remained same, planning and control of sawmill production have gone through a remarkable change during the last three decades, mainly as a result of the development in automation and computer technology. In the 1990's the emphasis in information-related development has been on the on-line networks from the customer to the sawmill to the forest (Simula 1995). Development of the sawmill machinery itself provides the technical basis for realising a broad variety of customised sawnwood products. In addition to computer-based statistical quality control and optimisation, the current research and development efforts in the field of value-added primary wood processing focus on cutting efficiency and accuracy, computer-vision scanning systems, minimising set-up times and flexibility of manufacturing (Usenius and Song 1994, CAWP 1996).

Marketing channels. Uotila and Juga (1993) point out that while information technology helps facilitate communication and production, the success of the business system is more dependent on the ability of the system to respond to sudden and unexpected changes. Technological change is the most concrete part of the emerging new industrial operating mode, and it will extend its effects on management and seller-buyer relationships.

Advantages of direct industrial sales include speed in production control, established customer base, accurate segmentation information, and maintained ability to provide consistent services to the customer. Difficulties include high entry level of direct relationships, need for continuous follow-up of customer satisfaction, and need for continuous research and development of products and the production system. Of these difficulties, the high entry level is a factor somewhat external to the company, and the rest remain issues that can be treated within the sawmill company, if so decided (Silén 1993). The principles of integrated supply chain management are suggested by Uotila and Juga (1993) as a useful framework for identifying potential success factors in the domain of materials and information management, supplier relations, and the delivery of the product. The direct marketing channel would be described as a pull system, where nothing is produced until a customer has been found.

1.3 Opportunities in the Secondary Wood Processing

Changing market. The sawnwood market in Europe is ambiguous because of globalising competition and unpredictable effects of local market turbulences. The Russian Federation and other countries in economic transition are reconstructing their economies and exports. Also other features of doing business have changed: customers are not willing to keep large stocks, the delivery sizes have decreased, and customer needs seem to be more varied, demanding, and price sensitive. Niemelä (1993) refers indirectly to what is called in this study the late-industrial features in sawnwood markets, when stating that end-product life cycles are shorter, the number of variations is increasing and customers are demanding higher quality products. One big challenge for the sawmill industry is to be able to respond to the changing customer needs.

Production systems. The situation and directions of change at secondary manufacturers are described in brief by Hirvelä et al. (1987) in a study about subcontracting relationships. The supply of physical products and materials to the secondary wood industry is plentiful, but scarcity prevails in quality, reliability of deliveries and terms, management of total service, and delivery contents strictly according to the orders. Emphasis is moving from tangibles to intangibles, from volumes to quality, and from static orders to dynamic co-operation. The solutions based on machinery are enriched by solutions originating from human skills and needs. A Swedish study (NUTEK 1992) argues that manufacturers wish to receive the wood material they need from fewer primary producers with bigger delivery capacities, though in smaller but more frequent deliveries. They also look for broader variety (more types of material) and in certain cases also deeper variety (more variants of the same material). This means that demand for tailor-made deliveries of wood-based materials will increase. Customers seek suppliers competent in delivering complete product families of wood mechanical products (NUTEK 1992).

Potential in benefit segmentation of sawmill customers. The idea of tailor-made offerings is supported by a study on product tailoring and benefit segmentation in the US market by P.M. Smith (1988), who studied product quality as a competitive advantage for the forest products industry in the professional contractor and remodeller market. Smith argues that the benefits (product and service attributes) customers seek define their perception of quality. These benefits are the basic rationale for the existence of market quality segments. Referring to several authors and empirical studies Smith suggests that this causal approach to marketing has been shown to determine purchase behaviour much more accurately than do demographics or volume consumption. Conclusions of the study suggest that by examining customer segments individually and tailoring specific market offerings to better meet their needs, the competitiveness of the sawnwood products industry can be enhanced.

Quality and its dimensions. Secondary manufacturers of wood products are usually interested in as homogenous materials as possible, just like any other manufacturers. Material that causes unexpected breaks in production and needs extra manual handling reduces the motivation to use it, especially today when the timing factor and views on quality costs are becoming more significant (NUTEK 1992). An empirical example of this can be found from Bush (1989), who studied the US hardwood sawnwood industry. The customer part of the study included high quality sawnwood us-

ers from joinery (millwork) and wood furniture industries. The study sought to characterise the product and supplier attributes required by industrial end-users. The largest determinant attributes in hardwood sawnwood purchase decisions were grading accuracy, freedom from surface checks, within-load thickness consistency, supplier reputation, and competitive pricing. Bush (1989) concludes that in order to optimise the marketing mix for a particular market segment, sawnwood producers may wish to look at determinant attribute differences between types of users. The results suggested that sawnwood producers have underestimated the importance of quality to their customers in secondary industry, and that improving quality of sawnwood may provide an opportunity for the sawmills. This kind of improvement could be the basis of a focus strategy in porterian terms.

Dimensions of quality for softwood sawnwood were studied by Hansen (1994) in a study of wood treaters, truss manufacturers and home centres. Using the dimensions presented in previous studies by Garvin for product quality and Parasuraman et al. for service quality, he rated the importance of product and service characteristics to quality. The resulting re-specified model included five dimensions: sawnwood characteristics, supplier or salesperson characteristics, performance of the sawnwood, supplier services, and supplier facilities. As the results differed from past findings on the inherent dimensions or quality, Hansen (1994) concludes that the dimensionality of quality may be product type or industry specific. Following the same line of arguments as Smith (1988) and Bush (1989), Hansen (1994) argues that firms seeking to remain competitive must actively work to improve the quality of their total produce. According to Reddy et al. (1996), market-oriented companies will seek to understand customer preference structure and to provide products which match these preferences.

Customer relationships. Niemelä (1996) used a selected set of success factors in comparing Finnish and Swedish sawmills as perceived by their industrial customers. The study indicates that the customers have positive perceptions of the sawmill performance on environmentally sound forestry, quality of wood material and sawnwood, and reliability of deliveries. The perceptions are negative on stability of pricing, electronic data interchange connections, and product development. Emphasis of the sawmills on good performance of product quality and deliveries but less emphasis on customer relationships would indicate that the strategies of Finnish and Swedish sawmills are still just production and raw material oriented, or that the emerging market-orientation is not yet felt at the customer level (Niemelä 1996).

Some studies on the European secondary manufacturing have concentrated on determining the attitudes of potential sawmill customers towards sawn-faced components and on the attractiveness of the market (e.g., Juslin et al. 1988, Juslin and Kaijala 1988, Makkonen 1991, Pesonen 1991). Like the US studies, these also state the central role of offering the benefits that the customers seek. In general, the greatest potential for sawn-faced components has been found in the window, door, furniture, and building part manufacturers. The competitive advantages of the sawmill were identified as differentiated product, consistent quality corresponding to customers' needs, and accurate, reliable deliveries. The successful producer-user relationships were characterised as close and solid, including technical service and support activities, few middlemen, and enabling direct information flow between the sawmill and the manufacturer. The main conclusion of these studies is that market areas that are advanced in their infrastructure and technologies require advanced marketing strategies, whereas more standard market areas can be served through less advanced strategies.

New sawnwood materials. The above-cited studies suggest that customised sawmill products and service offerings are increasingly demanded by the market. In the physical products this may mean, for example, an increase in the share of component-type sawnwood. The use of highly customised sawnwood in the secondary manufacturing offers several advantages but also some disadvantages (NUTEK 1992). On the negative side, the manufacturer loses some control and management of product quality, especially when consistency of wood quality provided by the sawmill falls short of the expected. Together with delivery problems this can lead to decrease in flexibility. Manufacturers have often difficulties in giving explicit definitions for the quality they seek

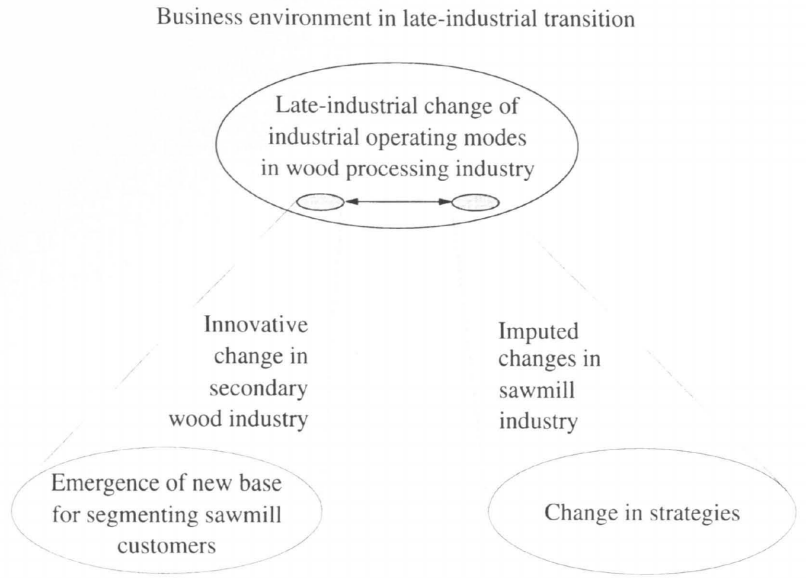

Fig. 1. The preliminary frame of reference of the study.

in customised wood material. The sawmills' knowledge of the customers' needs is suspect and sawmills actually supplying further processed wood are few. The advantages of using customised sawnwood may include following issues (NUTEK 1992). Resources are freed from wood processing for the core activities: marketing, distribution, and product development. Direct production costs decrease: transportation, waste of volume and quality, drying, cutting, reject, planing, etc. Indirect production costs diminish because of simplified production lay-out, shorter production cycles, decreased handling of waste and reject, more homogeneous quality of incoming material, higher quality of the end-product and lower storage costs.

Problematisation. Change in the industrial operating modes in the secondary wood industry may be characterised as a combination of changes in the pattern of important decisions and actions taken by the secondary manufacturers. The previous research findings and descriptions of today's secondary wood processing industry support the assumption that their industrial operating modes do change. Several studies suggest that this change will have consequences for the wood supplying sawmills and that the interest in intangible aspects of the supply increases. What are these challenges for the traditional sawmilling and opportunities within the secondary wood processing forms the special problematization of this study. The late-industrial transition of economy reflected to the wood industry is accepted as the theoretical background. The preliminary frame of reference of the study is summarised in Fig. 1.

2 Purpose and Design of the Study

2.1 Purpose of the Study

This research aims at producing information that would help sawmills in utilising opportunities provided by advances in technology and information management systems, and in adapting their operations to the needs of emerging new customer types in the secondary wood industry. The results help when developing the product, customer, and competitive advantage strategies at sawmills.

On the theoretical level the objective is to introduce the concept of late-industrial transition to the research on sawmilling and its business environment. The study to collects constructs of the late-industrial from several directions and compiles them into a theoretical framework for the study. So far any explicit mentions of applying the late-industrial concept to the sawmilling business were not found in related research. Promotion of market orientation is one of the strongest issues in recent studies suggesting that a general framework of late-industrial society may also be applicable to wood processing industry, at the expense of prevailing production orientation. The operationalisation of the theoretical construct within the preliminary frame of reference is made with the concept of an industrial operating mode.

The empirical objective is then to measure different industrial operating modes and diagnose their proposed differences: that is, whether the modes are still industrial in the traditional sense or to what extent the late-industrial features are exhibited. The specific objectives of the empirical analyses are:

1. Identify dimensions best differentiating between the industrial operating modes.
2. Create sawmill customer typology based on the industrial operating modes and describe distinctive features of the customer types.
3. Describe degree of satisfaction to sawmill performance by customer type.
4. Analyse connection between customer types and customer background variables.

The first and second tasks are to investigate how to differentiate late-industrial customers from traditional customers. The idea is to group for marketing attention customers having similar needs, to be matched with competencies of the possible supplier. The third task is to describe whether there is a gap of expectations between the present supply and the emerging new style demand. As the analyses will be based on survey data that are not directly visible from outside of the firm, the fourth task is to relate the findings to more easily identifiable company background variables.

2.2 Research Design

This study focuses in its operationalisation on the industrial operating mode, its change in the secondary wood processing industry, and the significance of this development to the sawmill industry. The concept of industrial mode is discussed and defined in the following chapter, but it is already used in this section in the basic assumptions and the implementation idea of the study.

The industrial operating mode refers to the behaviour of a company related to its products, customers, suppliers and other factors of its business environment. One central component of it is the production model applied, with the two complementary components of business philosophy and supplier choice criteria. Three industrial operating modes are outlined to be measured. The traditional industrial mode believes in economies of scale and cost leadership of bulk production for a homogeneous market. The first late-industrial mode believes in advanced mass production that aims at specialisation through increased flexibility and serves a more heterogeneous markets. The second late-industrial mode believes in truly flexible production model, and economies of scale as a goal are replaced with economies of precision, variation management, and differentiated response to the demands by an ever more divided market.

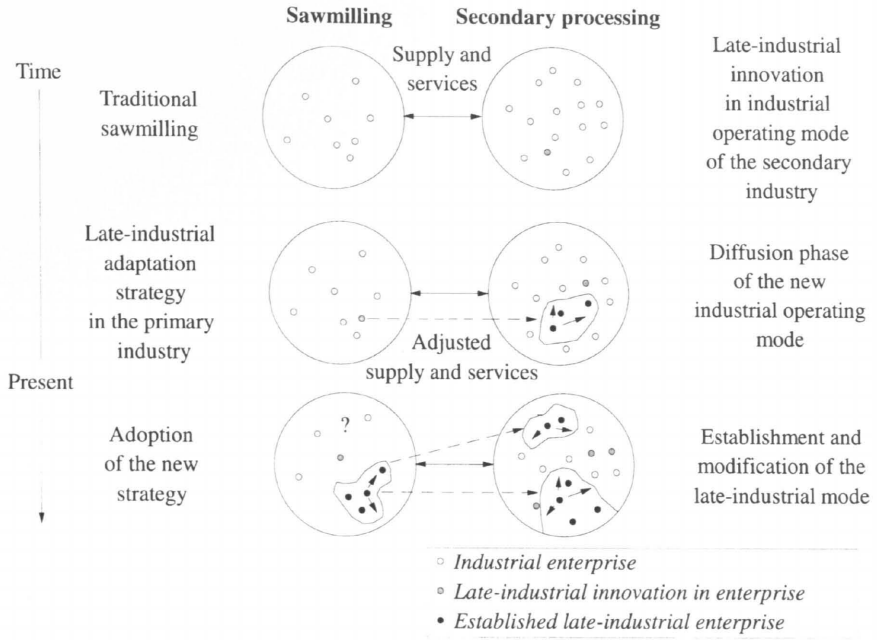

Fig. 2. Assumptions of the study about the development of industrial operating modes in the secondary wood processing and sawmilling industries.

The preliminary frame of reference presented earlier in Fig. 1 assumes that the change of business environment and demand causes change in the industrial operating mode of the secondary wood industry. The logic of this change and its implications to the whole wood industry is explicated in Fig. 2. A change in industrial operating mode begins from an innovation made by an individual firm in the secondary industry. The innovation may be based on market orientation or technological development or both at the same time. A new industrial operating mode is established including possibly product design, production process, logistics, assembly, market channel, maintenance, finance, etc.

A successful innovation leads to diffusion of the innovation to other firms, and thus the new operating mode starts to spread within the industry and also to the related business areas as a change push. The initial effects may already be felt within the supplying companies, and a derived innovation is assumed to take place there in the form of adapted supply and service offerings. In Fig. 2 this is labelled as a late-industrial adaptation, in order to emphasise that this change may be also deliberate and not only due to external pressures. As the new industrial operating mode gains ground in the secondary wood processing industry, it is diffused to a certain extent and forms a substantial segment of the market.

This change process is assumed to be continuous. The innovations in the industrial operating mode in general are in reality of course more complex than in Fig. 2. There may be simultaneously change going on towards several directions in various areas of business operations, and the changes may not always be even perceived or regarded as significant advancements at first. They may be what has been called weak signals, and not only left unnoticed at first but also become wrongly addressed as disadvantages if they are analysed too short-sightedly. The multiplicity of the meanings of the change makes the research problem more difficult. It is assumed that by us-

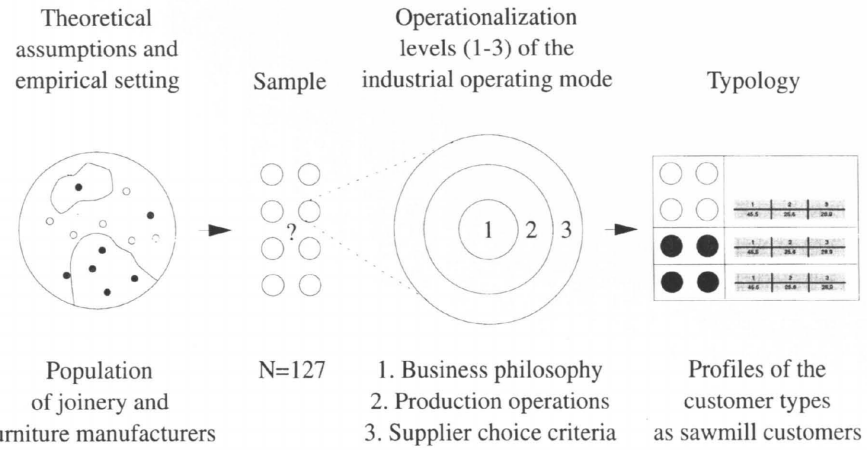

Fig. 3. Implementation of the study.

ing complementary levels of empirical data it is possible to discover advancement differentials in the various industrial operating modes. In order to keep the amount of data manageable within a single study, the operationalisation of the industrial operating modes is restricted to what is assumed to be the most central areas of industrial activity.

The theoretical assumptions of the change process of the industrial mode form the basis for the empirical analysis. According to Fig. 2, the present situation is assumed such that a late-industrial operating mode has already been established and may thus be detectable. However, the presence of new modes in the company population is not explicitly known, and a sample of companies is to be observed to deal with the question.

Fig. 3 outlines the implementation of the study as a non-probabilistic sample study (interviews using a survey questionnaire). The concept of the industrial operating mode of the secondary wood processing industry is composed of three components, which will be measured. They are the business philosophy component, the production operations component, and the supplier choice criteria component. Empirical data are collected in four countries, of a total number of 127 joinery and furniture manufacturers, and a statistical analysis is conducted.

The push and pull dynamics between the primary and secondary business levels of the wood processing chain form a time-evolutive model. The empirical implementation of the study leads to a cross-sectional portrait of this model. The high level of abstraction in the point of departure – the change from industrial to late-industrial mode – adds a significant new element to the study as it provides a theoretical basis for conceptualising and operationalising the industrial operating mode. This is essentially important when studying a business that is more dominated by short-term practical issues than any visionary management views. It also improves the applicability of the theoretical contribution of the study beyond the target industries.

3 Theoretical Background of the Study

3.1 Late-Industrial Transition

3.1.1 Significance of the Transition

A significant transition of the industrial societies is taking place, and, in a different manner within the non-industrialised parts of the world as well. One of the best popular descriptions of the change has been published by Toffler (1980). His thinking flows from the assumption that we are the final generation of an old civilisation and the first generation of a new one. He uses a wave metaphor, the meaning of which is to demonstrate the dynamics of successions and cross-over effects of several, partly simultaneous processes. Beginning with the idea that the rise of the wave of agriculture was the first turning point in human social development, and that the industrial revolution was the second wave of a great break-through, Toffler views each of these not as a discrete, one-time event but as a wave of change moving at a particular velocity. Toffler's third wave is to him descriptive of the present period of transition.

Hutchinson (1995) argues too that the transition we are now experiencing is comparable in magnitude to the agricultural and industrial revolutions. The transition has no accepted common description. The post-industrial age, as Bell (1973) calls it, is for Hutchinson descriptive of where we have been rather than where we are going. Terms like the information revolution, a social transition, the age of communications or the global village are also used. These terms identify some important characteristics but do not quite capture the essence of the transition that is taking place. Malaska has used the terms society of intangible needs (1983, 1985) and late-industrial (1993) to give a more appropriate association with present and near future economic development than the term post-industrial, which refers to the future after the industrial. The late-terminology conveys the continuation of dominant structures and relations, but in a more particularised and precisely-adapted way.

When analysing the cause of the change, Sternberg (1993) presents two potential causes. The first possible cause would be the changing economic preferences of consumers as they shift their interest from physical goods to information goods. The second potential cause would be pure technological drive: in industrial society, new industrial innovations, the bureaucratic and corporate organisation of society, the information-imperatives of organised warfare on a world scale, new demands for education and social services – in short ever greater complexity – increased the need for rapid access to information. The industrial world itself, therefore, had in it the seeds of the birth of the information age. Malaska (1985) supports the former cause. The needs to be satisfied together with the dominant sector of economy and its rationale describe the transitions from pre-industrial society to industrial and late-industrial society.

There are several levels of abstraction used by authors for describing the change process outlined above. The highest level can be referred to as discussion on the cultures or civilisations. The discussion on modernity and post-modernity would seem to belong to this level (Table 1).

Several theoretical notions in the literature try to capture the change at the level close to people's everyday life. Divisions between basic, tangible and intangible needs; goods, information and services production; material growth and reflexive modernisation are quite close to each other. In addition to these, the rationale underlying the society is commonly mentioned – be it cyclical, mechanistic, or based on human consideration. These two or three levels provide the background for narrower definitions that are needed in the empirical part of this study.

The dominant sector view can be adapted for the purposes of this study, and it would incorporate the various "-industrial" terms. The econom-

Table 1. Levels of the change process and principal terms used in literature (adapted from several sources mentioned in section 3.1).

Level	Terms used
Cultural era	Pre-historic – historic – modern – late-modern – post-modern
Societal phase	Basic needs – tangible needs – communication – reflexive risk society
Guiding rationale	Past experience – mechanistic – human consideration – visionary
Dominant sector	Collecting/hunting – agricultural – industrial – information – services
Paradigm of production	Self-sufficiency – craftsmanship – fordism – neo-fordism – post-fordism
Paradigm of marketing	Relationship marketing – transactional marketing – relationship marketing

ic dominance has shifted from collecting-hunting to agricultural and industrial sectors. The present time could be described as the late-industrial transition period, which could perhaps even develop into a more steady-state post-industrial phase. The focus of this study, however, is on the transient late-industrial.

The paradigm of production is the subsequent, more detailed level of abstraction. It tries to describe the most important way of realising the goals set by the dominant sector. In the collectors-hunters' society and in the agricultural society self-sufficiency and craftsmanship were the prevailing paradigms. The industrial phase brought along the mass-production defined by some authors as "fordism". The present age of transition is supposed to express itself either as a better version of fordism (neo-fordism) or a totally new paradigm (post-fordism).

From the marketing perspective the process need not be linear. Though the present seller-buyer relations are different from the agricultural society, the current rise of relationship marketing can be interpreted as a return to the ancient mode of agricultural and crafts market, where good times and bad times were levelled off by retaining loyal customers through close relationships. The industrial phase, on the other hand, has been characterised by more transaction-oriented customer relationships, usually meaning indirect selling and distribution (Sheth and Parvatiyar 1995).

It may be useful to mention that the age of transition also has its antithesis. One example of the "industry as usual" view can be read in a report published by the Finnish government in 1992, when the economic depression was at deepest (Suomi... 1992). The government report defines neo-industrialisation as opposite to post-industrial, when stating that "it is impossible for Finland to survive in these [economic and geographical] conditions with the means of post-industrial production and services. Growth is possible only through increase in the competitiveness of the industry." The post-industrial products and services refer in the report to specialised and perhaps small-scale offerings, as opposed to the bulk of traditional export products. The large-scale type of neo-industrialisation could be achieved through price competitiveness, productivity, availability of investment capital, increased returns on investments, and sufficient cheap energy supply – an "industrial", mechanistic rationale.

The following sections present positions that consider the change a real phenomenon – an assumption of this study. These positions cover a variety of ideas on the present and future change on the levels of culture, society and dominant sector. The changing modernity, the post-industrial, the information society, the risk society, and the late-industrial will be briefly described.

3.1.2 Change of Modernism – Subjective Fragmentation

Modernity has had a long and complex historical evolution comprised of the coincidence of a number of historical processes. The label of modernity generally refers to the period in Western history starting from the late sixteenth century or early seventeenth century (1500–1600) up to the present. *Modernity* refers to the time period, and

modernism to the philosophical and socioculturel ideas and conditions marking this period. In the nineteenth century, modernity became identified with industrialism and its associated social, economic, and cultural changes (Hall 1992), Flrat and Venkatesh 1995). No single master process was sufficient to produce modernity; it might be described as a sum of these different forces. The main processes included were:

- the rise of the secular state and polity
- the capitalist economy
- formation of classes and an advanced sexual and social division of labour
- the separation of the sphere of production (institutional and public) from the sphere of consumption (domestic and private).

Flrat and Venkatesh (1995) elaborate ideas as to post-modernism, the period that will follow modernity. In post-modernism, the notions of culture, language, aesthetics, narratives, symbolic modes, and literary expressions and meanings are considered central whereas in modernism, these are all considered secondary to economy, science, concrete objectifications, analytical constructs, and metaphorical representations. In terms of processes, modernism is more interested in continuities, progressions, stable order, and harmony. Post-modernism considers these processes to be illusory, fictional and argues that the micropractices of everyday life – discontinuities, pluralities, chaos, instabilities, constant changes, fluidities, and paradoxes – better define the human condition. Nothing in the logic of human affairs defines the categories privileged under modernity as natural or timeless. In terms of social and political theory, post-modernism accepts the possibility that several theories, which may or may not agree with each other, can each have a legitimate position in human discourse.

In his latest work "Critique of modernity" (1995) Touraine defines the present situation as characterised by subjectivation, rationalisation, and the appearance of new social actors. There is no longer faith in progress or belief that greater prosperity will lead to democratisation and happiness. People are afraid that growth will destroy natural equilibria and lead to increased inequality on a world scale. Existence of a society is no longer perceived to be organised around political institutions. Centres of economic, political and military power and related administration are separate from the private world of needs and well-being. While the market forces are replacing social norms and cultural values with competition, an obsession with identity is replacing involvement in society at the personal level.

In the economic sphere of life, post-modernism considers both symbolic production and consumption to be major areas of community participation. In sum, post-modernists view all knowledge to be a construction of one sort or another and the product of language and discourse. As a conclusion to their analysis, Flrat and Venkatesh (1995) define a position of their own labelled "liberatory post-modernism". They partially agree that post-modern conditions cannot be considered a break from modernism but a radical extension and maturing of it. Brown (1995) has screened post-modernism into a book that is aimed at the mainstream marketing audience, and which examines the nature of post-modernism in contemporary marketing theory and practice.

3.1.3 Post-Industrial – Intelligent Service Economy

The post-industrial terminology was developed as a product of visions constructed upon projected developments of the computer and related technologies. The industrial history can be divided into four stages. The first of these stages is *pre-industrial* and represents an early period of craftsmanship where mass manufacturing is virtually non-existent and where the economy is dominantly based on agrarian or extractive technology. The second stage, called the *industrialising* era, marks the beginnings of manufacturing capability in an economy first with cottage or "guild" production, and later with simple forms of mass production. The third stage is characterised as an *industrial economy* where manufacturing dominates and which is based on machine or fabricating technology. An industrial economy produces for a demand of manufactured goods. The fourth, most "advanced" state of development is termed *post-industrial* and it is characterised by a shift from a manufacturing-based economy to a service or information-processing

based society. Both "industrialising" and "post-industrial" economies are depicted as net importers of manufactured goods; these are supplied by the production surpluses of "industrial" economies (Winsor 1992).

The concept of the post-industrial society is far-reaching. Its meaning can be more easily understood if one specifies five dimensions, or components of the term (Bell 1973):

1. Economic sector: the change from tangible goods production to an intangible service economy;
2. Occupational distribution: the pre-eminence of the professional and technical class;
3. Axial principle: the centrality of theoretical knowledge as the source of innovation and of policy formulation for the society;
4. Future orientation: the control of technology and technological assessment;
5. Decision-making: the creation of a new "intellectual technology".

According to Rose (1991), a closer look at all these components reveals, however, that not only are they too generalisations, but also that they may, according to some interpretations, just as well describe some aspects and philosophies of the industrial societies of the past century. There is also a conflict between the emphasis on service production and emphasis on professional and technical workers: those engaged in producing services are missing. In all, these five points describe a rather optimistic view.

Touraine (1974) describes the post-industrial society as programmed by its technologies and dominated by technocratic power. He argues that economic decisions and conflicts no longer possess either the autonomy or the central importance that they had in an earlier society. Such a statement may seem paradoxical since society as a whole is more than ever influenced by the instruments of economic growth and its tangible results. Touraine states that factors like the ever-growing geographic and social mobility, the massive diffusion of information and propaganda, and broader political participation than ever before make it impossible for exclusively economic mechanisms to be maintained any longer at the centre of social organisation and activity. Although some issues in the post-industrial metaphor are today considered ill-formulated or old-fashioned, deeper insights like the one presented by Touraine may be as applicable today as they were two or three decades ago.

Post-industrial may best mean something after the industrial society. The proponents of it usually do not make it clear whether they connect the term to some future state of the world or to the present also. Malaska (1985, 1993) regards the post-industrial society as a future vision where the industrial mode of production does not have anymore the dominance and the underlying industrial rationality has also lost its dominant role as the rationality of the whole society. Then it must be asked what is the new dominant mode of production and what is the dominant (non-industrial) rationality of society.

3.1.4 Information Society – Services and Interaction

In 1972, Yoneji Masuda presented his development program for the Japanese government. The key term in the report was "johoka shakai", translated to English as "information society". This was the new ideal state to be pursued by Japan through the use of computer and communication technology. Masuda (1981) points out that rapid innovations in the system of societal technology have usually become the axial forces for societal transformations. Recent views, however, suggest that "johoka shakai" should be translated as "communication society". The system of societal technology shows four basic characteristics:

1. Many kinds of innovative technologies come together to form one technological system.
2. These integrated systems of technology spread throughout society and gradually become established.
3. The result is a rapid expansion of a new type of productivity.
4. The development of this new type of productivity has sufficient societal impact to bring about the transformation from what had become traditional to new societal forms.

The image of the information society by Masuda (1981) builds on two premises. First, the information society is a new type of human society,

completely different from the present industrial society. The production of information values and not material values is the driving force behind the formation and development of society. Second, the past developmental pattern of human society can be used as a historical analogical model for future society. Masuda is very optimistic about the power of this analogy. Authors on information society typically show a degree of technological optimism – belief that new equipment for data processing and transmitting will solve the present societal problems and will open a new golden era for the humankind. Masuda exemplified this optimism: he expected the information society to boost one's individual freedom for setting self-fulfilling goals.

The optimists on the information society anticipate potential for saving natural resources, increasing productivity of work, creative and rich leisure time, free or unblocked communication between individuals, and development of democracy. Pessimists, on the other hand, see the threats of such society as the increased wastage of natural resources, destruction of the beauty and health of the environment, loss of work motivation, structural unemployment, control of individuals, and the rise of an egotistic, competition-driven class society (Niiniluoto 1989).

According to Malaska (1985), production and use of information is only the nucleus of late-industrial transition – not a separate societal phase. The society of intangible needs (e.g., communication, information, human-human interactions) will be the result of regenerative growth based on the traditional industrial society. Services become the dominant sector of economy and the guiding rationale is built on human consideration. This view interprets the information society as a late-industrial hinge between industrial and post-industrial. Masuda (1981) sees the need for human interaction as follows. In industrial society the most important subject of social activity was the enterprise, the economic group. There were three areas: private enterprise, public enterprise, and a third sector of government ownership and private management. In the information society the most important subject of social activity is the voluntary community, a socio-economic group that can be broadly divided into local communities and informational communities (Masuda 1981).

3.1.5 Risk Society – Reflexive Modernisation

One school of thought in social sciences with the label of "risk society" has been documented and developed by Beck (1988) in reference to emerging new types of risks in the society. Massa (1995) points out how unidimensional and unquestioned was the concept of development in the West after the world wars. Resources were put to work for technological advancement, economic growth, and the process of creating the welfare state in the European sense). Life styles were guided by trust in continued increase in consumption and material security. This steady and consensus-like picture of the future of the industrial societies has been shattered recently because of many problems and deepening threats like economic crisis, vast unemployment, nuclear accidents, and environmental crisis.

Massa (1990) describes the concept of risk society in his preface to the Finnish translation of Beck's work (1988). In traditional view of the "technological risk society" various risks such as the environmental threats are seen as an externally given part of normal life and subject to normal logic of decision making. Risks can be controlled by technical means; here calculation of risk probabilities has a central role. Technical interpretation of risks may lead to a bureaucratic society where individual creativity and autonomy are repressed by force, in order to meet selected safety standards ("ecological safety state"). In the sociologico-historical view on risk society, the view supported by Beck (1988), risks are seen as products of societal history. The most significant risks for future are unseen and incremental "post-industrial mass catastrophes". Massa (1990) suggests that term "exploitation society" might be more descriptive of the phenomenon than "risk society". The main strategy of healing adaptation would be to transform the society into a more ecological one: as Beck puts it, to move from stone age industrialism to industrialism aware of its consequences and responsibilities.

Contemporary sociological debate on risk society concentrates on the so-called reflexive modernisation (Massa 1995). This concept is based on Beck's separation between "simple" and "reflexive" modernisation. Simple modernisation means a projective model of linear development

based on the economic growth of the traditional industrial society. Beck argues that this model is facing a crisis because of globalisation and environmental damages. Reflexive modernisation suggests a line of thought that is radically suspicious of the industrial society, but is, at the same time, self-correcting and learning. Beck refers to the possibility that uncertainty may provide good mental soil for cultural renewal and regeneration. Reflexive modernisation is associated with the concept of "post-traditional society" by Anthony Giddens: it refers to modern western society within a global interactive network – a society whose traditions have become under strong scrutiny (Massa 1995). The discussion of post-traditional society leads on to the debate on the role and limitations of science in contemporary societies, and as such, it is beyond the scope of this study.

3.1.6 Late-Industrial – in a Cross Swell

According to Malaska (1983, 1985) we are not yet in a post-industrial society nor any longer in a plain industrial one, but going somewhere between them. We are in a transition period which he has named late-industrial (Malaska 1993). It is a transient period where it can be assumed that a rapid evolution is observed, but not permanent outcomes reached. Malaska (1985) describes the transition as "a change of vital parameters characterising the economic and social values and a change of mutual interactions and links between these values and between the nations of the world." He assumes that the world as a system is shifting away from its previous equilibrium or steady state towards a bifurcation. Importance of this bifurcation could be compared with that of the industrial revolution. The driving force of transition is the growth in the economies and economic interactions in the industrialised world which has been brought about.

Godet (1993) presents a list of key features of changing societal environment; a list that can be interpreted to also describe the late-industrial concept of this study. Godet's list continues with specific issues that affect manufacturing, which will be discussed in section 3.2.1. On the level of society in general the issues and their strategic consequences are:

- uncertainty: need for flexibility, versatility, active promotion of one's own projects
- interdependence and complexity: necessity of global vision and simple structures
- international imbalances: regulation by "world systems"
- globalisation: redeployment of activities, internationalisation of management
- slow, irregular and unequal growth: battle for market sectors, productivity, quality, diversification.

As the sections above show, the substance and terminology connected to the societal transition and industrial change is manifold and diffuse. Independent of whether the change is described through post-modernism, post-industrialism, information society, risk society, or a late-industrial period of bifurcations, the assumption of industrial change going on is plausible.

The concept of the late-industrial transition is used as the theoretical background of this study, and the following description is accepted as a working definition. When seen in short perspective, the changes in economic and social parameters are not discrete but continuous, and as the world "moves on" within a longer time frame, the small changes add up to bigger structural changes that are often noticed only after their establishment. Industrial production does not abruptly transform to services production, but is more and more guided by the changing demands of the evolving market and by the opportunities provided by information-intensive technologies. Growth of production in material terms is losing its position as the dominant rationality. During the late-industrial, various driving forces are influencing the society simultaneously, resulting in a period of disequilibrium. Whether any steady state or post-industrial phase will follow is not known, though in the long run it seems possible. The following section outlines the late-industrial phenomena at the company level according to this view and presents a preliminary operationalisation for the empirical application.

3.2 Industrial Operating Modes

3.2.1 The New Enterprise

The structures of companies and industries keep changing in an evolving society and economy. Vartia and Ylä-Anttila (1993) regard this as a condition of long-term economic dynamics. New enterprises are established, the unprofitable ones go bankrupt, some are merged, and some reorganise their activities. Hutchinson (1995) describes business enterprise as the most powerful, dynamic force in industrialised countries. The nature and scale of the response from business, as influenced by communities and households, will be the determining factor in achieving a sustainable society. Malaska (1985) adds some aspects to the role of industry. It offers the most efficient methods of producing goods and it will do so in the future. However, there will be a change in the way it functions: it will be built around human interaction instead of mechanistic thinking as at present.

Giarini and Stahel (1989) argue that the notions of risks and uncertainty, typical to late-industrial transition, form new challenges in the business environment. Godet (1993) lists changes in the business environment and their consequences for corporate organisation and strategy. Slow and irregular growth, technological change in processing, and deregulation are combining to organise competition, and the battle for market sectors becomes the search for the best quality-price ratio. Companies have simultaneously to diversify, to boost productivity where possible, and to confront new competitors. The human and organisational factor is crucial for competitiveness, so, according to Godet (1993) it is wise to take advantage of new information technologies and communication networks to move towards being "small, beautiful, and profitable". The age of the economy of diversity means that the future trend is towards mass production of variety and profitable small-scale production. This techno-economic evolution is taking place in step with the transformation of individual needs and aspirations towards more autonomy and diversification. For companies this means setting up small, autonomous teams of responsible intrapreneurs. Thus new forms of management, attitudes and behaviour are gradually emerging at all levels of the organisation.

Raux (1994) states that compared to the situation of the 1970s and 80s, the concept of the enterprise developing today is different. The enterprise is seen as a portfolio of generic competencies. These competencies form matrices where various markets of the company are born, live, and die. They are complex combinations of knowledge, know-how, and skills developed over time with practice and validated by their utility in different tasks within the enterprise. Generic competencies offer access to a great variety of markets, either directly or through "generic products" that are needed in a great number of final products. Raux (1994) believes that when rediscovering the economic uncertainty, the individual as well as the enterprise will probably also have to rediscover its sense of strategy and necessity of self-guidance in the continuous adaptation process. Like the human of the 21st century will not necessarily be a "finished" character according to its education in the youth, also the new enterprise will be in perpetual process of "becoming-learning-adapting".

3.2.2 Production Models in Change

Numerous concepts have been newly introduced to the discipline of business management. The total world effort addressing manufacturing competitiveness is considerable (Harvey and Gavigan 1996). Kotha (1995) argues that emergence of new manufacturing systems, increased pace of technological change, and the shifting nature of customer demand for increased product variety result in a transformation of the fundamental nature of competition in many industries. Firms competing in industries undergoing such transformation find that they are no longer able to compete on the basis of standardised products or services alone. The goal of business strategy in such environments is strategic flexibility, and the role of manufacturing is to provide the required flexibility.

Winsor (1992) classifies many of the contemporary buzzwords into the post-fordist paradigm, whose message is that the modern or fordist organisational design and production techniques

have outlived their appropriateness, and need to be replaced by more rational, flexible, and humanistic structures and methods. This vision differs significantly from the post-industrial paradigm, and is derived from multiple sources. Both paradigms discount the future viability of standardised mass production, and they both are based on the view that advanced countries are on the verge of new and radically different forms of social and industrial organisation. But then the similarity ends. The post-fordist paradigm is constructed upon the premise of a twenty-first century nation which continues to be dominated by a manufacturing-based economy, one which is perhaps even stronger than in the fordist era. The post-industrial paradigm, conversely, depicts a future nation in which manufacturing has only a small role to play, being and is displaced by services and information. The term post-fordist may be equated with "mass customisation" (Kotha 1995) or "flexible manufacturing" (Allen 1992, Vartia and Ylä-Anttila 1993).

In his analysis, Winsor (1992) claims that the present reality does not comply to either post-industrial nor post-fordist paradigms. The contradiction between reality and the two suggested paradigms of production may be solved by using a mediating concept offered by Allen (1992), the neo-fordism. This stage is based upon the role of the human work in moving from one regime of accumulation to another. While highly skilled technical workers amass the advantages gained from increased automation, the majority are either deskilled or unemployed. Meanwhile, at the global periphery, routinised, labour-intensive methods of production predominate. Allen (1992) does not imply that the latter is entirely a negative phenomenon; it may create the possibility for economic and social advance among the newly industrialised countries. For him, post-fordism would represent a move beyond fordism, whereas neo-fordism is still a form of traditional mass-production, though in an advanced form.

Allen (1992) summarises the regime of post-fordism as follows. Computer-controlled and integrated flexible manufacturing systems enable the fabrication of a diverse array of tailor-made or nearly tailor-made products in short but profitable production runs, and thus generate economies of scope as well as economies of scale. New forms of work organisation involve smaller but more adaptable, multi-skilled workforces committed to teamwork, total quality, mutual support and monitoring. Changes in management structure comprise flat or matrix organisational forms, fewer layers, less hierarchy, rigidity and bureaucracy, greater autonomy among and competition between divisions or subsidiaries and a more egalitarian managerial ethos.

Alterations in external relations consist on the one hand of strategic alliances with organisations of a comparable size and, on the other hand, of a process of vertical disintegration whereby production processes are subcontracted to networks of small, specialist suppliers sinked to the core company by just-in-time materials handling and computerised stock control procedures. The transition from fordism to post-fordism is marked by a geographical paradox where routine, labour-intensive production is decentralised, on a global scale, often to low-cost countries, but counterbalanced by the emergence of distinctive clusters of small, highly interdependent companies specialising in a particular category of products (Allen 1992, Brown 1995).

Harvey and Gavigan label the new paradigm of manufacturing emerging as "agile (manufacturing) enterprise". The fundamental feature of agility is an absolute customer and market orientation, characterised by the rapid provision of solutions to customer needs (rather than 'products) and the capacity to survive and thrive on unpredictable changes and events (changing customer needs, new market opportunities, etc.). An agile response will require the re-organisation of management accounting procedures used to measure and cost the production process, moving away from product-cost-driven prices, towards activity-and-project based costing, with price being based upon comprehensive market intelligence. Above all, agility has major implications for the organisation of manufacturing, and the role of the work force. Workers will become "project stakeholders" rather than simply employees. Natural resistance to such a radical change of organisation, especially from middle management and workers, is probably the greatest barrier to the creation of agile enterprises.

The three models of production (mass production, advanced mass production, and flexible production) can be roughly separated by the general tendencies associated with industrial activities (Table 2). Ollus et al. (1990) make distinction between mass production and flexible production, and Allen (1992) formulates a mediating position describing advanced mass production. The core investments move from plants and machinery toward information systems and intellectual or abstract innovations. The functional production rationale is replaced with advanced processes and product-centred organisation like workshops or cells. The production workers are not anymore in as central role as before; the core human resources are to be found in skilled technicians using advanced machinery or in teams and individuals responsible for connecting the enterprise to the markets. The traditional fragmentation of worker skills deepens in the neo-fordist mode, but may be transformed to multi-skilling in the flexible production model. Hierarchical bureaucracies are replaced with workgroups and flat structures.

Vartia and Ylä-Anttila (1993) argue that inter-firm co-operation will find new forms beyond the anonymous market relationships. This is mostly due to the attempts towards specialisation and risk sharing. Specialisation, however, no longer means manufacturing of few products in as long series as possible. Rather the specialisation will be in the form of producing as more differentiated products than before within the chosen product family or business area. The economies of scale are replaced with economies of scope. Doyle (1995) supports this view in saying that in an era of rapidly changing markets and accelerating technology, companies no longer can have all the necessary skills inside the organisation. Technological alliances with competitors, suppliers, consultancies, partnership, and consortia will play an increasing role.

The environmental and organisational development factors affecting the supplier/customer

Table 2. Comparison of production models (adapted from Ollus et al. 1990, Allen 1992, Vartia and Ylä-Anttila 1993, Kotha 1995).

Production model (Henry Ford metaphor)	Mass production (Fordism)	Advanced mass production (Neo-fordism)	Flexible production (Post-fordism)
Goal	Goods and services at prices low enough that nearly every customer can afford them	Goods and services with enough variety that nearly every customer group finds what they demand	Affordable goods and services with enough variety and customisation that nearly every customer finds exactly what they demand
Focus	Efficiency through stability and control	Efficiency and variety through specialisation and flexibility	Variety and customisation through flexibility and responsiveness
Core investments	Tangible investments in plants and machinery	Information-intensive tangible investments	Intangible investments
Rationale	Mechanistic, functional processing	Functional processing with organic machinery	Organic, product workshops and cells
Core human resources	Production workers and supervisors	Skilled technicians	Production teams, persons responsible for marketing and product planning
Internal relations	Hierarchical, bureaucratic organisation	Workgroups and quality circles	Dispersed network, flat structures
Workforce	Semi-skilled mass workers, taylorism	Polarisation; elites and the deskilled	Multi-skilled, self-organising teams, stakeholders

relationship are according to Sheth and Parvatiyar (1995) the following:

- rapid technological advancements, especially in information technology;
- the adoption of total quality programs by companies;
- the growth of the service economy;
- organisational development processes leading to empowerment of individuals and teams; and
- increase in competitive intensity leading to concern for customer retention.

These forces are reducing the reliance of material producers as well as material users on middlemen, as they are better able to communicate directly. Producers are building such systems that allow them to undertake quick responses with regard to manufacturing, delivery and customer service, eliminating the need for inventory management, financing and order processing through middlemen. The just-in-time inventory system which is made possible by the real time transportation and communication systems, allows a manufacturer to eliminate the need for an intermediate inventory holding institution between itself and the suppliers. Rapid convergence of technologies mandates that companies work on joint projects to leverage their combined resources and to share risks; interfirm partnering and alliances are becoming popular. When companies embrace total quality management to improve quality and reduce costs, it becomes necessary to involve suppliers and customers in implementing the program at all levels of the value chain. This needs close working relationships with suppliers and other members of the marketing infrastructure. Just like retaining customers is less expensive than acquiring new customers, on the supply side it is more feasible to develop closer relationships with a few suppliers than to develop more vendors (Sheth and Parvatiyar 1995).

3.2.3 The Concept of Industrial Operating Mode and Its Components

From the viewpoint of this study, the concept of production model described above needs to be adjusted both in scope and focus in order to reach the level of operational measurement. Because the seller-buyer interface has an essential role in the preliminary frame of reference, closer focus is necessary on the principles used by the joinery and furniture manufacturers when selecting their wood material suppliers. On the other hand, changes in the business environment occur during a rather long time span – tens of years most likely. This necessitates a closer focus also on the intentions of the enterprise in the long run; the strategic decisions it takes based on its basic beliefs within the limits of product and market potentials together with external factors.

These two additional foci cover some aspects of the concept of production model, but they also bring in further elements in both concrete and abstract dimensions, and they leave only the most central issues related to production operations to form an intermediate level of company behaviour. In order to cover these three components, and to express the aspects under special attention in the study, the concept of industrial operating mode is used. An industrial operating mode becomes thus initially defined as a combination of three components in the company behaviour: the business philosophy, production operations, and supplier choice criteria.

When the more established concept of production model is expanded to form the concept of industrial operating mode, as done above, it raises the question of how the industrial operating mode is related to the well-established concept of strategy, and what differences justify the use of the former concept in this study. In his detailed analysis of the usage of strategy concepts in strategy research, Niemelä (1993) deals with the multitude of definitions by separating five categories of strategy concepts, which present strategy as:

- a plan resulting from a formal planning process
- a position or adjuster between the company and its environment
- a pursuit of sustainable competitive advantage over competitors
- a pattern in the important decisions and actions of the company
- an atmosphere or a conceptual framework for the decisions made in the company.

Bush (1989) states that the dimensions used in various operationalisations of stratregy reflect

the researcher's field of study and objectives of the study. In this study, the focus is on how companies are positioned in the process of industrial transition (Fig. 2); the position referring to the position in "time" rather than position compared to competitors. When reacting to changes in the business environment, the company can belong to the avant-garde of innovators, it can follow the great majority adopting well-proven practices, or it can lag behind the majority. Seen this way, the phenomenon being analysed in this study could be called strategy as an adjuster between the company and its environment or a shared conceptual framework for decisions taken – with the addition that this strategy is analysed in the context of late-industrial transition.

The view on strategy as a pattern of decisions and actions includes both the intentions and resulting consequences, as the deliberate strategies are adjusted over time with the unrealised strategies being abandoned and emergent strategies being added (Minzberg et al. 1995, Miles and Snow 1978). This definition of strategy fits well to the assumptions of this study about the diffusion process of fundamental business innovations. This descriptive view on strategy suggests that strategies of an organisation can be formed without being consciously formulated. When thinking of a long process of industrial development and adaptation, it is possible that the strategies in the end consist more of the emergent elements than of the deliberate elements. Considering the assumptions of this study, it may even happen that some strategies remain unrealised, but without conscious effort engaged, they are not abandoned.

The concepts of business strategy and industrial operating mode include several common aspects, and in principle the former could have been used in this study with appropriate modifications. However, the concept of industrial operating mode is used, because it gives direct connotation of the late-industrial transition (*industrial*), it includes the aspect of realised actions taken in guidance of strategic intentions (*operating*), and it implies positioning of the company behaviour along a continuum of a diffusion process of business innovations (*mode*). All the three aspects suggest a broader context of analysis than is usual in strategy research. Based on both the common and distinguishing elements, the industrial operating mode can be generally defined as *a pattern in a company's important decisions and actions which describes the company's level of adjustment in the late-industrial transition*. In a cross-sectional image of a business, several subsequent phases are assumed to be present. Below, a succession of modes during the late-industrial transition is proposed and a preliminary operationalisation of the three components is presented.

The search for a useful division between the various industrial operating modes can best be started by looking for what has been said of the intermediate level, the production operations. Vartia and Ylä-Anttila (1993) suggest that the post-fordist model of production is only emerging in the 1990s and will be seeking its form long after that. Allen (1992) stages a debate about the issues between protagonists who tend to fall into the position of arguing either that the fundamental dynamic which shaped the modern growth-oriented industrial economy is still operating, or that the changes taking place add up to the emergence of some new, post-industrial form of capitalist economic organisation.

Vartia and Ylä-Anttila (1993) formulate their position to the issue saying that on one hand, those who think that the new model will solve the problems of profitability, employer-employee conflicts, competitiveness problems and regional imbalances, are wrong, and that on the other hand, those who think that there is no change at all are also wrong. This middle of the road formulation can be appropriately associated with the concept of late-industrial used in this study, because late-industrial is a transition process and period. Both neo-fordist and post-fordist paradigms of production are counted in this study as late-industrial forms. This rather broad definition is necessary for capturing changes in the empirical application at hand.

The two remaining components, those of business philosophy and supplier choice criteria, can be divided in the same way to one traditional and two late-industrial modes. Table 3 presents a synthesis based on the following sources: Juslin and Tarkkanen 1987, Ollus et al. 1990, Allen 1992, Vartia and Ylä-Anttila 1993, Kotha 1995, Sheth and Parvatiyar 1995, and Harvey and Gavigan 1996. The three components of the industrial op-

erating mode are presented according to their level of abstraction or visibility from outside the enterprise, in descending order.

Table 3 is a matrix of the items for the three components of the business behaviour and the industrial operating modes expected, and it can be regarded as the central theoretical contribution of this study. This structure borrows from the idea of the nested segmentation approach by Bonoma and Shapiro (1985). The concept of industrial operating mode presented here and the idea of several levels to be measured for developing a typology of sawmill customers are an integral part of the research design (see Fig. 3). The argument for applicability of the nested approach is presented in section 3.3.

Business philosophy. The concept of business philosophy used in this study is an adaptation from the marketing strategy concepts used by Juslin and Tarkkanen (1987), Niemelä (1993), and Martikainen (1994). In these studies, a strict concept of marketing strategy formulated at the level of corporate strategy is used, which consists of four components (customer, product, market-area, and competitive advantage strategy). These components were modified and extended according to the theoretical analysis of the industrial change process and late-industrial enterprise.

The advantages sought reflect the overall starting point of business and range from economies of scope and cost leadership to a specialising and customising response to customer needs. The product strategy in the traditional industrial mode is anchored to that of the competitors, whereas in advanced modes it is based on either functional or user-based differentiation. In homogeneous and slowly evolving markets the customer strategy could well be based on a general focus on all customer types. As the markets become heterogeneous or even more remarkably diversified, the customer selectivity is likely to increase. Customer relationships in turn range from transaction and exchange orientation to market orientation and relationship orientation.

In the industrial mode, the special resources were usually fixed according to geographical or climatic features. In the first late-industrial mode, the material base may be defined in other manners too, but basically it remains independent of external and market pressures. The second late-industrial mode also adopts a flexible approach to the raw material sourcing and narrows down the focus. Fordist, mechanising technological orientation is transformed towards post-fordist flexible automation and information-intensive control systems. External relations in a horizontal direction, to the competitors, become co-operation oriented as the focus shifts to the core business and opportunities for complementary action are increased.

Production operations. The more concrete aspects of the industrial modes are listed in Table 3 as production operations features and the most imminent issues in supplier relations as supplier choice criteria. Production systems that were guided by material and product flows become controlled by demand and integrated to marketing and product planning. Special purpose machinery of mass production may be replaced first with computer-controlled processes and further on with genuinely flexible manufacturing and assembly units. The masses of commodity products become small series of special products or even smaller batches of customer products and service packages.

Supplier choice criteria. The technical criteria in the supplier relationships probably retain their traditional importance, but deliveries, services and communications are likely to increase in their significance. The traditional mode pays attention to receiving a steady flow of standard material. In late-industrial modes, the attention is on a comfortable supply of various types of materials and more fine-tuned variety within material types. Volume and cost oriented delivery criteria become more concerned with timing and quality questions. This is accompanied by an increasing importance of information and immaterial services on the cost of traditional physical product "service". As the role and significance of middlemen in the supply chain diminish, the activity of communication at both institutional and personal level is more appreciated.

3.3 Consequences for Marketing

3.3.1 Reinventing Relationships

Sheth and Parvatiyar (1995) argue that the marketing field of study and practice is changing in

Table 3. Preliminary operationalisation of the three components of the industrial operating mode and the three modes expected.

	Traditional industrial	Late-industrial 1	Late-industrial 2
Business philosophy			
Starting point	Economies of scale and cost leadership	Specialisation and cost reduction	Economies of flexibility and scope, ability of variation and response
Product strategy	Competitor benchmarking, commodities, low cost, consistent quality	Functional differentiation, special products, low cost, consistent or high quality	User differentiation, customer products, adapted cost, required quality
Market characteristics and customer strategy	Homogenous markets, foreseeable changes, limited by supply, broad focus	Differentiated markets, foreseeable changes, limited by demand, limited focus	Niche markets, unforeseeable changes, limited by demand, narrow focus
Customer orientation	Vertical integration, exchange orientation	Vertical integration, market orientation	Partnerships in value added chain, relationship orientation
Material resources, supplier orientation	Fixed material base, broad focus	Fixed material base, limited focus	Flexible material base, narrow focus
Technological orientation	Mechanistic, extensive energy use	Increased automation, intensive energy use	Flexible automation, regenerative energy use
Competitor orientation	Competition, self-sufficiency, and cost leadership	Differentiation	Networking, co-operation, and focus on core business
Production operations			
Production system	Mass production, controlled by production and inventories	Advanced mass-production, pull-controlled within raw material supply	Flexible production, pull-controlled, integration of marketing, production and planning
Technology	Special purpose machinery, assembly line	Numerical control, computer integrated manufacturing	Flexible manufacturing and assembly units
Products	Long runs of standardised products	Small batch production, special products	Changing, modularised, customer products and services
Supplier choice criteria			
Technical supply	Commodity materials	Broad variety of material types	Deep variety of material specifications
Deliveries	Volume and cost orientation	Cost and timing orientation	Timing and quality orientation
Services	Tangible core product only	Information-related services	Intangible services
Contacts	Indirect, through distribution chain, passive	Both indirect and direct, active institutional communication	Direct relationships, active personal communication

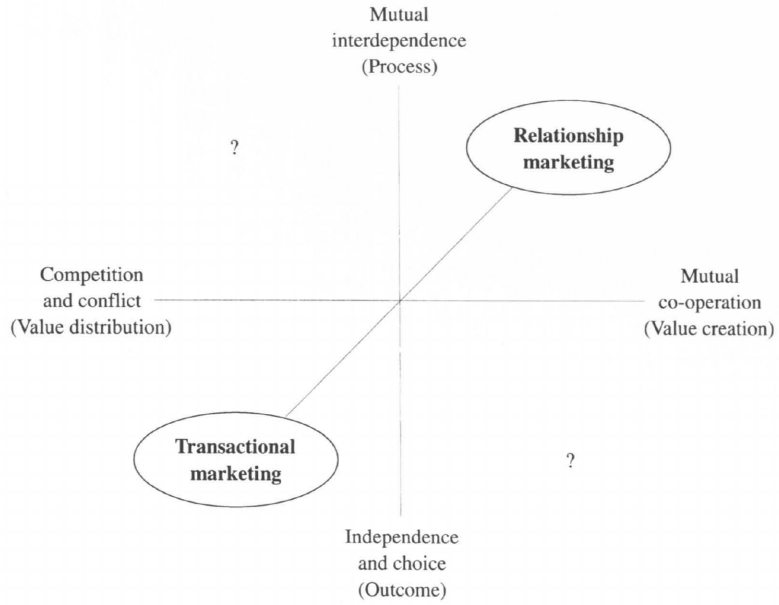

Fig. 4. Axioms and orientations (in brackets) of transactional marketing and relationship marketing (compiled from Sheth and Parvatiyar 1995).

its orientation from transactions to relationships. In this view, the pre-industrial era was characterised by direct marketing practices of agricultural and artefact products. In the industrial era, separation of the producers from the users was a natural outcome. Mass production forced producers to sell through middlemen and while industrial organisations created specialist purchasing departments and professionals. The contemporary paradigm shift is associated with the return of direct marketing both in business-to-business and business-to-consumer markets. Gummesson (1995) defines relationship marketing as marketing which keeps relations, networks, and interaction in the center of activities. Relations between two parties form networks, and the contacts between the parties is called interaction.

When producers and users deal directly with each other, there is a greater potential for emotional bonding that transcends economic exchange. They can understand and appreciate each others' needs and constraints better, are more inclined to co-operate with one another, and thus become more relationship oriented. This is in contrast to the exchange orientation of the middlemen buyers and sellers. Sheth and Parvatiyar (1995) state that to the middlemen, especially the wholesalers, the economics of transactions are more important, and therefore, they are less emotionally attached to their products. Sheth and Parvatiyar suggest that the relationship focus in the late-industrial era is a rebirth of marketing practices from the pre-industrial age. At that time, the producers and users were also sellers and buyers, and were engaged in market behaviours that reduced the uncertainty of future supply and demand assurances which could not be otherwise guaranteed due to unpredictability of weather, raw materials, and customers' buying power. Today's uncertainties have their origins in broader and more social economic fluctuations, but the principle is similar.

Fig. 4 presents the differences between transactional marketing and relationship marketing as outlined by Sheth and Parvatiyar (1995) and other authors in relationship marketing. Relationship marketing attempts to involve and integrate customers, suppliers, and other infrastructural partners into a firm's developmental and marketing activities. This means a significant shift in the

axioms of marketing: competition and conflict to mutual co-operation, and choice independence to mutual interdependence. The new paradigm is based on value creation instead of value distribution, and it focuses on the processes of relationship engagement and not on the outcome or consequence of the relationship.

3.3.2 Adjustment of Segmentation Bases

Segmentation is one specific element of the overall strategic management (Aaker 1984, p. 23) This element may also be considered as the core of marketing. Markets are usually heterogeneous, there exist different types of needs and expectations, and the consumers or industrial customers respond to marketing measures in various manners. Segmentation aims at finding the significant differences and at tailoring communications, products, and services as efficiently as possible (Ranta 1993).

The advances in technology and the development potential of human resources provide opportunities for both new focus and new broadly-targeted strategies. Cohen and Smith (1991) formulate these two strategies for the forest product industries as global marketing and international marketing. Global marketing would mean selling a standard product line using mainly similar marketing functions in all markets. This implies coordination of intercountry linkages in order to capture economies of scale and provide competitive advantage. International marketing would mean selling a different product line using dissimilar methods for each international market. This is often equated with market segmentation and targeting specific segments through a high degree of product differentiation through processing techniques, product design, and innovative distribution or service.

This view can be analogously transferred below the country level. A sawmill may target customer industries either through a single value chain or through value chains tailored within industry. Instead of traditional segmentation bases like industry codes, marketing channel structures, and company size and location, new ways of segmentation could be based on the needs of the customers. Business philosophy in general may indicate a match between a sawmill and a manufacturer. Characteristics of the actual production operations may help in finding counterparts. Benefits that the customer is seeking can be formulated to supplier choice criteria in order to check gaps between expectations and sawmill performance.

According to Kotler (1988), companies find it increasingly unrewarding to practice mass marketing or product-variety marketing, and they are increasingly embracing target marketing. Mass markets are becoming "de-massified", dissolving into mini-markets. The ultimate degree of market segmentation is called customised marketing or precision marketing, where the seller is able to prepare on a mass basis individually designed products to meet each customer's requirements. Sinclair (1992) warns that target marketing needs probably more resources than product variety marketing. The greatest advantages of this approach can be reached when the segments are truly unique.

Rao and Wang (1995) make a division between segmentation schemes based on easily identifiable "macro-segments" and a cluster-derived segmentation approaches based on managerially relevant "micro-segments". The difference is in whether customer characteristics identify customers or describe how they behave towards a product or service. A priori segmentation of customers uses variables like industry type, company size (sales volume, number of employees), and geographical location. An approach that estimates similarity of customers according to some behavioural dimensions uses bases like customer benefits, customer buying behaviour, application or usage situation, or sensitivity to marketing variables (Plank 1985). This approach was labelled "benefit segmentation" by Russell Haley in 1968, based on the idea that the benefits which people are seeking in consuming a given product are the basic reasons for the existence of true market segments (Moriarty and Reibstein 1986). Basing segmentation directly on response profiles seems rational, because the ultimate goal of market segmentation is not always to look for homogeneous markets, but rather homogeneous responses to marketing stimuli. Rao and Wang (1995) see the main advantages of benefit approach in its relative superiority in terms of responsiveness and stability.

Although the benefit segmentation technique is quite straightforward, some barriers may inhibit its use (Moriarty and Reibstein 1986). Data for the demographic segmentation approaches are usually readily available. This is not true for such specialised approaches as product-specific attitudes, product usage, or benefits sought. In these cases, special data must be collected in order to develop the segmentation strategy. A second problem relates to the criterion that the segments must be identifiable and accessible. Once the market has been divided into benefit segments, it is difficult to identify which segment a potential customer belongs to without measuring the benefits it seeks. Ramaswamy et al. (1996) argue that as markets continue to fragment, identifying niches through multi-basis segmentation analyses may become increasingly necessary. The following section will describe one way of handling several dimensions of behavioural segmentation.

3.3.3 Nested Approach to Characterising Customers

Bonoma and Shapiro (1985) define segmentation as the process of separating a market into groups of customers, prospective customers, or buying situations such that the members of each resulting group are more like the other members of that group than like members of other segments. Market segmentation can be viewed either as a process of aggregating individual units into groups or as a process of disaggregating a total market into pieces.

The central idea documented by Bonoma and Shapiro (1985) and supported by Chéron et al. (1996) is the applicability of several different segmentation bases. The five general dimensions are presented in Fig. 5. At the outermost level are variables that give a broad description of the company, such as industry branch, company size, and location. These variables can be ascertained externally to the customer through available directories, statistics and privately developed reports.

Somewhat less general are a variety of bases called operating variables, which can be used to separate customers within a general industry category. These include technology, user/non-user status of a product or a brand, and the operating, technical, and financial capabilities of the customer. The company's technology, related to either its manufacturing process or a product being planned, has a great deal to do with its buying needs. Companies that operate well with particularly tight raw material inventory might be especially appropriate for a supplier with an unusually reliable delivery record. Regarding lack of operating competence, customers not capable of performing quality control tests on incoming raw materials might be willing to pay more for supplier checks regarding quality. The operating variables are to some extent visible from outside the company, and they have the advantage of being relatively stable.

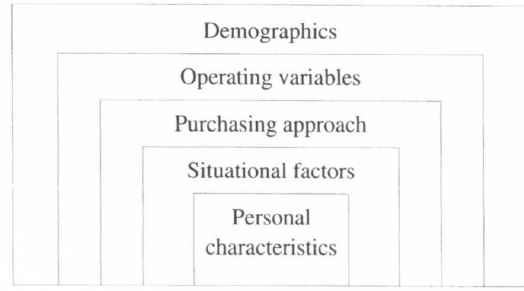

Fig. 5. Nested approach to segmentation bases (Bonoma and Shapiro 1985, p. 10).

Bonoma and Shapiro (1985) consider the purchasing approach and philosophy of a company one of the most important yet neglected bases for segmenting a market. This level includes variables such as formal organisation of the purchasing function, power structure, nature of existing organisational relationships, general purchasing policies, and purchasing criteria. The data necessary at the level must be usually gathered directly from the personnel of the customer or prospect.

Purchasing criteria can be an important segmentation variable even in situations where a marketer cannot seem to find a more basic reason for the criteria used. Situational factors in the nested approach include urgency, application specificity, size of order, and composition of order. Purchasing decisions are made by people, not by companies. Among the variables in the nest of personal characteristics are buyer-seller similarity, buyer

motivation, individual perceptions, and risk management strategies.

Both Bonoma and Shapiro (1985) and Chéron et al. (1996) seem to ignore variables at the level of strategic decisions. According to Porter (1985) strategic groups are the result of differences in firms' strategies, one dimension of which may be the different customers they serve. This concept has been applied, e.g., by Bush (1989) in grouping the US hardwood sawnwood industry. As the concept of industrial operating mode used in this study covers aspects even more diffuse than strategy, the term business philosophy was suggested in section 3.3.3. as an appropriate title for the most strategic variables that may distinguish industrial operating modes. The other two levels presented in Table 3 were the production operations and the supplier choice criteria. These components are used in this study as segmentation bases for grouping sawmill customers. Chapter 4 presents the methodology for applying the matrix of the three components and the three expected modes to the secondary wood processing industry.

4 Methodology

4.1 Framework of the Study and Research Propositions

4.1.1 Frame of Empirical Reference

The increasing fragmentation of the market for wood products has been noted already by Rich (1970). Besides the obvious differences between various end-use sectors, a characteristic of all the markets for sawnwood is the development of more specialised product needs. Sinclair (1992) defines a market as the set of all current and potential buyers of a particular product or service. As marketing strategy is increasingly organised around target markets, market segmentation becomes more important. Market segmentation permits defining target markets and tailoring marketing efforts to each segment or target. The nested segmentation approach adapted from Bonoma and Shapiro (1983) provides the means of operationalising the concept of industrial operating mode. Data on three levels of observation are used to develop a customer typology.

The guiding hypotheses presented below form the bridge from the theoretical background to the frame of empirical reference. The three nested areas of measurement, a summary of the expected industrial modes, and the customer profile from the sawmill's viewpoint are presented. In addition to these, the company demographic variables are included. The descriptions are formulated to cover the central features in an late-industrial enterprise in secondary wood processing, thus describing the advanced end on the continuum of the industrial operating modes. The traditional end and the transient positions within this continuum are left to be implicitly described as preceding phases. Fig. 6 presents the frame of reference for the empirical operationalisations based on the following guidelines.

Business philosophy. The enterprise has moved on from the traditional mass-production orientation. It aims at economies of scope, flexibility, and variation. Windows, doors or furniture are produced according to individual customers' needs and technical requirements. The customer strategy is based on a set of known customers. The customer orientation is co-operative and supports the customers' own activities. The wood material supply comes from certain specialising producers that can offer the required quality and service. The technological orientation of the firm enables genuine flexibility in fulfilling the tailor-made orders. Competitors are seen as complementary agents in a network serving the heterogeneous market.

Production operations. The production system is integrated with marketing and is controlled by the market pull with short notice. Production facilities include flexible manufacturing and assembly units. Products are differentiated from those of the competitors from the beginning and ultimately tailor-made according to customer specifications, in short production runs.

Supplier choice criteria. The critical features sought from the supplier are related to availability of deep range of specifications in wood material. Quality and timing are important. In addition to the physical product, information-related and other intangible services are appreciated. The firm prefers an active direct relationship with the sawmill and dynamic personal sales communication.

Industrial operating mode. The three levels of measurement described above provide the basis for developing a typology of the sawmill customers in the sample based on the industrial operating mode they apply. The following customer types are expected:

- traditional mass producer in the industrial operating mode
- advanced mass producer in late-industrial mode, and
- flexible producer in late-industrial mode.

Profiles of the sawmill customers. The industrial operating mode is assumed to have effects on the

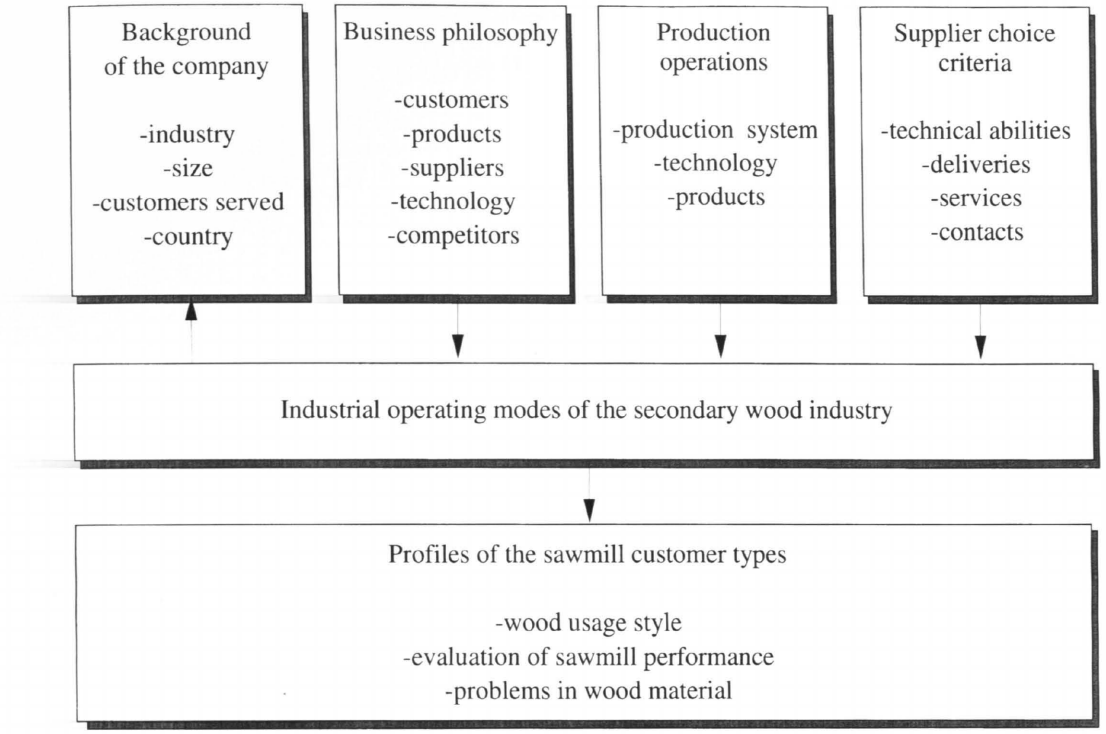

Fig. 6. The frame of empirical reference.

wood usage style (standard sawnwood – special and customer sawnwood), perceived sawmill performance and problems that are encountered with the wood material. The contents for this area is derived from the practical motivation for the study; how to improve the match between secondary wood processing and sawmilling.

Background of the company. The industrial operating modes may be connected to the company demographics, and for this purpose the main product, customer groups served, company size, and nationality are analysed.

Operationalisations of the frame of empirical reference are described and the research propositions formulated in the subsequent sections. The operationalisations present the rules of correspondence between the concepts and the empirical phenomena. Multiple operationalisations are applied to strengthen internal consistency, reliability, and construct validity. The questionnaire used and the list of variables are presented in appendices 1 and 2.

4.1.2 Operationalisation of Business Philosophy

The business philosophy covers seven key areas of the industrial operating mode. The operationalisation below is related to the way Juslin handles marketing strategy (Juslin and Tarkkanen 1987, Juslin 1994, Niemelä 1993, Martikainen 1994). The view on the product strategy component according to the emphasis placed on commodity, special, and customer products is here transformed into more verbal statements. This similarity is also present in the key area of customer strategy. Three items were formulated for each area. The first and third items formulated the flexible production approach and mass production approach to the issue, with a mediating position between as the second alternative. Using this same logic, three statements, to be evaluated, were built for each of the remaining areas.

As this operationalisation includes elements beyond the core strategic decisions in the tradi-

Table 4. Items for measuring business philosophy.

Variables describing point of departure of business idea:	The starting point of our business is...	1. Satisfying individual needs of each customer 2. Responding to the needs of certain end-use situations 3. Efficient utilisation of raw materials and machinery
Variables describing product strategy:	Our wood products...	1. Are made according to the requirements and specifications of individual customer 2. Meet the functional requirements of certain specific end-use situations 3. Fulfil the same requirements as do our competitors' products in general
Variables describing customer strategy:	When forming customer relationships, we focus on...	1. Certain specified customers 2. All those customers that our products fit best for 3. All possible customer groups
Variables describing customer orientation:	Our customer relationships are by nature...	1. Co-operative, as a complementary part of our customer's own business 2. Based on long-term interaction 3. Unselective and temporary
Variables describing supplier orientation:	When buying wood, we take into consideration...	1. Certain specialised suppliers 2. All those suppliers that meet the product-specific requirements 3. All possible suppliers that we come across
Variables describing technological orientation:	The technical solutions in our production enable...	1. Flexible manufacturing of special orders 2. Large selection of models and sizes of the products 3. Efficient and high-speed production process
Variables describing competitor orientation:	Other manufacturers in our business...	1. Participate networking and co-operation in production 2. Enable us to differentiate and focus 3. Are just competitors for us

tional sense, use of the term business philosophy is more appropriate. This wording also conveys the more qualitative sense in the concept of industrial operating mode sought in this study. The items used in the questionnaire are presented in Table 4.

4.1.3 Operationalisation of Production Operations

As the three-level idea of operationalisation described above places the respondents under a task that consumes a lot of effort and time, the remaining levels of measurement (the production operations and the supplier choice criteria) were operationalised in a much simpler way. This was considered justifiable in that the business philosophy set of variables tries to capture the most abstract level of the industrial operating mode concept, and the other two levels are more concrete by nature.

The production operations level could be equalled with the concept of production model that is commonly used in the literature on industrial change.The three areas of production operations covering the production system, technology, and products were operationalised as as ten Osgood's semantic differentials between bipolar statements on seven-point scale. Five items are related to the production system in general, three items focus on production facilities, and two on the type of products. Items in brackets both in this and the following section were excluded from the final factor solutions due to analytical reasons.

Guided by storage situation – Guided by order situation
Long production series – Short production series
Sudden changes in an order are difficult to realise – Sudden changes in an order can be handled flexibly
(As much subcontracting as possible – As much own processing as possible)
(Capacity exceeds market potential – Capacity too small to serve whole market potential)

Craftsmanship – Automation
Old production technology – New production technology
(Complex technical solutions – Simple technical solutions)

Standard production – Customised production
Cost minimisation – Product differentiation

4.1.4 Operationalisation of Supplier Choice Criteria

Rich (1970) presents the main factors in purchasing behaviour of industrial customers as the costs (initial, processing, and installation), product performance, and assurance of supply. Also the non-economic factors of habit and tradition play a role, such as preference of certain wood species in various regions or tendency to stick with a species that the firm has used when learning and fine-tuning its processes. The items applied to secondary wood processing were based on previous studies (Juslin and Kaijala 1988, Juslin et al. 1988, Makkonen 1991, Pesonen 1991, Hansen 1994) with minor adaptations. However, the personal interview procedure used in data collection limited the feasible number of items and as detailed itemisation as by Hansen (1994) or by Bush (1989) was not possible. The supplier choice criteria were evaluated on a five-point Likert scale according to how critical they are when selecting suppliers. The criteria were divided into the following items:

- Ability to deliver specified knot quality
- Ability to deliver specified wane quality
- Ability to deliver specified lengths
- Ability to deliver specified moisture content
- Consistency of quality grading
- (– Expertise of the importer in combining wood from various suppliers)
- (– Price)
- – Short delivery times
- – Ability to deliver small orders
- – Just-in-time deliveries
- – Reliability of repeated standard deliveries
- – Readiness for special service
- – Technical expertise of supplier
- – Ability to react to long-term changes in needs regarding wood material
- (– Flexibility in the terms of payment)
- – Long-term customer relationship with the sawmill
- – Activity of personal sales communication
- – Activity of relationship to supplier

4.1.5 Variables Describing the Profiles and Background of Sawmill Customer Types

The description of the customer type profiles was divided into four areas: wood usage, anticipated changes in production and wood use during the next five years, evaluation of supplier performance, and defects occurring in wood material.

Type of wood material used was measured as a

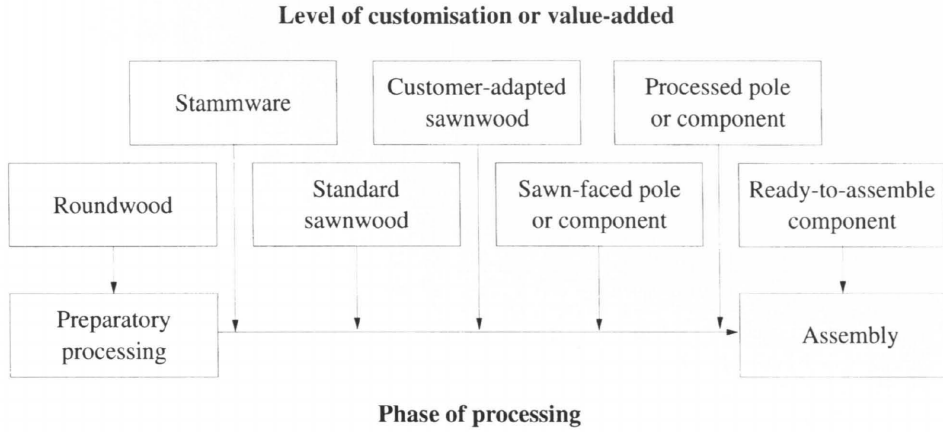

Fig. 7. The levels of customisation from roundwood to components (adapted from NUTEK 1992)

percentage of each material type, levels defined as roundwood or logs, stammware, standard sawnwood, customer sawnwood, sawn-faced component poles and components (length cut to final measure), poles and components further processed, and ready-to-assemble components (Fig. 7). According to NUTEK (1992) value-added levels most in demand by joineries are customer-adapted sawnwood or sawn-faced components. Standard sawnwood means the common dimensions and qualities of the trade, according to standard grading rules. No deliberate adaptation to the requirements of the end-user is present.

Customer-adapted sawnwood conforms to one or a limited number of adaptations according to the requirements of the end-user, usually relate to quality, length or drying. Components were defined as solid wood that is adapted in dimension, length, moisture content, quality, and delivery time and form, that replaces own preparatory processing for a specific end-user (drying, sorting, splitting etc.). This category was divided in the questionnaire into four subcategories according to length (either cut-to-length or a pole of *n* times the final length) and amount of other processing (either solid sawn-only or processed through gluing, finger-jointing, planing, profiling etc.). Ready-to-assemble component was defined as solid or glued wood processed to final dimension and profile, ready for assembly without processing by the customer. In the analyses these five categories, or the three most right-hand value-added level boxes in Fig. 7, are referred to as "special and customised sawnwood" or "component-type sawnwood".

Volumes for each value-added type were calculated from total volume used. Additional information was gathered on the number of deliveries per year, average size of delivery, countries of origin, and volumes of main wood species used.

Anticipated changes in production and wood use during the next five years were measured through semantic differential between bipolar statements on a seven-point scale. The items were formulated as follows:

Using more components – Using more standard sawnwood
Using smaller wood deliveries – Using bigger wood deliveries
More individual sales and customised specifications – More standard sales and repeated orders
Using fewer wood suppliers – Using more numerous wood suppliers
Dealing with sawmills more directly – Dealing more through middlemen

Importance-performance analysis provides a simple but useful way of guiding a quality-based marketing strategy (Hansen 1994, Hansen and Bush 1996). As the importance of the supplier choice criteria was measured in order to be used when building the customer typology, the evaluation of sawmill performance was divided into those same items, listed in section 4.1.4. The respondents were asked to rate the performance of their present supplier base on each item using the scale 0–10 (very poor–very good).

The regularity of problems encountered in wood material was assessed on the following items, using the scale 1–5 (often–seldom).

- Dimensions
- Lengths
- Knot quality
- Sound knots
- Dead knots
- Rotten knots
- Knot holes
- Wane quality
- Moisture content
- Annual rings
- Drying checks (significant)
- Hair fissures (thin)
- Deformation
- Heartwood
- Wood stored in water
- Log blue stain
- Resin/bark pockets
- Reaction wood
- Insect attacks

Background characteristics of a company determine and to some extent restrict the company behaviour. The variables used to describe the background characteristics of the interviewed companies were:

- Industry / main product (Window, window and door, door, furniture)
- Size (Turnover, employees, volume of wood usage in 1994/5)
- Country (Denmark, Germany, the Netherlands, Finland)
- Shares of product groups of turnover (Windows, doors, furniture, other)
- Main customer groups (Applicable categories within new construction, renovation and remodelling, retail and do-it-yourself)

4.1.6 Propositions to Be Tested

The substantive hypothesis of this study is that the industrial operating mode is useful in detecting strategic differences in sawmills' customers. This hypothesis is related to the assumptions of the study presented in section 2.2. If the results would suggest that there are no differences in the way the respondent companies operate, these assumptions would be considered untenable. In the opposite case of differences being discovered, the assumption about evolving and different industrial operating modes would gain support.

The applicability of the industrial operating mode and the customer typology based on it is tested in the customer profiling part of the analyses. The detailed research questions of the study, the propositions P1–P4 are formulated according to the assumption that the wood supplying sawmill industry still operates mainly in the traditional industrial mode (as suggested in Fig. 2), and is not quite able to match the developing requirements of the more advanced end-users. This assumption is supported by the research findings of Niemelä (1996), indicating that the strategies of Finnish and Swedish sawmills are still raw material- and production-oriented or that the effects of emerging market-orientation are not yet felt by the customers.

P1. Share of component-type sawnwood as raw material is positively associated with the degree of late-industrialism of the firm.
P2. Direction of change in near future is towards the late-industrial modes.
P3. Evaluated performance of sawmills is negatively associated with the degree of late-industrialism of the customers. The areas of performance are:
P3.a. Evaluated technical quality performance.
P3.b. Evaluated delivery performance.
P3.c. Evaluated service performance.
P3.d. Evaluated contact performance.
P4. Occurrence of problems in wood material at present is positively associated with the degree of late-industrialism of the customers.

The propositions suggest that new needs and demands are emerging within the secondary wood processing industry and that they are not yet being fully met by the sawmills as a whole. If the propositions were supported by the analysis, it would suggest an opportunity for those sawmills that are able to take the challenge. Proposition P1 points to the issue that some firms already use component-type sawnwood, indicating that part of the supply has already been transformed

or is being replaced by remanufacturing middlemen. Proposition P2 confirms the that the trend really is towards more advanced industrial operating modes. Propositions P3 and P4 reflect a gap between the performance of the prevailing primary wood processing mode at the sawmills and the emerging late-industrial secondary wood processing industry.

4.2 Data Collection

4.2.1 Population and Sample

The observations were made of joinery (window and door) or furniture manufacturer companies purchasing their wood raw material independently and preferably using component-type customised sawnwood (SIC 2431 Millwork, 2511 Wood household furniture, 2512 Upholstered furniture, 2521 Wood Office furniture). The companies interviewed included firms using sawnwood that is customised to various degrees, as well as firms using only the common trading qualities and dimensions. Data were collected of the industrial operating modes. Differences in the operating styles and orientations of the companies were found identifiable in the analyses, and the quality of the data obtained was found satisfactory. In some cases, presence of the differences in operating modes was even explicitly recognised by the respondents in the interview. The geographic distribution of the sample (Table 5) was determined by the limited resources and the opportunities met during the research period. Denmark and Germany were the initial target countries because of their attractiveness from the component-sawmilling viewpoint (Sirviö 1996, Kärnä 1996). The opportunity to include the Netherlands was provided by the Erasmus program for student exchange (Stomp 1995, 1996). The Finnish furniture manufacturers were interviewed in the context of a B.Sc. thesis project (Kataikko 1996). The interviews of Finnish window and door manufacturers were connected to a M.Sc. thesis (Ventonen 1997).

The directories and catalogues used when deriving the samples are listed in the end of the list of references. The companies to be contacted were picked based on information from various directories and industry experts in each country; companies using Scandinavian wood species were selected. In Galtung's (1967) terminology, the sample used in this study would be a purposive sample with heterogeneous observations, which implies that the results will remain exploratory. The data were collected according to the research plan of the author. In all the countries, the most common reasons stated for not participating in the study were lack of time, a prohibitive company policy, or being annoyed with frequent survey-related solicitations.

Table 5. Observations by country.

	Total number of companies	Interviewed	Final sample	Coverage of wood usage (appr.)
Denmark	~ 560	43	41	13 %
Germany	~ 1650	16	15	3 %
Netherlands	~ 500	50	41	15 %
Finland	~ 680	30	30	4 %
All	~ 3290	139	127	7 %

In 1995 there were 112 window and door manufacturers listed by the certification organisation and about 450 furniture manufacturers in Denmark (DVK/DVS 1995, Pesonen and Sundén 1995). Of these, a group of 100 companies was contacted by way of a notification letter and after that, 70 of them through a telephone call in order to arrange interviews. Twenty-five firms refused to participate the study. The interviewed sample was 45 companies, of which two were excluded from the analyses due to divergent line of production and two concerns due to their large size. The data were collected by Ms. Sari Sirviö in November 1995.

In 1995 there were about 400 industrial manufacturers of wooden windows and doors and about 1250 furniture manufacturers in Germany (RAL 1994, Pesonen et al. 1996). Of these, 60 companies were contacted through a notification letter and a telephone call. The response rate in Germany was lower than expected despite an experienced interviewer speaking fluent German. Telephone calls to 46 companies resulted in a refusal, and the interviewed sample was 16 companies, of which one was excluded due to divergent product line. The biggest reason for the low response was

the coincidental occurrence of several surveys before this study – a reason that was regularly cited by the contacted companies as grounds for not participating in the study. The data were collected by Mr. Jari Kärnä in October 1995.

In 1995 there were more than 800 window and door manufacturers and about 1500 furniture manufacturers in the Netherlands; those operating at an industrial scale were, respectively, about 100 and about 400 companies (NBvT, CBM, VvD, VvNH, GND 1995, Pesonen and Ristola 1995). Of these, a sample of 187 was contacted through a notification letter and 109 through a telephone call. In 59 cases the appointment for an interview was denied. The interviewed sample was thus 50 companies, of which 41 using softwood sawnwood were accepted into the analyses. The data were collected by Mr. Tibor Stomp in August 1995.

In 1995 there were about 550 furniture manufacturers in Finland, and there were 117 window and door manufacturing members in the joinery association and 19 in the association for building products industry (Puusepänliikkeiden liitto PL r.y. 1995, Rakennustuoteteollisuus r.y. 1995, Kataikko 1996). The interviewed sample was 30 companies. The data for furniture manufacturers were collected by Ms. Marja-Sisko Kataikko from August to October 1995 (23 firms contacted and interviewed). The data for window and door manufacturers in Finland was collected by Ms. Salla Ventonen in April–May 1996 (7 firms interviewed within timeframe for analyses of this study).

4.2.2 Interview Procedure and Handling of the Data

The data were collected through personal interviews using a structured questionnaire (App.1). As it was first used in the Netherlands, the questionnaire was pre-tested with experts within Dutch joinery industry. Minor adjustments were made to the questionnaire for interviews in Denmark, Germany, and Finland. The questionnaire was developed in Finnish and English and translated into Dutch, Danish, and German. The Dutch translation was done by the native interviewer with the help of Dutch specialists. The Danish questionnaire was first drafted into Danish by a Swedish-speaking person and then checked by a native speaker. The German translation was done by the interviewer and checked by a German language specialist.

The interviews were limited to one person in each company. The persons who were targeted for an interview were the ones with the highest responsibility in wood supplier relationships, usually the buyer, production manager or the president in smaller firms. The person was assumed to have accurate perception of the company's operations. The unfortunate low response rate in Germany reminds once again how difficult it is to secure company data face to face. However, a mail survey would not have worked out in this study because of the detailed sawnwood-related questions and the apparent need of personal administration of the other questions.

The questionnaires were coded to separate data files by the interviewers. This enabled minor adjustments that were useful in reporting the technical results related to wood material. The files were then merged and checked for both numerical and logical conformity. Consistency checks were done in order to identify data out of range, logically inconsistent, or having extreme values. Miscoded and misinterpreted figures were corrected. The turnover figures were converted from local currencies to the ECU. Missing responses in the items subject to multivariate analyses were checked. If only a few of the items per respondent company were missing a response, they were substituted with the mean response to the variable. Some questions in the questionnaire used for the Finnish window and door manufacturers were different from the questionnaires used for other subsamples. Ordinal scale variables were manually rescaled, and percentages and volumes transformed through calculation in order to make them comparable.

4.2.3 Structure of the Sample

Altogether the usable interviews provided a sample of 127 companies from the European secondary wood industry. A sample of this size, collected through personal interviews, is relatively large if compared to previous studies. It can be argued that similarities within product lines or business branches across (relatively similar) countries should be greater than similarities

Table 6. Value of production of respondent companies by country and main product group (mill. ECU).

(n)	Window and door manufacturers (75)	Furniture manufacturers (52)	Total (127)
Denmark (41)	56.75 (23)	180.84 (18)	237.59 [30 %]
Germany (15)	172.51 (13)	8.89 (2)	181.39 [24 %]
Netherlands (41)	194.92 (32)	36.67 (9)	231.58 [30 %]
Finland (30)	55.45 (7)	65.41 (23)	120.86 [16 %]
Total	479.62 [62 %]	291.81 [38 %]	~ 771.42 [100 %]

Currency cross rates of February 1996 used: 1 ECU = 0.137 DKR, 0.529 DEM, 0.472 DFL, 0.175 FIM, 0.803 USD.

within different manufacturing businesses in one country. The multi-country structure of the sample seems well suited to the objective of this study. If the assumption, that the industrial operating mode has potential as a segmentation base, does gain support, data originating from several countries is regarded in this case to provide further reliability to the results. Hypotheses regarding generalisation from the sample to the population (the operating modes are similarly present outside the sample as well) may not be quantitatively tested using a purposive sample.

Figures on production values by country are presented in Table 6. It should be noted that the German companies interviewed have a relatively big share of the production value in the sample: this somewhat balances the low response rate while increasing the population bias. Danish furniture manufacturers together with German and Dutch window and door manufacturers make up the largest groups in data if measured by the value of production.

The person with highest responsibility in wood purchases within a company was targeted for an interview. In smaller companies it was typically the president or CEO, while in larger companies the buyer or production manager was interviewed (Table 7).

Table 7. Title or position of the respondent.

	f	%	Mean (median) number of employees
President / CEO	59	46.5	38 (28)
Administ. manager	26	20.5	62 (47)
Buyer	16	12.6	125 (70)
Production manager	20	15.7	62 (60)
Other	6	4.7	104 (37)
Total	127	100.0	61 (40)

4.3 Frame of Analysis

The objectives for the analysis of the empirical data can be derived from the purpose of the study as described in section 2.1. The main tasks of the analysis were the development of customer typology and relating the typology to data on sawmill performance, and analysing the connection between segment membership and segment demographics. The frame of empirical analysis is presented in Fig 8.

Each block contains a group of variables describing one aspect of the phenomenon under study. The arrows between blocks describe the relationships or connections of interest. The blocks B–D will be described first separately, and screened for the purposes of analyses that follow. The problem areas for descriptive and connective analyses with methods to be used are presented in Table 8.

The structure of the theoretical assumptions for the study has been described above. The theoretical concept of late-industrial enterprise was connected in chapter 3 to the most central areas of the industrial operating mode (business philosophy, production operations, supplier choice criteria), and in section 4.1. to the measurable empirical concepts. This chain builds on the assumption that the described change in industrial activities is a real phenomenon.

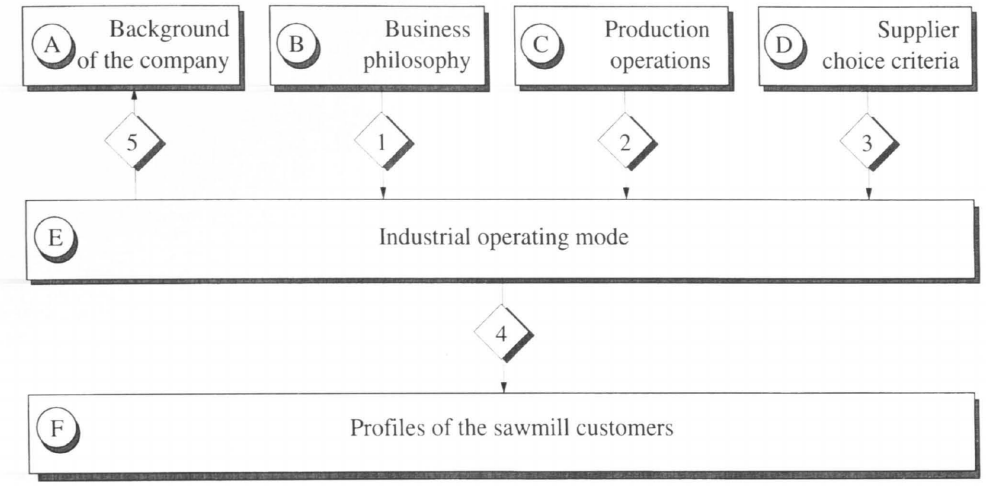

Fig. 8. The frame of analysis.

4.4 Methods of Analysis

The choices of the methods of analysis and the technical implementation were guided by the purpose of the study, the frame of reference, and limitations of the data. Both univariate and multivariate methods were used. The analyses were done using SURVO 84C statistical software (Mustonen 1992). The main authors guiding the use of methods in this study have been Galtung (1967), Anderberg (1973), Everitt and Dunn (1991), Mustonen (1992, 1995), Malhotra (1993), Dillon and Goldstein (1994), Alkula et al. (1994), Arabie and Hubert (1994), Bagozzi (1994b), Iacobucci (1994), and "Tilastolliseen..." (1996).

When describing the data on the components of the industrial operating mode, the multivariate method of factor analysis was used. The choices made in the measurement of business philosophy, production operations, and supplier choice criteria required data reduction, identifying of underlying dimensions, and extraction of a new set of uncorrelated variables for further analyses. Multivariate techniques shift the focus away from the levels (averages) and distributions (variances) of the phenomena, concentrating instead upon the degree of relationships (correlations or covariances) among these phenomena (Malhotra 1993, p. 470).

Factor analysis denotes a class of procedures primarily used for data reduction and summarisation, and it belongs to the interdependence methods, as no dependent-independent division between variables is made. It can be described as first measuring a phenomenon from several different aspects using "rough" scale, and then reducing the measurements into a smaller number of derived measures. The derived variables are referred to as either latent variables or factors. Relationships among sets of many interrelated variables are examined and represented in terms of a few underlying factors. Variables are apportioned to factors in degrees, and not in terms of either-or, yielding thus more realistic picture of the variables used (Galtung 1967, p. 307). This feature of factor analysis is essential when looking for the subtle differences in industrial operating modes.

In this study the maximum likelihood method (ML) of factoring is used. One of the main advantages of ML-method of estimation is that it ena-

Table 8. The problem areas and the related methods of analysis.

Block	Problem area of descriptive analysis	The method used
A	Background profile of the companies	Means, distributions Cross tabulation
B	Description of the business philosophies	Factor analysis
C	Description of the production operations	Factor scores
D	Description of the supplier choice criteria	Cluster analysis
E	Description of the industrial operating modes	Cross tabulation
F	Description of the customer profiles by group	Means, distributions Factor analysis Factor scores
Arrow	**Problem area of connecting analysis**	**The method used**
1–3	Formulation of the final clustering base	Frequency tables Factor scores Canonical correlations Canonical variate scores Cluster analysis
4	Connecting the industrial operating mode to the evaluated sawmill performance and problems in wood material	Cross tabulation
5	Identification of potential segment identifiers	Cross tabulation

bles testing the sufficiency of the number of factors used to describe the dimensions in data. In exploratory factor analysis the researcher does not specify the structure of the relationships among the variables in the model. As a crude form of confirmatory analysis, the transformation analysis developed by Yrjö Ahmavaara was applied in this study (Mustonen 1992). The empirical factor solution can be compared to a restricted factor matrix, where each variable is assigned to one or two factors only using the theoretical a priori expectations.

Canonical correlations analysis is useful in analysing several predictor variables and criterion variables simultaneously. It is particularly appropriate when the criterion variables are themselves correlated. In these cases it can uncover complex relationships that reflect the structure between the predictor and criterion variables (Dillon and Goldstein 1994). Use of canonical correlation analysis for descriptive purposes does not require distributional assumptions, but to test the significance of the relationships between canonical variates the data should meet the requirements of multivariate normality and homogeneity of variance (Ranta et al. 1989, Mustonen 1992).

Loadings and interpretations of loading patterns in canonical correlations are analogous to factor analysis. The canonical variates extracted can be characterised according to magnitude and sign of loadings for the variables. These indicate the nature of the individual contribution of individual variable to the linear combination. The ultimate function of canonical correlations in this study was to overcome the problem of how to weigh the factor scores in order to receive an optimally balanced solution that reflects the differences on as many dimensions as possible. When clustering analyses were performed using more than five factor score variables, the solutions were regularly insensitive to the additional factors, and were dominated strongly by one or two variables. As the factor scores themselves are linear combinations of the original response values, they could

have been prioritised by simply assigning weights manually. The canonical correlations provided a more nuanced solution as they resulted as analytically derived weights and it was also possible to assign complementary weights for different patterns of factor scores (more than one canonical variate).

Cluster analysis is a class of techniques used to classify observations into relatively homogeneous groups called clusters. Objects in each cluster should be similar to each other and dissimilar to objects in the other clusters. In an ideal situation the clusters are distinctly separated, whereas in practice the boundaries of the clusters are often not as clear cut.

Cluster analysis has been used in marketing for a variety of purposes, such as segmenting the market, understanding buyer behaviours, identifying new product opportunities, selecting test markets and simply for reducing data. For example, consumers may be clustered on the basis of benefits sought from the purchase of a product: each cluster would consist of consumers who are relatively homogeneous in terms of the benefits they seek. Respondents can be also clustered on the basis of self-reported importance attached to each factor of the choice criteria utilised. Cluster analysis can be used as a general data reduction tool to develop clusters or subgroups of data which are more manageable than individual observations. Subsequent analysis can then be conducted on the clusters rather than on the individual observations (Malhotra 1993). Thus cluster analysis appears to be a feasible method for this study.

The variables used in clustering should be selected based on past research, theory, or a consideration of the hypotheses being tested. In exploratory research, the researcher should exercise judgement and intuition. Inclusion of even one or two irrelevant variables may distort an otherwise useful clustering solution (Malhotra 1993). Prior to clustering it is often feasible to decrease the number of variables by using principal component analysis or factor analysis, as was done in this study. This adds to the descriptive power of the variables and to the presence of multinormality. It also adds to the speed of clustering and facilitates more trials of initial groupings. A nonhierarchical method called statistical cluster analysis provided by the SURVO 84C software was used in this study (Mustonen 1995, p. 140–141)

Cluster analysis provides a tool for dealing with multidimensional phenomena and developing the optimal grouping of observations. This means that the differences between the observations within a group are minimised on base variables, and that the differences between the groups themselves are maximised on base variables. Although the clustering algorithms build on various heuristic principles, they provide the analyst with a method that enables daling with more than one or two variables simultaneously. In this study, the number of dimensions derived through factor analyses necessitated this kind of analytical method to be used. Use of cluster analysis is supported also by Anderberg (1973), who argues that grouping of observations must not be done based simply on a plot or chart using visual judgement because the multidimensionality would be probably misinterpreted.

4.5 Validity and Reliability of the Data

Validity is defined by Tarkkonen (1987) as the property of the measurement scale to really give unbiased information about the desired trait under study. Reliability means the accuracy of the measurement or the lack of random measurement error. In behavioural sciences it is seldom possible to measure the concepts under study directly. One must thus use a number of indicators and form the measurement scale as a composite of the original variables. Tarkkonen (1987) argues that the reliability of a composite scale is usually higher than the reliability of its member variables, and that the validity of a composite scale is higher than that of its members.

Validity can be divided into external and internal validity. External validity is related to the sampling theory and gives an indication as to the extent that the results of the sample are generalisable to the total population. In this study a purposive sample is used and numerical assessment of predictive validity is not feasible. According to Galtung (1967, p. 55) a substantive theory can be tested using a purposive sample ("Are there differences in the industrial modes?"). As to generalisability of the findings ("Are these differences similarly present in the whole industry?"), one is

left with the hypotheses until a probability sample has been drawn, or one may use replication techniques that are more difficult to evaluate.

Internal validity of measurement consists of content validity and construct validity. Assessment of content validity in this study is limited because there is, so far, no unified definition for the industrial operating mode in the late-industrial context. As the theoretical contents gain support from the study, the results can be interpreted as supporting the assumption that the variables used are measures of the theoretical constructs targeted. One aspect in the content validity of the measurement in this study is related to the possibility that the results may reflect country or culture differences rather than differences in the industrial operating mode. However, it can be argued, that the cultural dependencies are an inherent part of the industrial operating mode, and do not reduce the significance of the differences found. Construct validity of the measurements – whether the structures are correct or expected – has been assessed in this study along with the factor analyses.

Reliability of the multivariate measurements in this study was estimated through the method presented by Tarkkonen (Tarkkonen 1987, Mustonen 1995), which calculates separate reliability estimates for each variable. This method avoids some of the limitations assumed in other estimates. For example the Cronbach's alpha is based on uni-dimensional factoring. If this method is applied in the case of more than one factor, the estimated criteria is not valid, because it assumes the same unique (error) factors for all variables. This limitation has been ignored in many previoius studies. For detailed statistical argumentation see Tarkkonen (1987). The results of the reliability estimations are presented in connection with the factor analyses.

Given the several judgements entailed in cluster analysis, no clustering solution should be accepted without some assessment of its reliability and validity. Formal procedures for assessing clustering solutions are complex and not fully defensible (Malhotra 1993, p. 659). The quality of clustering results was checked along the more practical principles. The research design is based on three different sets of variables to be first used separately as clustering variables, and the most detailed analysis is based on the measures considered most relevant after initial analyses. During the clustering analyses, several combinations of variables were examined and variables were deleted stepwise in order to compare groupings. The principle of clustering analysis provided by SURVO 84C software includes making multiple runs using random order of observations thus enabling the identification of the most stable clustering solutions. Use of a holdout sample (data splitting) was not possible, because sample size was too small to accommodate this approach. According to Kluyver and Whitlark (1986) this is usually the case in most industrial segmentation problems.

5 Results

5.1 Background Profile of the Sample

A total of 127 window, door, and furniture manufacturers were included in the analysis. The companies interviewed were from Denmark, Germany, the Netherlands, and Finland. The German manufacturers interviewed were relatively big both by turnover and number of employees although their number was rather small. The mean size of the companies was at lowest in the Finnish subsample due to a large proportion of furniture manufacturers. Danish and Finnish companies used on average more wood, most of which was softwood (Table 9).

The total volume of wood usage by the companies interviewed was about 390 000 m³/a. The calculated volume of special and customised (component-type) sawnwood purchased by the companies was about 70 000 m³/a. The total number of employees in the companies was 7747. Almost half of the companies (58/127) had less than 31 employees (min. 3). There were 32 companies with between 31 and 60 employees, 28 with between 61–150, and nine with more than 150 (max. 600).

Dividing the companies according to their main products was not very easy. Table 10 presents the characteristics of the sample when divided into companies producing either only windows (100 %), windows (>50 %) and doors, mainly doors (>50 %), or mainly furniture (>50 %). The 52 furniture manufacturers used 63 % of the total wood volume. The eight manufacturers focusing mainly on doors used on average more wood than those making mainly windows. Softwood usage was greatest with the furniture makers, seemingly because of the large proportion of Danish and Finnish companies.

The value of production covered by the companies was around 790 mill. ECU (Table 11). The share for the furniture manufacturers was 37 % and of window and/or door manufacturers accordingly 63 %.

Table 12 presents the shares of customer groups served by the respondent companies. Most of the windows and doors were sold to building contractors, builders' merchants, or to the renovation and remodelling contractors. Retail and other customers had a 10 % share together. Most of the furniture was sold to furniture chains and one fifth was sold to independent stores. One third of the sales was split between several channels with the do-it-yourself stores in the lead.

The most important wood species used by the

Table 9. Means for background variables of the sample companies by country.

	Denmark	Germany	Netherlands	Finland	All
Respondents	41	15	41	30	127
Mean (Median) turnover (mill. ECU)	5.79 (3.43)	12.09 (7.94)	5.65 (3.54)	4.03 (2.45)	6.07 (4.27)
Mean (Median) employees	56 (38)	114 (50)	55 (35)	48 (30)	61 (40)
Mean (Median) wood purchased (m³)	4284 (1680)	1267 (850)	1970 (1500)	3749 (2500)	3054 (1600)
% of wood purchases in sample	45 %	5 %	21 %	29 %	100 %
Mean (Median) softwoods (m³)	4207 (1680)	860 (400)	890 (420)	3503 (2000)	2574 (684)
Mean (Median) special and customised wood > 0 (m³) [n]	1184 (198) [22]	1093 (806) [12]	983 (750) [16]	1700 (150) [9]	1190 (484) [59]

Table 10. Means for background variables of the sample companies by main product.

	Only windows	Win & door	Doors	Furniture	All
Respondents (% of all)	31 (24.4 %)	36 (28.3 %)	8 (6.3 %)	52 (40.9 %)	127 (99.9 %)
Mean (Median) turnover (mill. ECU)	5.54 (5.19)	6.24 (3.70)	10.37 (8.58)	5.61 (3.79)	6.07 (4.27)
Mean (Median) employees	52 (45)	68 (30)	120 (80)	52 (32)	61 (40)
Mean (Median) wood purchased (m^3)	2023 (1500)	1462 (900)	3343 (2800)	4727 (1963)	3054 (1600)
% of wood purchases	16.2 %	13.6 %	6.9 %	63.4 %	100.1 %
Mean (Median) softwoods purchased (m^3)	997 (500)	1169 (600)	1954 (502)	4519 (1958)	2574 (684)
Mean (Median) special and customised wood > 0 (m^3) [n]	1536 (900) [16]	854 (350) [25]	1263 (1000) [6]	1392 (198) [12]	1190 (484) [59]

Table 11. Annual turnover of products by main product (mill. ECU).

n = 127	Only windows (31)	Windows and doors (36)	Doors mainly (8)	Furniture (52)	All	%
Windows	170.1	171.8	10.3	-	352.2	44.4
Doors	1.0	36.1	72.2	-	109.3	13.8
Furniture	-	-	-	291.2	291.2	36.7
Other	1.7	32.8	0.4	6.0	40.9	5.2
Sum	172.8	240.7	82.9	297.2	793.6	100.1

companies were Scots pine, meranti, and Norway spruce. The data collection aim was to include those companies that used primarily Scandinavian species. However, the final range of species used was rather wide due to the preferences of window makers and furniture makers (App. 3).

The countries of origin for the wood used were recorded on the basis of relative importance for the respondent company. Respondents in Denmark used wood mainly from Sweden, Finland, Norway, Denmark, and Germany. German respondents listed Sweden and Finland as the main suppliers but also mentioned Russia, Indonesia, Poland, Canada and USA. The respondents in the Netherlands purchased from Sweden, Finland, Malaysia, Indonesia, Canada, USA, Russia, and France. Several other countries were mentioned. The Finnish companies relied almost exclusively on domestic sawnwood.

5.2 Dimensions of Business Philosophy

Observed variables for business philosophy were subject to maximum likelihood factoring (Mustonen 1992, 1995). Two of the original 21 variables were excluded from the final analysis due to near zero communality, absence of significant correlations, and diffuse loading patterns. The correlation matrix of the remaining data (App. 4) showed relationships between the variables and the number of significant correlations was considered sufficient to reject the hypothesis of independent variables. As there were missing values in eight cases, the data included 119 observations. The ratio of observations to the number of variables was 6.2.

The maximum number of factors showing convergence was 12, explaining 65.6 percent of the common variance. Six of them obtained eigen-

Table 12. Values and shares of customer groups for joinery and furniture manufacturers.

	Window & door manufacturers		Furniture manufacturers	
	Mill. ECU	%	Mill. ECU	%
Builders' merchants	99.6	24.0	4.1	1.5
Building contractors	170.0	40.9	7.0	2.5
Renovation contractors	97.6	23.5	0.4	0.1
Do-it-yourself stores	1.6	0.4	17.0	6.2
Retail customers	35.6	8.6	4.9	1.8
Furniture chains	-	-	160.4	58.1
Independent furniture stores	-	-	62.3	22.6
Mail order companies	-	-	10.6	3.8
Others	11.2	2.7	9.5	3.4
Sum	415.6	100.1	276.2	100.0

values greater than one, indicating retention of those factors. Chi-squared test statistics indicated that at least seven factors would be needed to provide an adequate fit. Along the arguments of Everitt and Dunn (1991, p. 250) this was considered too complex in practice. A five-factor model, explaining 41.2 percent of the variance, provided groups of items that appeared to be content valid and thus provided the most interpretable solution.

Malhotra (1993) recommends that the factors extracted should account for at least 60 % of the variance. However, in previous studies on the forest industries and their markets (e.g., Bush 1989, Niemelä 1993, Martikainen 1994, Hansen 1994) the levels accepted for central factor solutions range usually from 40 to 50 % and are in some cases as low as 35 %. The common variances explained by the factor solutions in this study range from 39 to 41 %, which can be considered acceptable. However, from the theoretical point of view, the fit of the factor structure to the expectations is the most essential criterium for evaluating the results.

Five variables had communalities below 0.20; this was likely due, in part, to the limited number of dimensions used. These variables were however retained in the analysis because they received interpretable loading patterns and retention of all three complementary items for each issue was considered to help evaluate the validity of the measurement strategy chosen. However, after the exclusion of two variables, the customer relations issue and the relations to other manufacturers in the same business consisted of two items. Dillon and Goldstein (1984) suggest that with regard to statistical significance of the loadings, in most instances with sample sizes just below 100, the smallest loading would have to be greater than (0.30 in order to be considered significant. However, the size of the loadings is always subject to relative evaluation within the data and against the theoretical background. The factor image is presented in Table 13 with coefficients equal to or larger than ±0.50 printed in bold.

Tarkkonen's reliabilities for the factors, calculated using the factor score coefficient matrix as weights, ranged for the factors between 0.68 ... 0.84. The estimates were quite acceptable. Generally, the bigger the estimate is, the better is its relative merit.

The measurement scheme used was built on seven issue areas, and in principle, seven corresponding factors were expected. As two of the areas (customer strategy and customer orientation) were related to customer issues, and two to product issues (starting point and product strategy), a five-factor solution should have produced factor dimensions related to product, customer, technology, supplier, and competitor elements in business philosophy.

Examination of the contents of all factors suggests the presence of two product-related, two customer-related factors, and one related to tech-

Table 13. Factor and sub-measure structure of business philosophy. Five-factor maximum likelihood solution with orthogonal varimax rotation.

% cv	Factor loading *Reliability* F1	F2	F3	F4	F5	**Factor** Variable (level of item on the issue)	h^2
8.0						**F1: Late-industrialism of product philosophy**	
	0.89	–0.04	–0.07	0.04	0.03	The starting point of our business is satisfying individual needs of each customer (1.)	0.80
	0.61	0.12	0.19	–0.18	–0.06	Our wood products are made according to the requirements and specifications of individual customer (1.)	0.46
7.8						**F2: Late-industrialism of customer philosophy**	
	0.17	**0.73**	0.05	0.12	–0.14	Our customer relationships are co-operative, as a complementary part of our customer's own business (1.)	0.60
	–0.23	**0.65**	–0.00	–0.13	–0.21	When forming customer relationships, we focus on certain specified customers (1.)	0.54
	0.08	**0.50**	0.06	–0.35	–0.02	When buying wood, we take into consideration certain specialised suppliers (1.)	0.38
9.6						**F3: Traditionalism of product philosophy**	
	0.09	0.01	**0.85**	–0.08	0.07	The starting point of our business is responding to the needs of certain end-use situations (2.)	0.74
	0.15	–0.12	**0.58**	–0.09	0.15	The technical solutions in our production enable efficient and high-speed production process (3.)	0.41
	0.04	0.12	**0.54**	0.02	0.03	The starting point of our business is efficient utilisation of raw materials and machinery (3.)	0.31
	–0.06	0.03	0.38	–0.04	–0.20	Our wood products fulfil the same requirements as do our competitors' products in general (3.)	0.19
	–0.06	0.10	0.20	–0.15	0.18	When buying wood, we take into consideration all those suppliers that meet the product-specific requirements (2.)	0.11
8.1						**F4: Technical flexibility**	
	0.06	0.04	0.05	0.37	0.16	Other manufacturers in our business participate networking and co-operation in production (1.)	0.17
	–0.15	–0.04	0.28	–0.43	–0.14	Other manufacturers in our business are just competitors for us (3.)	0.31
	0.21	0.11	0.15	**–0.67**	–0.05	The technical solutions in our production enable large selection of models and sizes of the products (2.)	0.53
	0.25	0.36	–0.03	**–0.68**	–0.15	The technical solutions in our production enable flexible manufacturing of special orders (1.)	0.67
7.6						**F5: Advancement of customer philosophy**	
	–0.01	–0.12	0.06	0.09	**0.61**	When forming customer relationships, we focus on all those customers that our products fit best for (2.)	0.40
	0.08	–0.13	–0.08	0.14	**0.60**	Our customer relationships are based on long-term interaction (2.)	0.40
	0.25	–0.07	0.22	0.02	0.27	Our wood products meet the functional requirements of certain specific end-use situations (2.)	0.19
	–0.00	0.13	–0.12	–0.07	–0.33	When buying wood, we take into consideration all possible suppliers that we come across (3.)	0.14
	0.17	–0.13	0.29	–0.23	**–0.53**	When forming customer relationships, we focus on all possible customer groups (3.)	0.46
41.2							
	0.84	*0.75*	*0.81*	*0.74*	*0.68*	For unweighted sum *0.73* (Tarkkonen)	

nological orientation. Both the product-factor pair and customer-factor pair appear to include a factor consisting of variables from the most late-industrial mode, and another factor consisting of items from the remaining modes (traditional–developing late-industrial). The division of product and customer-related variables into 1) clearly late-industrial and 2) traditional or advanced industrial was also present in other solutions explored.

The factors were interpreted using the theoretical expectations as guidelines, but allowing for the twofold dimensionality. The labels used when describing the various stages of development in the industrial operating modes (see Tables 3 and 4) were used to name the factor dimensions as:

F1: Late-industrialism of product philosophy
F3: Traditionalism of product philosophy

F2: Late-industrialism of customer philosophy
F5: Advancement of customer philosophy (bipolar)

F4: Technical flexibility (neg.)

In F3, the strong contribution from the variable "The starting point of our business is responding to the needs of certain end-use situations" was interpreted to reflect the traditional mode also in addition to the late-industrial mode 1. In the target industries this level of specialisation is a natural part of everyday business, even in the most traditional views. The factor solution makes a clear distinction between the highly individualised product philosophy and more traditional approach based on effectiveness and rationalisation. Variables describing customer strategy and customer orientation are divided between factors F2 and F5. Factor F5 has a bipolar structure, and the ends of this dimension represent advanced customer focus and customer non-focus.

An interesting and counter-intuitive feature of this solution is that F4 (technical flexibility) includes two moderate loadings on variables of competitor orientation. Absence of co-operation with other manufacturers has the same sign as presence of technical flexibility, whereas presence of competitor networking has a reverse sign. This may be explained by considering that, since the most advanced production technology usually has a high cost, it is therefore perhaps only accessible to the larger firms – those that no longer are dependent on co-operation with other manufacturers. The factor solution points out the conceptual difference between the technological items: the efficiency is considered to be a general goal, whereas flexibility is seen as a specific issue within the overall activities.

Because the measurement of business philosophy was based on a rather complex measurement, the resulting factor image was checked against the expectations through transformation analysis (Mustonen 1995), an elementary form of confirmatory analysis. The factor solution was compared to a restricted factor matrix using the theoretical a priori expectations about the three-level operationalisations of each issue, with the addition of empirically derived twofold dimensionality. Each variable was assigned to one factor only (unity coefficient with the sign based on the empirical matrix). The transformation matrix showed a strong similarity of the factors (coefficients between 0.96 ... 0.99). The residual matrix, however, displayed interpretable differences especially in the variables describing the orientation to competing manufacturers (App. 5). The transformation analysis provides support to the construct validity of the measurement of business philosophy. The latent structure matches well the a priori expectations with the exception of separate dimensions of late-industrialism. Technically the a priori structures could have been isolated to separate factors had the number of factors been large enough, but this was considered too misleading for the subsequent analyses.

The resulting twofold division to absolute late-industrialism and traditionalism or moderate advancement in product- and customer-related issues is interesting from the theoretical viewpoint. From the outset of initial factoring experiments, the factor dimensions behaved as if there existed a basic scale for industrial sophistication, and another scale comprising any additional (late-industrial) innovations in business philosophy. Superficially these notions of "late-industrial extras" could be equated with the concept of success factor that has been recently much discussed (e.g., Uotila and Juga 1993, Niemelä 1996).

Table 14. Factor and sub-measure structure of production. Two-factor solution with orthogonal varimax rotation.

% cv	Factor loading *Reliability* F1	F2	**Factor** Variable end (1) – Variable end (7)	h^2
25.1			**F1: Agility**	
	0.89	0.03	Standard production – Customised production	0.80
	0.65	–0.02	Guided by storage situation – Guided by order situation	0.42
	0.47	–0.20	Long production series – Short production series	0.26
	0.43	–0.24	Cost minimisation – Product differentiation	0.25
	0.34	–0.06	Sudden changes in an order are difficult to realise – Sudden changes in an order can be handled flexibly	0.12
15.5			**F2: Machinery emphasis**	
	–0.03	**0.74**	Old production technology – New production technology	0.55
	–0.15	**0.66**	Craftsmanship – Automation	0.42
40.6				
	0.84	*0.68*	For unweighted sum *0.64* (Tarkkonen)	

5.3 Dimensions of Production Operations

The measurement scale of the actual production operations was formed of a smaller and more straightforward set of variables. It consisted originally of ten variables, three of which were excluded during the analysis due to communalities below 0.05. These items dealt with complexity/simplicity of production technology, over/under capacity as compared to the market, and subcontracting/in-firm production practice.

The correlation matrix indicated that relationships existed between the variables, and that the number of significant correlations was sufficient (App. 6). Nine observations were excluded due to missing values. Table 14 shows the resulting image of a two-factor solution.

Tarkkonen's reliabilities for the factors were acceptable, and the solution is simple. The first factor is very clear, dominating the solution with its five variables. The customisation level of products and production guidance principle are the most important variables, followed by the length of the product series, product differentiation, and flexibility of the production system. This factor reflects those features that were used by Harvey and Gavigan (1996) when describing an "agile manufacturing company" and closely related to the late-industrial phenomena being searched for in this study; the factor dimension was accordingly named as Agility. The second factor consists of only two variables that receive also a quite simple loading pattern. This factor was labelled the Machinery emphasis as it reflects using the newest machines and automation. The content of this factor is different from the Technical flexibility as a business philosophy (BF4) which reflected more the desired functions in technology than what the technology actually is like. In the late-industrial context, factor F2 cannot be assigned a strictly traditional or late-industrial character; rather it only describes the production facilities.

When looking for late-industrial features in production, the agility factor includes the most central variables. The Machinery emphasis factor is related in a way that the newest technology is usually considered as the most flexible and adjustable, although in this factor solution these characteristics are followed by long production series and cost minimisation. In principle there are no obstacles for realising customer-oriented business relations and customised products through older machineries or manual processing. In fact, for some furniture manufacturers the latter option may appear more feasible.

The structure of the production operations factor solution matches the a priori expectations in discovering an obviously late-industrial dimension. At the same time it reveals that a more comprehensive set of variables could have produced a more detailed description of the production operations. The Agility factor represents nicely the reality of industrial production described on a more abstract level by the business philosophy factors 1, 2, 3, and 5. The Machinery emphasis factor covers the basic nature of the production technology used, while missing clear connections to late-industrial features beyond using modern technical solutions.

Table 15. Factor and sub-measure structure of supplier choice criteria. Three-factor solution with orthogonal varimax rotation.

% cv	Factor loading *Reliability* F1	F2	F3	**Factor** Variable	h^2
18.1				**F1: Appreciation of wood material precision**	
	0.78	0.18	0.04	Ability to deliver specified knot quality	0.65
	0.71	–0.04	0.06	Ability to deliver specified wane quality	0.51
	0.66	0.05	0.26	Ability to deliver specified moisture content	0.50
	0.54	0.02	0.13	Ability to deliver specified lengths	0.31
	0.47	0.32	0.46	Technical expertise of supplier	0.54
	0.40	0.21	0.32	Reliability of repeated standard deliveries	0.31
	0.40	0.12	0.10	Consistence of quality grading	0.18
10.5				**F2: Appreciation of delivery services**	
	0.14	**0.65**	0.34	Short delivery times	0.55
	0.32	**0.54**	0.02	Ability to deliver small orders	0.39
	0.02	**0.50**	0.26	Readiness for special service	0.32
	0.11	0.35	0.11	Just-in-time deliveries	0.15
	0.21	–0.46	0.17	Long-term customer relationship with the sawmill	0.29
10.6				**F3: Appreciation of personal contact**	
	0.33	0.04	**0.71**	Activity of personal sales communication	0.61
	0.02	0.14	**0.62**	Activity of direct relationship to supplier	0.40
	0.21	0.24	0.27	Ability to react to long-term changes in our needs regarding wood material	0.17
39.2					
	0.82	*0.71*	*0.72*	For unweighted sum *0.85* (Tarkkonen)	

5.4 Dimensions of Supplier Choice Criteria

The supplier criteria were measured through a set of 18 variables, formulated as how critical the following features are for the firm's operation. Three of them were excluded from the final analysis due to low communalities and diffuse loading patterns. These items were the expertise of importers in combining wood from various suppliers, terms of payment, and price. Exclusion of the importer item was supported by its inapplicability for the Finnish respondents, who use mostly domestic wood. The correlation matrix was considered sufficiently significant (App. 7). The ratio of observations to the number of variables was 8.1. As values were missing in five cases, the data included 122 observations.

The Chi squared test suggested the retention of five factors. This was deemed too complex for analytical purposes, and as the three-factor solution showed good interpretability of content, it was chosen for the analyses. The variables do not differentiate as clearly from each other in the factor space as was the case with business philosophies and production operations. Table 15 presents the factor image.

Reliability estimates for the factors and for the solution as a whole are quite satisfactory. Varia-

bles related to the technical precision in wood material as criteria when choosing suppliers load on the factor F1. Technical expertise of the supplier and reliability of repeated deliveries however have moderate loadings on the other two factors also. This dimension was named the Appreciation of wood material precision.

Variables related to delivery services load on the second factor, labelled the Appreciation of delivery services. Long-term relationship with the sawmill receives a negative loading that makes the dimension bipolar. This peculiar structure suggests either a distinction between established relations and ad hoc relations or the definitive importance of delivery services, even if it risks long-term relationships. For simplicity of the analyses to follow, the positive end will be handled as the late-industrial direction. The third factor consists of three variables related to communication between the manufacturer and the sawmill. Activity of personal sales communication and direct relationship to the supplier form the main part of this dimension, which was named as the Appreciation of personal contact.

The late-industrial phenomena are represented to some extent by all of the three factors. Appreciation of wood material precision however seems to cover also the traditional criteria of supplier choice criteria based only on the physical product received. The items were worded so as to capture the idea of technical features specified exactly by the buyer – instead of the precision performance within standard trade qualities and measures – but there remains some doubt whether the respondents did all understand this emphasis.

The variables for supplier choice criteria produce a satisfactory factor structure. The expectations included a distinction between physical supply, deliveries, services, and contacts. In the solution achieved, the items describing forms of service are divided to all three factors.

In initial clustering experiments with this particular set of factor score variables, it was noted that the supplier choice criteria are diffusely related to the actual usage of value-added sawnwood. This would provide support to the idea of also using other levels of company data in defining the late-industrial company behaviour for the purposes of customer segmentation at the sawmill. In the case of clear match between supplier choice criteria and usage patterns, the motivation for applying more subtle constructs would have been diminished.

5.5 Customer Typology

The three sets of factor score variables for business philosophies, production operations, and supplier choice criteria were first each subject to a separate cluster analysis. On all three levels of measurement, a four group solution was found to be the most informative and distinct. When the solutions were compared through frequency tables of group memberships, the best correspondence of membership was found between business philosophy and production operation groups.

In order to get a more detailed picture of the connections between the potential clustering variables, analysis of canonical correlations was carried out. Canonical correlation is a measure of the extent of association between two sets of variables, searching for two linear combinations: one for the predictor set and one for the criterion set. The three sets of factor score variables were subject to a pairwise analysis. From the three pairwise analyses between the sets of factor score variables, the business philosophy factor scores and the supplier choice criteria factor scores were selected to be used in the combined clustering. The main results of the other two pairs are presented in Appendices 8 and 9.

Canonical correlations for business philosophy factor scores and supplier choice criteria factor scores resulted in three canonical variates with correlations of 0.63, 0.38 and 0.25. Each pair of variates represents an independent relationship between the original variable sets so that the first pair of variates has the greatest correlation, the next pair the next greatest, and so on. The first two variates were significant beyond the 0.05 limit; these are presented in Table 16. The following three factor score variables have high loadings on the first variate: Appreciation of delivery service as a choice criteria (SF2), Late-industrialism of customer philosophy (BF2), and Advancement of customer philosophy (BF5). This variate seems to cover both narrow late-industrial and general industrial customer foci, as factor BF5 score variable has a reverse sign compared to factor BF2 scores. This was interpreted to mean that delivery services may dominate the supplier choice in both approaches to customer strategy.

Table 16. Canonical correlations between factor score variables for business philosophies and supplier criteria.

	Canonical variate 1 Customer philosophy	Canonical variate 2 Product philosophy
Variables X	U1	U2
BF1: Late-industrialism of product philosophy	–0.053	0.298
BF2: Late-industrialism of customer philosophy	**–0.768**	–0.381
BF3: Traditionalism of product philosophy	–0.181	**0.611**
BF4 (neg.): Technical flexibility	0.385	**–0.647**
BF5: Advancement of customer philosophy	**0.606**	0.066
Variables Y	V_1	V_2
SF1: Appreciation of wood material precision	0.245	**0.596**
SF2: Appreciation of delivery services	**–0.944**	0.180
SF3: Appreciation of personal contact	–0.096	**0.870**
U1,2 score variable ends interpreted	(–) Combination of late-industrial and inadvanced customer philosophies, flexibility (+) Advanced customer philosophy in traditional sense, inflexibility	(–) Late-industrial customer philosophy, inflexibility (+) Traditional product philosophy, flexibility
Correlation	0.625	0.377
χ^2	79.528	24.294
p	0.000	0.002
df	15	8

The second variate reflects the following four factor score variables: Appreciation of personal contact (SF3), Technical flexibility (BF4 neg.), Traditionalism of product philosophy (BF3), and Appreciation of wood material precision (SF1). This means that material precision and personal contact as supplier choice criteria are associated with product and technology oriented business philosophies. The third variate, which had a complex loading pattern and low significance, was excluded from the subsequent analyses. As the main contents of variates 1 and 2 are related to customers and products respectively, the variates were named as the Customer philosophy and the Product philosophy. These broad labels of course include some overlapping elements in the correlations and weights to be used in calculating the variate scores. The dimension ends are characterised in Table 16.

The canonical correlation scores U were calculated from the business philosophy factor score variables (BF1–BF5) according to the resulting coefficient matrix (App. 10). As there were considerable differences between the initial, separate clustering solutions based on the business philosophy and supplier choice criteria factors, this twofold clustering base was considered to have the advantage of bringing these dimensions into the combined solution. The exclusion of the factor score variables for the production operations was grounded on the notion that in the initial clusterings, their observation-divisive effect was quite similar to that of the business philosophy factor scores. The factor scores for supplier choice criteria SF1 (Appreciation of wood material precision) and SF2 (Appreciation of delivery services) together with the canonical correlation score variables U1 and U2 were selected as variables for the combined clustering. The two supplier choice variables were selected because of their clearly significant differentiating power shown in initial analyses, as compared to the differentiating power of factor SF3 (Appreciation of personal contact).

Table 17. Five-cluster solution, mean factor and variate scores (std. dev.) by group.

	n = 119		n = 122	
Cluster no. (Code) (clustered+attached)	Variate 1 Customer philosophy	Variate 2 Product philosophy	SF1 Material precision	SF2 Delivery service
Cluster 2 (Emp) (16+6)	0.55 (0.77)	–1.38 (1.08)	0.05 (0.65)	0.08 (0.47)
Cluster 5 (Smp) (28+1)	0.76 (0.67)	–0.04 (0.80)	0.21 (0.59)	–0.97 (0.45)
Cluster 1 (Amp) (33)	0.14 (0.76)	0.68 (0.66)	0.34 (0.43)	–0.01 (0.34)
Cluster 3 (Dm) (12+1)	–0.67 (0.74)	–0.18 (0.74)	–2.00 (0.85)	–0.27 (0.75)
Cluster 4 (Fm) (28+2)	–1.18 (0.57)	0.19 (0.54)	0.28 (0.49)	1.05 (0.33)

This combination had significant advantages compared to the attempts to use only original factor score variables in the cluster analysis. The canonical variates were able to convey differences in business philosophy but avoided the problem in that only one or two variables determine the main directions of division. This problem was frequently met in clusterings with either all the original factor score variables or their various subsets. Second order factoring was explored as one alternative but the resulting factor dimensions were less interpretable than the canonical correlations.

To be managerially relevant, the number of clusters must be small enough to allow complete strategy development. At the same time, each cluster should be large enough to warrant such strategic attention. The algorithm of the SURVO 84C uses the Wilks' lambda criterion L as a measure of intragroup homogeneity. The value of L decreases as the groups get more homogeneous and as they become more distinct. According to Mustonen (1995) Wilks' lambda appears to be the best indicator for multinormal groups with similar covariances. Its use was previously inhibited by complexities of calculation.

The resulting clustering solution was quite balanced in regard to the differentiating power while reasonably clearly divisive. Clustering with five groups produced the most interpretable solution (117 observations present). The chosen cluster pattern was achieved 8 times out of 100 trials. Within the various clustering solution reflecting the same pattern, the solution with the best Wilks' lambda value (0.024) was chosen for the analysis. Eight observations with missing values for either set of clustering variables were attached manually to the nearest group based on previous group memberships and the available factor or variate scores. Two companies had missing values for both sets, and these observations were grouped according to other available information, mainly the the written notes of the interviewers.

The cluster centroids for the variables used are presented in Table 17. There are significant differences in the mean scores by group. As the group numbers have only a technical sense here, the rows are arranged from the most traditional group to the most late-industrial and labelled with the final group codes in brackets, according to the interpretations reported later. The rows in Tables 18–19 and columns in Table 20 are arranged in the same manner.

The groups have at least one distinctive feature each, groups 4 and 5 have two. The negative location of cluster 4 on the customer philosophy variate is due to expressing emphasis on both limited and general customer foci (BF2 positive mean, BF5 negative). Cluster 2 displayed low interest in technical flexibility (BF4 positive), and thus its location on product philosophy variate is negative. The last two columns in Table 17 are directly interpretable as they are first order factor scores. Delivery services have the biggest weight for cluster 4 and lowest for cluster 5. Material precision is least valued by cluster 3.

Fig. 9 presents the variate and factor scores by company. Each observation is labelled with the cluster number and for each cluster an isodensity ellipse is drawn at 90 % inclusion probability. On the canonical variates U1 and U2 cluster 4 appears as the most distinctive while the others are more intertwined. Clusters 1 and 4 are well-defined on the factor score variables SF1 and SF2.

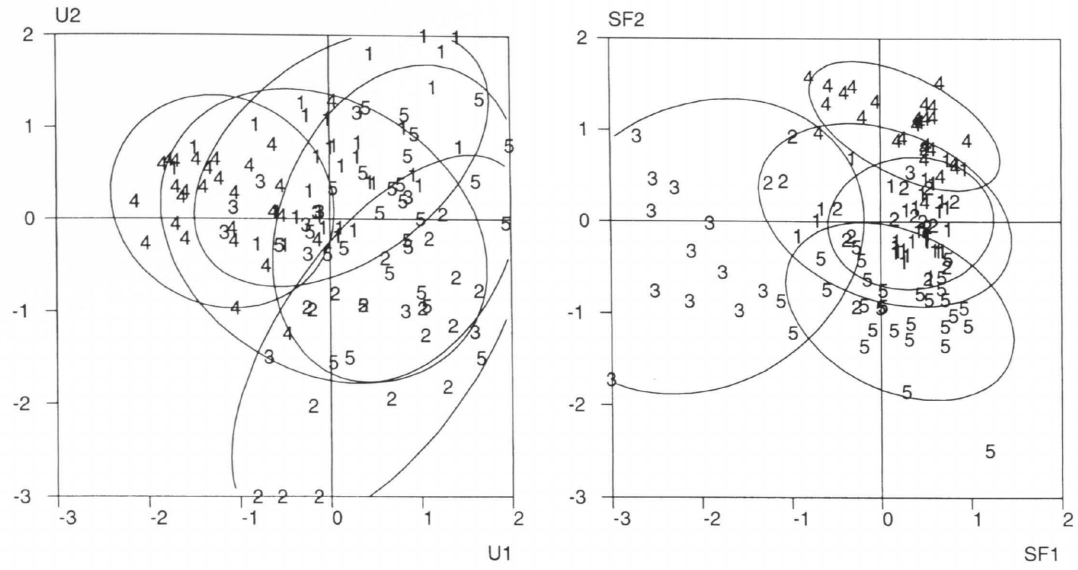

Fig. 9. Groups on the variate and factor dimensions used for the combined clustering. U1 = Customer philosophy, U2 = Product philosophy, SF1 = Appreciation of wood material precision, SF2 = Appreciation of delivery services.

Cluster 3 is clearly distinct on the material precision dimension (negative location), but has a large deviance on the delivery services dimension.

Tables 18 and 19 present the mean original factor scores by cluster for the business philosophy, production operations, and the third factor dimension of supplier choice criteria that was not used as a clustering variable.

The mean factor scores (Tables 17–19) suggest very significant differences between the groups. The F test produced values significant beyond the 0.01 level for the group means on variables BF2, BF3, BF4, BF5, and OF1. Differences in SF3 are significant beyond the 0.05 level.

On the five business philosophy factors, clusters 4, 3, and 1 are situated on the late-industrial side on three or four factors each, and clusters 2 and 5 on the traditional side. Cluster 2 has the most distinctively traditional profile. Groups 4, 3, and 1 also show the greatest agility (OF1) in their production operations. Differences on the technology emphasis factor (OF2) are not significant. The business philosophy factors provide the clearest support for naming groups 4, 3 and 1 as late-industrial ones, and groups 2 and 5 as traditional ones.

Table 20 characterises the clusters as to their size and basic wood usage figures. This solution

Table 18. Business philosophy factor scores (std. dev.) by group.

	n = 119				
	BF1	BF2	BF3	BF4 (neg.)	BF5
Cluster 2 (Emp)	–0.28 (0.78)	0.00 (0.87)	–0.68 (1.33)	1.17 (0.70)	0.01 (0.57)
Cluster 5 (Smp)	–0.20 (0.86)	–0.48 (0.81)	–0.04 (0.71)	0.29 (0.82)	0.36 (0.38)
Cluster 1 (Amp)	0.24 (0.87)	–0.24 (0.84)	0.13 (0.68)	–0.52 (0.50)	0.22 (0.77)
Cluster 3 (Dm)	0.36 (0.62)	0.28 (0.83)	–0.06 (0.86)	0.17 (0.68)	0.16 (0.70)
Cluster 4 (Fm)	–0.07 (1.12)	0.64 (0.45)	0.35 (0.80)	–0.49 (0.33)	–0.70 (0.99)

Table 19. Production operations factor scores and the third supplier choice criteria factor score by group (std. dev.).

	n = 118		n = 122
	OF1	OF2	SF3
Cluster 2 (Emp)	–0.74 (0.84)	–0.19 (0.88)	–0.16 (0.72)
Cluster 5 (Smp)	–0.44 (1.02)	0.24 (0.73)	–0.19 (0.80)
Cluster 1 (Amp)	0.15 (0.78)	0.08 (0.68)	0.35 (0.66)
Cluster 3 (Dm)	0.50 (0.79)	–0.02 (1.12)	–0.26 (1.13)
Cluster 4 (Fm)	0.59 (0.41)	–0.19 (0.90)	0.01 (0.87)

Table 20. Groups compared on background characteristics.

	Cluster 2 (22) (Emp)	Cluster 5 (29) (Smp)	Cluster 1 (33) (Amp)	Cluster 3 (13) (Dm)	Cluster 4 (30) (Fm)
Win-door–fur	2-1-19	10-1-18	23-2-8	10-1-2	22-3-5
DK-D-NL-FIN	3-1-2-16	18-3-2-6	20-6-7-1	0-5-3-5	0-0-28-2
Mean (Median) turnover (mill. ECU)	3.51 (2.45)	5.89 (4.11)	7.96 (2.65)	8.81 (5.82)	4.87 (4.72)
Mean (Median) employees	38 (29)	65 (50)	76 (30)	90 (80)	44 (35)
Mean (Median) wood purchased (m^3)	3612 (2 000)	4573 (2 800)	2919 (900)	2212 (1 300)	1789 (1 260)
% of wood purchases	20 %	34 %	25 %	7 %	14 %
Mean (Median) softwood (m^3)	3378 (2 000)	4296 (2800)	2633 (500)	1543 (300)	703 (338)
Mean (Median) special and customised wood > 0 m^3 [n]	391 (140) [5]	744 (300) [11]	1302 (400) [21]	2011 (1 000) [9]	1124 (900) [13]

does not make an absolute distinction between joinery and furniture manufacturers. Cluster 2 is most clearly dominated by furniture makers and 3 by window manufacturers. Windows have a slightly greater emphasis also in clusters 1 and 4. Cluster 2 includes on average the smallest firms, and clusters 1 and 3 the largest based on the turnover and number of employees. Cluster 5 has the largest wood purchases mean followed by cluster 2. Almost all of the wood appears to be softwood for these companies. Firms in cluster 4 use less wood and even less softwood. Usage of special and customised wood is most frequent in clusters 1 and 3 (about two thirds of the companies). The smallest volumes of component-type wood use are in clusters 2 and 5, where the use is also the least frequent. Cluster 4 consists almost exclusively of Dutch firms, otherwise the memberships by country are more mixed. The Danish firms dominate in clusters 1 and 5, and the Finnish furniture firms in cluster 2.

The clusters can be characterised by their distinctive features on the original factor score variables and on their background features as follows. Detailed analysis of the clusters as sawmill customers is presented in the following section.

Cluster 2: Eccentric mass producers (Emp). Traditional firms with low technical flexibility. No special profile in supplier choice. The group is dominated by furniture makers. Large number of Finnish companies. Wood usage is above average and based on softwood. Underdeveloped use of special and customised sawnwood.

Cluster 5: Stable mass-producers (Smp). Traditional firms with advanced customer philosophy. Low agility in the late-industrial sense. Overlook services as supplier choice criteria. All product groups and sample countries are represented. Wood usage is well above average and consists almost exclusively of softwood. Special and customised sawnwood is used by one third of the companies but only in small quantities on average.

Cluster 1: Advanced mass producers (Amp). Late-industrial product-oriented firms with a high emphasis on technical flexibility. Appreciation of personal sales communication somewhat developed. All products represented though dominated by joinery. Danish firms account for over two thirds of the companies. Wood usage is on the average level and consists mainly of softwood. Usage of special and customised sawnwood is quite frequent and slightly above average.

Cluster 3: De-massifying manufacturers (Dm). Late-industrial firms in both the product and the customer philosophy factors. Great agility in the late-industrial sense. Overlooking of wood material precision as supplier choice criteria. Mainly window and door manufacturers from countries other than Denmark. Wood usage below average, also hardwood species. Special and customised sawnwood is used frequently and in quantities above average.

Cluster 4: Flexible manufacturers (Fm). Late-industrial firms on the customer philosophy: narrow targeting with simultaneous unselectivity. High emphasis on technical flexibility. Great agility in the late-industrial sense. High appreciation of delivery services as supplier choice criteria. All products represented though window (and door) manufacturing prevails. Almost all of the firms are Dutch. Wood usage is below average and slightly dominated by hardwood. Use of special and customised sawnwood is on the average level and it is present in over 40 % of the firms.

Table 21. Connections between groups and wood usage volumes m^3/a (%).

N = 127	–500	501–1.000	1.001–2.000	2.001–5.000	5.001–30.000	Sum	n	Vol m^3
Eccentric mass producers (Emp)	36.4	0.0	18.2	27.3	18.2	100	22	79.464
Stable mass producers (Smp)	6.9	20.7	20.7	31.0	20.7	100	29	132.617
Advanced mass producers (Amp)	33.3	30.3	12.1	6.1	18.2	100	33	96.327
De-massifying manufacturers (Dm)	23.1	15.4	23.1	23.1	15.4	100	13	28.756
Flexible manufacturers (Fm)	16.7	26.7	26.7	30.0	0.0	100	30	53.670
All	22.8	20.5	19.7	22.8	14.2	100	127	390.834

p = 0.047

5.6 Customer Profiles

5.6.1 Wood Material Used

The proposition P1 was formulated suggesting that the share of component-type sawnwood as raw material is positively associated with the degree of late-industrialism of the firm. This section analyses the results with regard to this proposition. Table 21 presents the distribution of annual wood usage in the sample by group, as this information gives background to the analyses.

Although the dependence between rows and columns is significant, the late-industrial groups (Amp, Dm, Fm) do not exhibit clear dependency on company size by wood usage. Only in the group of flexible manufacturers (Fm) are the biggest firms not present. The stable mass producers' group (Smp) has the largest share of the biggest companies. The smallest companies have the biggest shares in both the advanced (Amp) and the eccentric (Emp) mass producers, about one third of each group. In the advanced mass producers' group, this is part of continuous distribution, but the eccentric mass producers are divided by an empty size class. The groups that are late-industrial by nature (Amp, Dm, Fm) represent about 46 % of the wood volume in the sample and the traditional groups (Emp, Smp) represent 54 %. The mean total volume for late-industrial companies is 2352 m^3/a and for traditional ones 4101 m^3/a. The difference in means is significant, and a conclusion can be made that in general, the late-industrial companies were smaller by wood use volumes than the traditional ones.

The average size of an individual delivery was

Table 22. Connections between groups and value-added levels of wood material (% of volume).

	Pre-sawnwood		Sawnwood		Special and customised sawnwood					Oth	Sum
	Round	Stamm	Stand	Cust	Sf-pole	Sf-com	Fp-pol	Fp-com	Rta-c		
Emp 2	0.2	3.3	88.3	4.9	0.1	1.6	0.2	0.0	1.4	0.0	100.0
Smp 5	6.2	0.4	57.7	29.0	1.1	0.0	1.8	3.3	0.0	0.0	99.5
Amp 1	0.9	0.0	56.1	14.6	6.2	0.7	19.0	2.4	0.1	0.0	100.0
Dm 3	0.0	0.5	18.5	14.9	25.5	22.0	11.9	0.0	5.6	1.1	100.0
Fm 4	0.0	6.5	39.9	26.3	5.9	7.4	1.7	12.3	0.0	0.0	100.0
All	2.4	1.6	56.9	19.9	4.8	3.2	6.8	3.6	0.7	0.1	100.0

Table 23. Connections between groups and share of special and customised sawnwood of total wood usage (%).

Group (n)	0 %	1–49 %	50–99 %	100 %	Sum	Mean (std. dev.)
Emp 5 (29)	62.1	20.7	10.3	6.9	100.0	19.6 (34.3)
Smp 2 (22)	77.3	13.6	4.5	4.5	99.9	10.5 (26.3)
Amp 1 (33)	36.4	33.3	18.2	12.1	100.0	32.0 (36.2)
Dm 3 (13)	30.8	15.4	30.8	23.1	100.1	46.3 (44.7)
Fm 4 (30)	56.7	10.0	20.0	13.3	100.0	25.5 (36.8)
All (127)	53.5	19.7	15.7	11.0	99.9	25.4 (36.2)

p = 0.095

40 m³, as it is related to the size of the transporting trucks and the container units. The average frequency of wood deliveries as a whole was 78 times a year: about 1.5 times a week. There was no significant dependency between the groups and the classes of delivery size or frequency. The observations were concentrated around the average.

The wood material used is divided between various value-added levels in Table 22. The first four columns present the shares of value-added levels up to the slightly customer-adapted sawnwood, as for example customer quality graded or customer dried sawnwood that otherwise complies to the common trading dimensions. The columns under the heading "special and customised sawnwood" include the material types that were handled as representing late-industrial sawnwood material.

For the whole sample the share of roundwood and stammware is 4 % and of sawnwood 77 % (both standard and modestly customer adapted). The share of special and highly customised sawnwood is 19 % (divided into sawn-faced poles and components, further processed poles and components, and ready-to-assemble components). The share of roundwood and stammware is biggest in the groups that include most of the furniture makers, i.e. groups Smp, Fm, and Emp.

The shares of standard and slightly customer-adapted sawnwood (traditional industrial) and accordingly the shares of special and customised sawnwood (late-industrial) in the groups are:

Group	Industrial	Late-industrial
Emp	93 %	3 %
Smp	87 %	6 %
Amp	70 %	28 %
Dm	33 %	65 %
Fm	66 %	27 %

The difference between the operating modes that is to some extent visible above, is clearly revealed when the groups are summarised into two. The mean volume of component-type material (including also the non-users) for the late-industrial firms was 790 m³ and for the traditional industrial companies 199 m³.

In Table 23 the distribution of the share of special and customised sawnwood is presented by group. Although the dependence is not very strong, it displays a pattern suggesting that the proportions of component-type sawnwood are bigger in the last three groups that were labelled as late-industrial.

Conclusion on proposition P1. The results above support P1, and the distinctively high proportion of components and poles in the group of advanced mass producers is an especially clear example. The share of late-industrial sawnwood material did not follow the analytical order of the groups from the most traditional to the most late-industrial, but the connection is very clear when the two operating modes were compared as bigger groups. The companies more advanced on their business philosophy and purchasing approach – as outlined in the theoretical background and as applied when developing the typology – are more likely to use sawnwood that has been processed beyond the commodity level.

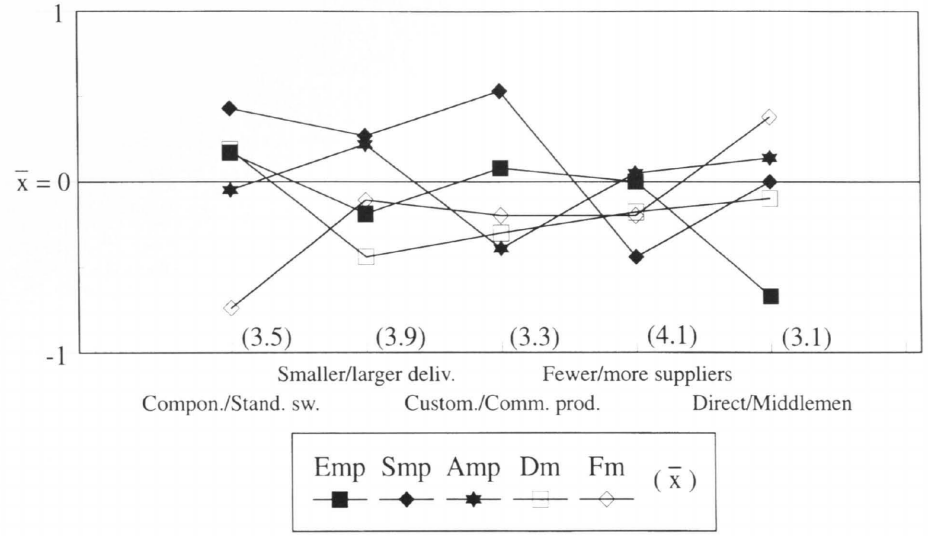

Fig. 10. Direction of change in production and materials during the next five years assessed by group on the scale from 1 to 7, 1 = former option, 4 = no change, 7 = latter option (deviance of group means from the sample mean).

5.6.2 Direction of Change

The companies were asked for the anticipated changes in production and wood use during the next five years, in order to check whether the direction of change in near future is towards the late-industrial modes, as was assumed in the research design (proposition P2). Five variables were measured on a seven-point scale of semantic differentials. Deviances of group means from sample mean for these variables are presented in Fig. 10.

Three of the variables produced significant between-group differences and two between-mode differences in cross-tabulation; these results are presented in detail below. As the question on the trend in production and materials was worded as "... will probably move to the direction of using more ...", the following analyses assume the information provided by the question concerns the direction and subjective strength of the change in the proportions of the variable ends.

Table 24 presents the answers by the group on whether the respondent companies will be using increasingly components or sawnwood. All clusters are centred on the middle of scale "no change",

Table 24. Connections between groups and direction of change in material type during the next five years (%).

p = 0.100	Using more components			Using more standard sawnwood		Sum	Mean
Group (n)	1	2–3	4	5–6	7		
Emp 2 (21)	4.8	33.3	38.1	23.8	0.0	100.0	3.7
Smp 5 (29)	10.3	13.8	58.6	10.3	6.9	99.9	3.9
Amp 1 (33)	21.2	15.2	48.5	12.1	3.0	100.0	3.5
Dm 3 (13)	23.1	15.4	30.8	23.1	7.7	100.1	3.7
Fm 4 (29)	24.1	41.4	31.0	3.4	0.0	99.9	2.8
All (125)	16.8	24.0	43.2	12.8	3.2	100.0	3.5

Table 25. Connections between the industrial and late-industrial operating modes and direction of change in delivery size during the next five years (%).

p = 0.05	Using smaller wood deliveries			Using bigger wood deliveries		Sum	Mean
Group (n)	1	2–3	4	5–6	7		
Industrial Emp, Smp (50)	2.0	30.0	40.0	22.0	6.0	100.0	4.0
L.-ind. Amp, Dm, Fm (75)	8.0	16.0	60.0	10.7	5.3	100.0	3.9
All (125)	5.6	21.6	52.0	15.2	5.6	100.0	3.9

except the flexible manufacturers. This group also has the lowest mean, well below the average. Of all companies, 41 % indicate a move towards components and 16 towards sawnwood. The ultimate component-type end of the scale (value 1) received greatest share of the answers in groups Fm, Dm, and Amp, which may be interpreted as reflecting the division into late-industrial and standard industrial firms. In groups Amp and Smp the standard sawnwood end (value 7) represents 7–8 %.

The five groups did not differ significantly on the variable regarding the future direction of change in the size of wood material deliveries (Table 25). Majority of the late-industrial groups have indicated no change, but a bigger share of them have chosen the alternative 1, the strongest change towards smaller deliveries. Almost one third of the traditional industrial firms have chosen the more moderate alternatives 2 to 3. The proportion of movement towards bigger deliveries is slightly bigger with the traditional companies.

The change between producing customer products and commodity products is presented in Table 26. A move towards standard sales and repeated orders is in the minority, although in groups Smp and Emp about one fifth of the firms have indicated alternatives 5 or 6 as their position and almost 14 % of the group Fm have indicated alternatives 5–7. About 46 % of all respondents fall into the late-industrial direction, whereas 12 % anticipate movement towards the traditional end. Group Amp has the lowest mean for this variable. When the groups were divided into traditional and late-industrial, the dependence was significant beyond the 0.001 level. This comparison suggested that 51 % of the late-industrial firms move towards customer products and 38 % of the traditional ones.

The variable dealing with anticipated direction in the number of wood suppliers used was ana-

Table 26. Connections between groups and direction of change in production during the next five years (%).

p = 0.006	More individual sales and cust. specifications			More standard sales and repeated orders		Sum	Mean
Group (n)	1	2–3	4	5–6	7		
Emp 2 (21)	4.8	42.9	33.3	19.0	0.0	100.0	3.4
Smp 5 (29)	0.0	31.0	48.3	20.7	0.0	100.0	3.8
Amp 1 (33)	21.2	33.3	42.4	3.0	0.0	99.9	2.9
Dm 3 (13)	15.4	38.5	46.2	0.0	0.0	100.1	3.0
Fm 4 (29)	34.5	10.3	41.4	6.9	6.9	100.0	3.1
All (125)	16.0	29.6	42.4	10.4	1.6	100.0	3.3

Table 27. Connections between the industrial and late-industrial operating modes and direction of change in number of suppliers during the next five years (%).

p = 0.030	Using fewer wood suppliers			Using more numerous wood suppliers		Sum	Mean
Group (n)	1	2–3	4	5–6	7		
Industrial Emp, Smp (50)	0.0	28.0	40.0	32.0	0.0	100.0	4.2
L.-ind. Amp, Dm, Fm (75)	1.3	21.3	60.0	13.3	4.0	99.9	4.0
All (125)	0.8	24.0	52.0	20.8	2.4	100.0	4.1

Table 28. Connections between groups and trend in supplier channels during the next five years (%).

p = 0.059	Dealing with sawmills more directly			Dealing more through middlemen		Sum	Mean
Group (n)	1	2–3	4	5–6	7		
Emp 2 (21)	28.6	42.9	28.6	0.0	0.0	100.1	2.4
Smp 5 (29)	13.8	44.8	34.5	6.9	0.0	100.0	3.1
Amp 1 (33)	9.1	42.4	42.4	3.0	3.0	99.9	3.2
Dm 3 (13)	15.4	30.8	53.8	0.0	0.0	100.0	3.0
Fm 4 (29)	24.1	6.9	51.7	17.2	0.0	99.9	3.5
All (125)	17.6	33.6	41.6	6.4	0.8	100.0	3.1

lysed between the industrial modes combined, as groupwise cross-tabulations did not show significant dependence (Table 27). The responses are distributed symmetrically for both modes, but the late-industrial mode shows wider variance although majority of the companies do not expect changes.

The proportion of direct sawmill relations is estimated to increase as a whole (Table 28). About 51 % expect to deal increasingly with the saw-

mills directly instead of retailers, importers and agents. Oddly this tendency is strongest in groups Emp (72 %) and Smp (59 %), the most traditional groups according to their business philosophies and supplier choice criteria. In a way this notion is consistent with the assumption that all the industrial end-users of sawnwood are increasingly looking for direct relationships. On the other hand, other direction would be logically impossible if the direct relationships were practically nonexistent so far.

Conclusion on proposition P2. The results support the proposition P2 that the direction of change in near future is towards the late-industrial modes. Increase in the proportion of various components is anticipated by 41 % of the respondents. In all groups except the flexible manufacturers there are however also firms anticipating increase in the proportion of standard sawnwood (16 % of respondents). The direction of increasing individual sales and customer specifications in their own products is represented by 46 % of all the firms as opposed to 12 % moving towards standard sales and repeated orders. Direct purchases from sawmills are expected to gain ground by 51 % and dealing more through middlemen by 7 %. The variables regarding the size of deliveries and number of suppliers have quite symmetrical distributions. As a conclusion it can be said that, based on the three most important variables in this set, the sawmill customers are moving towards the late-industrial in the form of customer products, special and customised sawnwood material, and direct sawmill relations.

5.6.3 Evaluation of Sawmill Performance

The evaluated sawmill performance was expected to be negatively associated with the degree of late-industrialism of the companies (proposition P3, a–d). The respondents were asked to evaluate sawmill performance on the same items that were used when expressing supplier choice criteria. The respondents were asked to rate the performance of their present sawnwood supplier base on a scale of 0–10. Inclusion of the zero value in the scale seemed to embarrass some respondents. While in the Netherlands the scale is in common use and was understood without difficulties, for example in Finland a scale 4–10 (traditional school grades) probably would have produced more consistent assessments. Imputed substitutes were used as a support to the original responses when analysing the sawmill performance because of the otherwise too large share of missing responses. This negligence was apparently due to the tendency of the respondents to ignore items considered unproblematic from their viewpoint and to the great effort required of interviewees. Missing values were estimated using the regression-based feature provided by the SURVO 84C software for 7 % of observation matrix cells for this set of variables.

The manufacturers are, in general, quite satisfied with the sawmill performance; assessments range mainly between 7 and 8. Differences between the group means are plotted in App. 11. *The technical aspects* of performance graded the lowest by the sample as a whole were the consistency of quality grading, ability to deliver specified knot quality, and technical expertise of the supplier. The de-massifying manufacturers have the lowest mean satisfaction with these variables.

On *the delivery aspects*, the readiness for special service has the widest variation between the group means. The group of stable mass producers gives the lowest grades for short delivery time, ability to deliver small orders, readiness for special service and JIT deliveries.

On *the contact aspects and price performance*, the de-massifying manufacturers give the lowest grades for activity of personal sales communication and the advanced mass producers for activity of relationship to the supplier. The eccentric mass producers are the least satisfied with the price performance.

As the analyses of separate variables for performance evaluation did not show clear enough differences for making conclusions on proposition P3, a factor analysis was undertaken to find out whether there is interdependency between the performance variables and whether the groups differ on the latent dimensions. The correlation matrix used is presented in App. 12. A three-factor solution that resulted in dimensions approximately corresponding to those received in the supplier choice criteria analysis was considered the most informative (Table 29). Tarkkonen's reliabilities for the factors were good.

Table 29. Factor and sub-measure structure of sawmill performance evaluation. Three-factor solution with orthogonal varimax rotation.

% cv	Factor loading *Reliability* F1	F2	F3	**Factor** Variable	h^2
8.3				**F1: Personal contact performance**	
	0.86	0.04	**0.51**	Activity of personal sales communication	0.99
	0.51	**0.50**	–0.02	Readiness for special service	0.51
14.8				**F2: Delivery services performance**	
	0.31	**0.85**	0.06	Ability to deliver small orders	0.81
	0.20	**0.54**	0.40	Reliability of repeated standard deliveries	0.50
	0.00	0.46	0.08	Just-in-time deliveries	0.22
	–0.05	0.46	0.22	Short delivery times	0.26
	0.09	0.45	0.40	Ability to react to long-term changes in our needs regarding wood material	0.37
17.5				**F3: Wood material precision performance**	
	–0.03	0.17	**0.70**	Ability to deliver specified knot quality	0.53
	0.28	0.17	**0.70**	Technical expertise of supplier	0.60
	0.04	0.28	**0.58**	Consistence of quality grading	0.42
	0.08	–0.01	0.49	Ability to deliver specified wane quality	0.25
	0.06	0.21	0.44	Activity of direct relationship to supplier	0.24
	0.05	0.38	0.42	Long-term customer relationship with the sawmill	0.32
	0.08	0.12	0.22	Ability to deliver specified lengths	0.07
	0.06	0.02	0.11	Ability to deliver specified moisture content	0.02
40.5					
	0.93	*0.87*	*0.87*	For unweighted sum *0.86* (Tarkkonen)	

The first factor consists of two variables, the activity of personal sales communication and the readiness for special service. This dimension was labelled the Personal contact performance. The second factor includes five main variables: ability to deliver small orders, reliability of repeated standard deliveries, just-in-time deliveries, short delivery times, and ability to react to long-term changes in material needs. This dimension was named the Delivery services performance. The rest of the variables load mainly on the third factor, and as they are related to the physical product, the dimension was named the Wood material precision performance. Variables for specified lengths and moisture content have very low communalities.

This factor solution is more complex than the one of the same items as supplier choice criteria, as there are several variables loading considerably on two factors. The structure of the performance factor solution differs from the criteria factor solution on two points. The variable "ability to react to long-term changes..." contributes in the evaluation solution to the delivery services slightly more than on the personal contact performance. In addition to this, the variable "long-term customer relationship" now contributes to the material precision performance but also to the delivery services performance, only this time positively.

The differences in group mean factor scores (Table 30) serve mainly to point out the same results as the original variables. The group of de-massifying manufacturers has a negative mean on the personal contact and the material precision factors, although on the latter a wide deviation. The eccentric mass producers' group is positively located on the precision factor, and the stable mass producers' group locates negatively on the delivery services factor (though with wide deviation).

As the group means on factor scores did not

Table 30. Four-cluster solution, mean factor score (std. dev.) by group and main industrial operating mode.

n = 122	F 1 Personal contact performance	F 2 Delivery services performance	F 3 Wood material precision performance
Eccentric mass producers (18)	0.04 (0.67)	0.08 (0.84)	0.25 (0.78)
Stable mass producers (24)	–0.11 (0.83)	–0.26 (1.15)	0.15 (1.32)
Advanced mass producers (31)	0.08 (1.32)	0.01 (0.75)	–0.06 (1.18)
De-massifying manufacturers (9)	–0.33 (0.42)	0.04 (0.44)	–0.48 (1.46)
Flexible manufacturers (26)	0.10 (0.77)	0.16 (0.66)	–0.07 (0.88)
Industrial Emp, Smp (42)	–0.05 (0.76)	–0.11 (1.03)	0.19 (1.11)
L.-ind. Amp, Dm, Fm (66)	0.03 (1.04)	0.07 (0.68)	–0.12 (1.11)

show statistically significant differences between all five groups, the groups were also analysed as two combinations according to their industrial operating modes. Only the factor F3 (performance on wood material precision) mean scores were different beyond the 0.1 risk level. This result supports the *proposition P3.a* that the sawmill performance in technical quality is perceived worse at the late-industrial firms than at the traditional industrial firms.

Proposition P3.b about the delivery performance of sawmills being negatively associated with the degree of late-industrialism of the customers does not gain support. Significant difference was only found related to the separate variable on sawmill readiness for special service, and even this difference was opposite to the expectations, as the late-industrial customer groups as a whole were slightly more satisfied than the traditional groups. A potential explanation to this is that some prior supplier selection has already taken place. Beyond that, it was not possible to assess *proposition P3.c*, as the empirical factor dimensions differed from the expected ones.

The *proposition P3.d* about the contact performance of sawmills being negatively associated with the degree of late-industrialism of the customers does not gain support as such. A weak notion can be made based on the performance factor image, where factor F3 (wood material precision performance) includes one large loading from the variable related to the activity of personal sales communications. The comparison of traditional industrial and late-industrial groups in Table 30 suggests then that the late-industrial customers may be slightly less satisfied with this aspect of contact performance.

When the cluster mean scores on the supplier choice criteria factors and the corresponding performance factors are compared, there does not seem to be either high gaps or over-performing. *The material precision* was the most important dimension for groups Amp, Fm, and Smp. The latter gives positive evaluation on the corresponding performance factor and groups Amp and Fm are located near average or slightly below. This criteria was least appreciated by group Dm, and still it gave the most negative evaluation of the sawmill performance in material precision. *Delivery services* were appreciated the most by group Fm, which also graded the performance on the corresponding dimension slightly positive. *The personal contact* dimension was the most important for group Amp, and the performance factor mean score was near average.

Conclusion on proposition 3. Three of the expected four dimensions of sawmill performance were identified in the data as: material precision, delivery services, and contact performance. Sawmill performance in technical quality is perceived slightly worse at the late-industrial firms than at the traditional firms. There is no defensible difference in delivery services performance or contact performance between the traditional industrial and the late-industrial firms. From the sceptic point of view, this means that that there is need for development in sawmilling only within the physical supply. From the viewpoint of the assumptions of this study, this means that the late-industrial firms have already been able to find

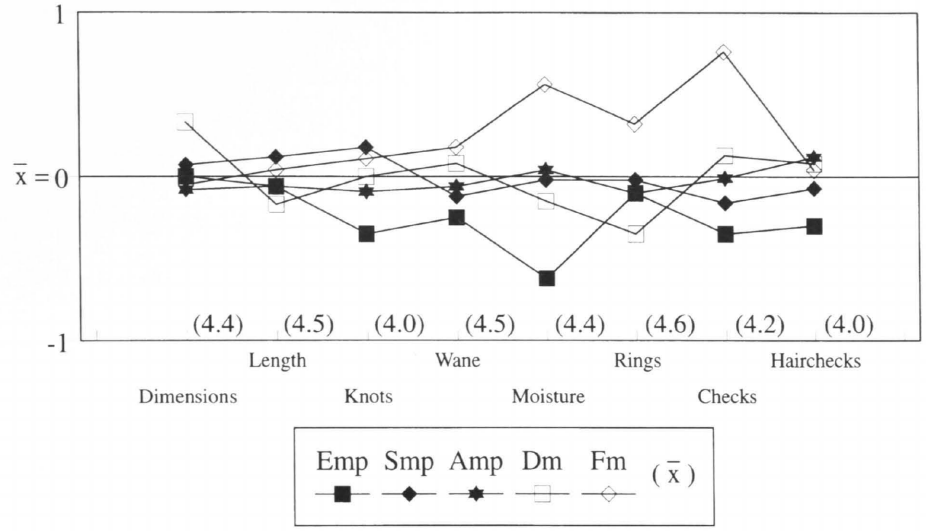

Fig. 11. Problems (1) encountered in wood material by group on the scale from 1 = often to 5 = seldom (deviance of group means from the sample mean).

suppliers that are at the level of their requirements, but perhaps still need encouragement in their efforts in offering variable accurate specifications in sawnwood material.

5.6.4 Problems in Wood Material

Proposition P4 suggested that the occurrence of problems in wood material be positively associated with the degree of late-industrialism of the customers. According to the data used in this study, problems in the wood material occur quite seldom. On the five-point scale used (1 = often 5 = seldom) the assessments range, in general, between 4 and 5. The differences of group means from the sample mean are plotted in Figs. 11 and 12. As the differences between the group means were not statistically significant as such, cross-tabulation was applied for more detailed analysis. The key findings are presented below in short.

The strongest dependence was shown between group membership and occurrence of problems with the *moisture content*. This problem occurred most often (alternatives 1–2) within the eccentric mass producers and the advanced mass producers, and distinctively least often (alternative 5) within the flexible manufacturers. Groups Amp and Smp had roughly similar distribution patterns to alternatives 3–5 (rather seldom). When the groups were combined according to their operating modes, the difference between the means for the late-industrial (mean 4.6) and the traditional industrial firms (mean 4.1) was significant beyond the 0.01 risk level. This notion suggests that the traditional firms meet more problems in moisture content.

The occurrence of problems with *checks* caused by the drying process is also least frequent within the flexible manufacturers' group, but most frequent within the stable mass producers. The industrial modes compared suggest that the traditional firms meet more problems (mean 3.9) than the late-industrial ones (mean 4.5).

The undesired presence or absence of *heartwood* was seen as most problematic in group Emp, followed by groups Amp and Dm. Again, this did not suggest positive connection to the industrial mode. The *resin or bark pockets* remaining in the sawnwood were somewhat problematic in groups Emp and Smp, both traditional. The frequency of occurrence was the least in group Fm. The problems caused by *reaction wood* were most visibly

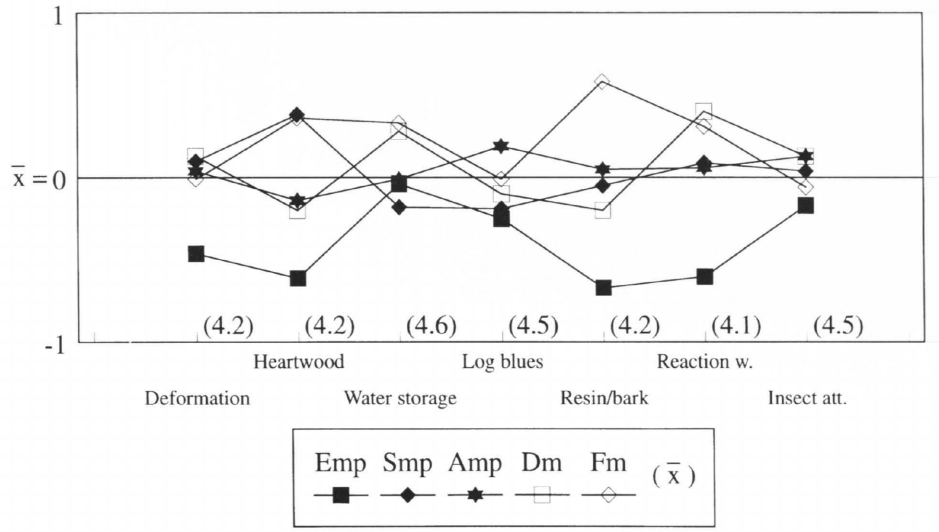

Fig. 12. Problems (2) encountered in wood material by group on the scale from 1 = often to 5 = seldom (deviance of group means from the sample mean).

present in the group of the eccentric mass producers, followed by the group of stable mass producers.

Conclusion on proposition P4. There was no evidence in support of P4. On the contrary, the results seem rather to point towards the opposite situation, that the sawmill customers operating in the traditional industrial operating mode report more frequent occurrence of some problems, especially related to moisture content, resin and bark pockets, and reaction wood. It is worth emphasising that there was no reported difference between the operating modes in problems with dimensions, lengths, knots, and wane – the most important variables in defining any piece of sawnwood. The logic of twofold interpretation offered with P3 applies to P4, too: either the increasing late-industrialism of the customers actually strengthens the position of the sawmill industry as a whole, or the late-industrial firms are being served by a different set of sawmills. Only in this case, it seems more obvious that a division into more capable and less capable sawmills has already happened. However, using the data available in this study it was not possible to check the validity of this conclusion.

5.6.5 Company Background by Group

Although there were no specific propositions formulated about the relationships between group membership and company background, an analysis of this connection was defined as one of the empirical research tasks. The initial description of the group backgrounds was presented in section 5.5 (Table 20). The following analyses provide a more detailed description of the dependence of group membership on the company classes based on the background variables. The dependence between company nationality and group membership is very strong (Table 31).

The most distinct connections can be seen as:

Denmark – Advanced mass producers and stable mass producers

The Netherlands – Flexible manufacturers

Finland – Eccentric mass producers

This result suggests that the construct of industrial operating mode measured in this study can be at least weakly linked to the home country of the sawmill customer. The exact nature of this connection, whether causal or due to a measurement scale too close to items that differentiate

Table 31. Connections between nationality and group membership (%).

n = 127 Country	Eccentric mass producers	Stable mass producers	Advanced mass producers	De-massifying manufacturers	Flexible manufacturers	Sum
Denmark (41)	7.3	43.9	48.8	0.0	0.0	100.0
Germany (15)	6.7	20.0	40.0	33.3	0.0	100.0
Netherlands (41)	4.9	4.9	14.6	7.3	68.3	100.0
Finland (30)	53.3	20.0	3.3	16.7	6.7	100.0
All (127)	17.3	22.8	26.0	10.2	23.6	99.9

p = 0.000

Table 32. Connections between wood usage class and group membership (%).

n = 127 m^3	Eccentric mass producers	Stable mass producers	Advanced mass producers	De-massifying manufacturers	Flexible manufacturers	Sum
–500 (29)	27.6	6.9	37.9	10.3	17.2	99.9
501–1000 (26)	0.0	23.1	38.5	7.7	30.8	100.1
1001–2000 (25)	16.0	24.0	16.0	12.0	32.0	100.0
2001–5000 (29)	20.7	31.0	6.9	10.3	31.0	99.9
5001–30000 (18)	22.2	33.3	33.3	11.1	0.0	99.9
All (127)	17.3	22.8	26.0	10.2	23.6	99.9

p = 0.039

Table 33. Connections between production value of main products and group membership (%).

n = 127 Product	Eccentric mass producers	Stable mass producers	Advanced mass producers	De-massifying manufacturers	Flexible manufacturers	Sum
Windows	1.7	12.1	37.3	19.9	29.1	100.1
Doors	6.6	13.5	49.8	7.1	23.4	100.4
Furniture	21.4	39.6	31.9	1.8	5.3	100.0
Other	4.8	9.0	0.6	77.5	8.1	100.0
All	9.8	22.2	35.1	14.4	18.4	99.9
Value mill. ECU	77.3	176.3	278.5	114.5	146.2	792.7

countries rather than modes used, remains subject to further research.

The dependence between turnover and group membership was not significant. Company size according to the number of employees followed the pattern in the turnover figures but also without significant dependence. Some dependence can be seen between the volume of annual wood usage and group membership (Table 32). The biggest category is quite clearly connected to the three groups characterised through mass production, and over 50 % of these firms fall into the two traditional groups.

Furniture production is similarly connected to the two most traditional groups and the group of advanced mass producers (Table 33). Windows

Table 34. Connections between sales per customer group and group membership (%).

n = 119 Customer group	Eccentric mass producers	Stable mass producers	Advanced mass producers	De-massifying manufacturers	Flexible manufacturers	Sum
Builders' merchants	1.3	11.3	66.8	9.0	11.7	100.0
Building contractors	1.7	15.9	29.3	9.8	43.3	100.0
Renovation contractors	0.4	5.8	41.2	22.7	30.0	100.1
DIY stores	8.6	0.0	83.9	0.0	7.6	100.1
Furniture chains	22.8	39.7	37.1	0.0	0.5	100.1
Furniture stores	16.4	49.9	25.3	6.7	1.7	100.0
Mail order firms	18.4	73.9	7.7	0.0	0.0	100.0
Retail customers	9.4	8.5	9.7	66.1	6.2	99.9
Others	2.3	43.8	19.9	0.0	34.1	100.1
All	8.6	23.2	37.7	11.5	19.0	100.0
Value mill. ECU	59.2	160.8	261.1	79.8	131.1	692.0

in turn are emphasised more in the advanced mass production with the two most late-industrial groups. Door production is most common in the advanced mass producers' group.

The total value of production by the traditional groups is about 254 mill. ECU and by the late-industrial groups about 539 mill. ECU. If the group of advanced mass producers was separated as a third category of its own, the volume of late-industrial production would be about 261 mill. ECU. A cautious interpretation of this division would then be that roughly one third of the production takes place in a genuinely late-industrial mode, one third is probably in the initial phases of late-industrial production, and one third remains in the traditional mode based on industrial mass production.

The connections between sales from secondary wood processing to the main customer groups and the group membership are presented in Table 34, upon which some notes can be made.

The customer groups follow mainly the natural division caused by relative shares of the main products in each group. The advanced mass producers have a share of almost 84 % of all the sales to do-it-yourself stores in the sample, and about 67 % of the sales to builders' merchants. These figures clearly exceed the overall share of 38 % by this manufacturer group. The customer groups related to furniture sales (chains, stores, mail order) have most weight among the stable mass producers, advanced mass producers, and the eccentric mass producers. Almost two thirds of the retail customers served by the sample are customers of the de-massifying manufacturers.

Conclusion on the company background. The connections between certain groups and countries are evident though not exclusive. The most late-industrial firms can be found in the Netherlands and Denmark, but in this sample the relations are effected by the uneven distribution of the observations with regard to sample countries and sample industries. According to the results presented above, the typical late-industrial customer for a sawmill could be a Dutch joinery manufacturer purchasing wood some thousands of cubic metres per year. If less enthusiastic about the technical aspect of flexibility, the customer could also be German or Finnish. Alternatively, a company well into a late-industrial product philosophy would be a Danish firm applying an advanced mass production concept for producing a changing variety of joinery products or furniture. The use of component-type wood could be expected to be at biggest in the case of a Danish advanced mass producer, on average around two thirds of all wood used and in every fifth company perhaps close to 100 %. In the first two cases mentioned the average share of component-type wood would be near one third of total volume and possibly 100 % in every tenth company.

6 Discussion

6.1 The Concept of Industrial Operating Mode

This study aimed at analysing the role of the industrial operating modes applied by joinery and furniture manufacturers using sawnwood, and at profiling the differences between the manufacturers as sawmill customers. Motivation for the study can be shortly rephrased by referring to Porter (1985): "Identifying a new way of segmenting an industry can be a major opportunity." Table 35 summarises the proposed industrial operating modes at the levels of measurement used in the study. Cells of the table give a compressed keyword review of the assumed characteristics of the industrial modes within each component of the company behaviour.

This concept of industrial operating mode showed good applicability in the empirical part of the study. The latent dimensions derived from the observed variables were a close match to the dimensions expected. The first-order conclusion of the study is that the theoretical ideas presented in the study are relevant in the academic field of forest products marketing. As is natural, the theoretical constructs collected and synthesised in this study need further development and testing. The current discussion climate, for example in Finland, is related to unemployment, national economics, forestry, and sustainable development. The principle and possibility of the industrial change process affecting some of these issues seems credible, and introduction of some aspects of this process as was done in this study is justifiable.

On the empirical level, the development of a customer typology based on the late-industrial construct was a reasonably successful attempt. The data collected provided sufficient basis for classifying observations, and the resulting division was close to what was expected. The difference in wood usage styles was the most important research finding together with the notion that the industrial change as related to the sawmill–sawmill customer relationship will seemingly continue in the near future.

The resulting typology can be compared with another a priori classification. The industrial change within secondary wood industries received attention of the Cei-Bois (1994), whose study identified three successful strategies in the intensifying European competition. The empirical clustering results of the present study are quite similar to this view, which may be interpreted to provide additional support to the validity of the concept of industrial operating mode as a basis for customer typology. The first of the three strategies suggested by Cei-Bois (1994) emphasises flexibility, service, and local experience; specialising in local markets and serving the preferences and requirements of local consumers and builders. This strategic definition is perhaps already in use by the group of flexible manufacturers identified in this study (late-industrial).

Table 35. The three components of the industrial operating mode and the three modes expected.

	Industrial	Late-industrial 1	Late-industrial 2
Business philosophy	Economies of scale	Differentiation	Economies of scope and responsiveness
Production operations	Mass production	Advanced mass production	Flexible manufacturing
Supplier choice criteria	Standards, volumes, costs	Variety, costs, timing	Specifications, quality, service

The second strategy would target the European open market as a whole and produce standardised building parts or furniture based on economies of scale. This strategy would be most likely followed by the biggest companies. Apparently the description applies to the two traditional groups of this study, the stable mass producers and the eccentric mass producers, though the latter may be falling short of achieving the necessary volume of production or stability in product philosophy to serve a large market. The third alternative is to specialise in a niche; to concentrate on a technically specialised product, but offer it to a large geographical area. According to Cei-Bois (1994) this strategy can also be pursued by small and medium-sized firms if they command deep enough expertise. Both the advanced mass producers and the de-massifying manufacturers would belong to this category (late-industrial).

The resulting groups of sawmill customers were analysed on variables related to their interface with sawmills: wood material use, evaluation of sawmill performance, and problems in wood material. The results defend strongly the assumptions of this study that the joinery and furniture manufacturers are applying various industrial operating modes, and on the highest level, a division into traditional and late-industrial sawmill customers is possible and credible.

As Vartia and Ylä-Anttila (1993) state, the "post-industrial" advancement in operating modes is only emerging, and then probably over a rather long period. A conclusion of this study also is that although various modes can already be detected, the late-industrial mode in its strictest sense still is in its development phase. This, genuinely late-industrial mode would be strongly characterised by a philosophy of variation and response, production technology that is able to realise the philosophy, non-adversarial relationship orientation, and absence of features related to the mass production.

The two most advanced groups in the sample represented 26 % of the number of the companies and 33 % of their turnover. The groups emphasise different late-industrial aspects (product philosophy, customer philosophy), and they also include an array of company locations on those aspects. Thus – allowing for some deficit in the reliability of the measurement and some bias in the purposive sampling – perhaps half of the de-massifying and flexible manufacturers each can be described as operating in the really late-industrial mode (2). These firms would then represent 17 % of the sample and 16 % of turnover.

The share of advanced sawnwood material (sawn-faced components, further processed components, component poles, ready-to-assemble components) is bigger in the late-industrial customers, and the change is continuing in that direction. Thus the notion of industrial change affecting also the sawmills, at least through the evolving demand, is tenable. The late-industrial customers are, in general, somewhat more satisfied with the performance of their wood suppliers than are the traditional customers. The same applies to the occurrence of problems in wood material. It is possible that a division into sawmills that meet the new standards and to those that do not has already happened. As the data of this study did not enable this notion to be verified, it remains a subject for further research.

6.2 Limitations of the Concept

The applicability and validity of the theoretical background chosen for this study and used to guide the empirical implementation could well be criticised in consideration of other, traditionally oriented prevailing views. The conclusions made from the results also give rise to reservations about the applicability of the concept of industrial operating mode in the context of sawmill customers.

The optimistic view on the sales potential of late-industrial customers is challenged by the view of Cohen and Smith (1991) on the disadvantages of basing activities on multiple value chains, segmenting, and product line differentiation. The small size of target markets may minimise production economies of scale and market growth potential. Focusing on several different markets, each with a different product line, can lead to a large array of product specifications, which leads to diversity in processing, packaging, and distribution. The corporate focus may become confused, and the organisation meets the threat of financial allocations becoming diffuse and ineffective. One of the greatest difficulties in operating a flexible manufacturing system is the tendency to produce too great a variety of products for profitable operations. Cohen and Smith (1991) continue the list of disadvantages in this approach by pointing out the large amounts of information required about many target markets, commitment of resources needed for product design, and expenditures on establishing raw-material supply and processing techniques. These particular constraints would render the idea of serving late-industrial customers useless for the smaller sawmills.

Dibb and Simkin (1994) argue that experience in industrial markets highlights the considerable practical problems that can be faced by companies attempting to put market segmentation into practice. The practitioner has to reconcile the potential benefits offered by the approach with the realities of a company structure, distribution system, and sales force that may be geared to satisfy operational considerations rather than marketing requirements and that may be seemingly well entrenched. Although segmentation theory may appear to offer considerable benefits in terms of satisfying customers and developing more effective marketing programs, the operational realities must be considered. These problems are also present in sawmill industry.

Although the literature is helpful in drawing attention to flexible production as an important strategic option, Kotha (1995) argues that it has failed to address many details. First, a critical examination of the literature suggests that the general prescription of mass production not being a viable strategy is perhaps too extreme an assessment. Theoretically a firm could pursue a flexible production strategy in one segment of its market and a mass production strategy elsewhere. It appears that the flexible manufacturers of this study are, indeed, actually using this approach as they show both a narrow and general customer focus at the same time. The suggestion that firms deriving a majority of their revenues from mass markets should abandon a mass production approach in favour of flexible production and de-massification seems unrealistic (Kotha 1995). Also the three strategies outlined by Cei-Bois (1994) see the position of mass production still as a successful one. The literature provides also little evidence that pursuing such strategy does in fact lead to superior returns. This question probably requires further research efforts within the secondary as well as primary wood processing.

Technology alone is insufficient to achieve flexibility. It requires an organisational climate that nurtures learning and knowledge creation. It is not clear how knowledge creation enables strategic flexibility in the context of flexible production. Kotha (1995) notes that western attitudinal and organisational differences may make a superficial approach to mass customisation a risky undertaking. The effective use of flexible manufacturing hinges on promoting an attitude that is helpful to continuous improvement, organisational and individual learning, the development of new capabilities, and the diffusion of the best practices among a firm's plants. How easily could these conditions be met for example in the Finnish sawmilling industry? The normative message promoting mass customisation can be seriously misleading. This message, taken to an extreme, positions the firm as trying to be all things to all customers, which is a recipe for competitive mediocrity, rather than competitive advantage (Kotha 1995). Usually the semi-finished wood material is produced either by middlemen between the sawmill and the joinery (remanufacturers of sawnwood) or by the joineries themselves. NUTEK (1992) states the difficulty of achieving the same level of expertise and experience at the sawmills, and concludes that component production at sawmill is successful only if it can use and allocate the wood material more effectively than the joineries and remanufacturers can.

Assuming that the theoretical background was valid, there remain the questions of whether it was correctly bridged with the joinery and furniture industries, and whether the operationalisations were built to measure the right things in a sufficiently reliable way. Because the data collection was focused on the core issues of the industrial operating mode, some areas that are clearly related to the constructs of the late-industrial were omitted. In further research, issues like environmental management, organisation of the work, and management hierarchies should also be investigated.

The division of industrial operating modes into two – traditional industrial and late-industrial – makes a large generalisation and would seem to

assume a discrete step somewhere between the modes. The division into three phases within these two modes in turn is closely related to the more common concept of production model. The necessity of the high level of abstraction used in the theoretical background could be challenged. The relative failure of the last two propositions could have been caused by a too rigid scheme of measurement of the profiler variables, based on previous studies and traditional items used to evaluate supplier performance and problems in material. As was noted in section 4.5, assessment of the generalisability of the results requires further research efforts, for example, through a probability sample.

6.3 Conclusion

The choice of a theoretical background used in a study is most often a matter of will, especially in the case of social scientific studies. In this case, the high abstraction of the basic assumptions of the study are well supported by the view of Touraine (1965): when studying social action, the constructs used should not be borrowed from the empirical reality as such, because this will cause distortion in the results and conclusions. A theoretical frame should be built independently first, and only then applied to the situation at hand.

The question about the proper connections from theory to the bridging laws, and from these laws or guiding hypotheses on to the measured variables has been answered in the analysis. As the study was aimed at developing a typology, the divisive line between industrial operating modes had to be drawn somewhere. This can be done arbitrarily on any continuous dimension when categorisation is needed. In this study, the location of the divisive line was determined based on empirical data, and the cluster analysis used was assumed to draw the group lines in a way maximising the between-group (that is, between-mode) difference.

The three-class characterisation of the stages in the industrial change was aimed at giving some idea of what is between the two ends, and to remind the reader that the question is not black-and-white. Several shades of grey were also needed in the empirical part for separating the sample companies into groups. The concepts of production model or business strategy and industrial operating mode are overlapping, and the use of the latter was justified by its contents and meaning, which emphasise the aspects of industrial change, actions taken and position along the continuum of the transition. The industrial *modus operandi* conveys well a pattern in a company's important decisions and actions, which describes the company's level of adjustment in the late-industrial transitions.

The measurement strategy chosen for the business philosophy component was proven quite successful. The multilevel–multi-item approach resulted in empirical dimensions close to those expected, but was able to accommodate the specific conditions of the target industries. Naturally, there is need for further development related to the scope of issues covered as well as the actual itemisation. The same applies, maybe more strongly, to the scales used for production operations and supplier choice criteria.

That the profiling variables were quite conventional, is true. The operationalisations of the profiling variables (wood usage, performance, problems) appeared still operational, and there was no explicit need for developing them into any new formula. Some adjustment may be needed in future with regard to research methodology, not so much on the items themselves. In this study, the rigid mask of operationalisations of both the clustering and profiling variables served as a restriction for drawing too far-reaching conclusions.

Instead of survey questions on five-point scales, the evaluations of performance and problems could be collected through an "ask-and-listen" method, using the thematic interview approach. The resulting data would then be subject to qualitative analysis. The disadvantages of this approach include the high level of analytic skills needed and the difficulty of reliable documentation. Also, use of a grounded theory approach may override the comment on the origin of analytical concepts by Touraine (1965) presented above. On the other hand, advantages of this methodology might include better correspondence of analytical concepts to the real phenomena, more accurate or detailed profiling of the observations, and a better acceptability of the results by the target publics.

Despite the constraints and reservations presented in the previous section, the idea of late-industrial acculturation at the sawmills remains viable. There is a clear connection between the amount of late-industrial elements in the customer company of a sawmill and the value-added level of the wood material it uses. The more advanced the joinery or furniture manufacturer is, the more likely it is to use component-type wood material and to appreciate technical precision defined according to its own needs and standards. In addition, the results show that the change really is towards the late-industrial sawnwood materials and supplier relationships related to these material types and variates. This means continuous adaptation to the evolving requirements of the customers.

6.4 Implications

Then what are the consequences at the sawmill, if the segment of late-industrial sawmill customers is as distinct and as attractive as this study would suggest? Despite that the absence of support for the propositions P3 and P4 – related to the expectation that there would be a negative gap in the sawmill performance and late-industrialism of the customer – is annoying from the analyst viewpoint, this result may have also some positive features. If even the most late-industrial firms are able to satisfy their material and service demands, the conclusion should be that these demands are not too high. Some sawmills have been able to upgrade their offerings to match the new demand, and the task then remains how to replicate this at sawmills that are possibly wishing to do the same. Although the questions of business re-engineering and change management are beyond the purpose and resources of this study, the following issues can be pointed out as implications for the sawmilling business as well as potential directions for further research.

Factory focus. Kotha (1995) provides some arguments in favour of applying the late-industrial operating mode also at sawmills. Like Cohen and Smith (1991), he notes that from a production perspective, competing on several segments usually results in inconsistent and conflicting task requirements regarding production volumes, process design, and process technologies. Kotha (1995) suggests a "factory focus", linking of production facilities to the appropriate competitive advantages, as a prudent measure for overcoming these difficulties. To an extent this approach has already been used by sawmilling industry, for example when dividing plants between main wood species or according to the sophistication of quality grading or further processing.

The combination of a series of small, incremental changes in plant construction and design, and a handful of specific technical advances has made small and medium-sized plants competitive with the giants (McRae 1994). The decrease in the minimum size of a sawmill plant may increase the feasibility of factory focus in serving late-industrial customers. This approach would then avoid the pitfall of human inflexibility as the complex of products and services needed is served through a set of virtually separate production units. Within these units, deeper multiskilling of the workforce could then be focused on a limited area of really variable and flexible production guided by very specific customer demands.

The "small is beautiful" view gains support from Cohen and Smith (1991), who list the advantages of segmentation strategy and product differentiation as follows. As the market size may be small, the resource requirements to enter the market are also smaller. Competition is diminished if the company is the first to better meet the specific needs of a small market segment. Pioneering advantage can be established, since the avant-garde supplier may influence initial customer perceptions and values of product attributes. The differentiation and segmentation approach can also increase the return to a forest products firm that has relatively scarce species in their round wood base.

Shared experience and orientation. The late-industrial sawmill units should not, however, be totally isolated from each other. Establishment of organisational mechanisms that foster interaction between the focused factories leads to new knowledge creation and greater strategic flexibility. These mechanisms may include worker rotation, the sharing of process ideas through such rotations, and centralisation of design and process engineering personnel (Kotha 1995). The ideas of intra-firm communication and interaction have been noted also by Jaworski and Kohli (1993). Their study suggests that the market orientation

of a business is an important determinant of its performance, regardless of the market turbulence, competitive intensity, or the technological turbulence of the environment in which it operates. Market orientation appears to be facilitated by the amount of emphasis top managers place on market orientation through continual reminders to employees that it is critical to be sensitive and responsive to market developments. Jaworski and Kohli also state that a market orientation appears to require a certain level of risk taking on the part of senior managers and a willingness to accept occasional failures of new products and services as being a normal part of business life.

Build on proven segments. Dibb and Simkin (1994) are concerned with the gap between elegant theory and realistic praxis – a reasonable concern in regard to this study. Their message is to not be afraid to use existing market divisions as starting point. This helps minimise the practical problems of existing, entrenched sales, marketing, and distribution systems, and allows companies to deal with the segmentation variables that are relatively easy to identify and measure. Using macro segments as a starting point, sub-segments can then be sought using other appropriate base variables. It may be possible to merge the marketing activity for a few of these sub-segments to create reasonably definable and robust segments. Dibb and Simkin (1994) state that where new segmentation solutions are sought, the importance of readily implementable, clear, and understandable schemes should not be obscured by the desire for a theoretically valid solution.

Take advantage of the industry breakpoint. Strebel (1995) presents the concept "industry breakpoint", which is somewhat contradictory to the transient concept of late-industrial used in this study, but perhaps useful when making conclusions on the position of sawmilling in regard to the secondary wood processing. Industry breakpoint means a discontinuous shift in an industry, for example a new offering to the market that is so much superior in terms of value perceived by the customer and the delivered cost of the offering that it changes the rules of the competitive game. From the psychological point of view, an arbitrary breakpoint may even be more useful in management than the more logical emphasis on continuous change.

Strebel (1995) suggests that divergent industry breakpoints that usher in an increasing variety of competitive product offerings can be created to certain extent. This can be done by directing innovation through dedicated task forces to transform new ideas, stimulating continual entrepreneurial activity from the bottom up, and developing intense, value-creating relationships with key stakeholders. For example, commodity sawnwood may be transformed into special and customer wood materials, and into a variety of offerings based on customer preferences. The new production methods and information management systems are entering a truly operative phase, and the innovative work may be directed to the products and customers. The stakeholder networking between forest owners, sawmills, machinery manufacturers, and industrial customers is compatible with the late-industrial mode. The leading indicators of a divergent breakpoint include saturation of commodity market, restless competitors searching alternative sources of profit, restless customers attracting new entrants, new sources of supply and new resources leading to new products. Change in the distribution channels is mostly a lagging rather than leading indicator of competitive divergence. All these criteria apply to the present situation in sawmilling.

The learning enterprise. Raux (1994) summarises the effects of the late-industrial transition on the enterprise in a manner also applicable to the match between sawmilling and secondary wood processing. He suggests that today's competitive enterprise is not anymore an enterprise having costs smaller than its competitors have. It is also, and perhaps above all, an enterprise who continuously develops its products to include new levels of functionality (innovations) that the customers acknowledge and whose scope of products is updated in advance, according to the needs of the market. The enterprise of the 21st century will manage a synthesis between two types of an enterprise: a society of the holders of the capital and a society of human participation, whose input is not anymore only the labour, but capital of competencies. The capital of human skills and competencies is becoming the determinant success factor also when serving the secondary wood processing industry.

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UNIVERSITY OF HELSINKI
DEPARTMENT OF FOREST ECONOMICS

SAWN-FACED COMPONENTS AS THE MATERIAL FOR JOINERY MANUFACTURERS

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This questionnaire is used to gather information about wood usage at window, door, and furniture manufacturers. All the information will be handled as confidential and individual companies cannot be identified in the final report. The questions deal with the following issues at your company:

- -Products and production
- -The most important customer groups
- -Use of wood
- -Suppliers and deliveries
- -Business philosophy
- -Measures and qualities of the components and sawnwood you use (separate form)

Name of the company: _____
Number of employees: _____
Annual turnover (1994/5): _____
Name of the respondent: _____
Position of the respondent: _____

Products and production

1. What was your production like in 1994 in and how would you estimate its development during the next five years (estimate of the situation in 2000)?

	Year 1994		Year 2000 (estimate)	
	Units	Share of the sales	Units	Share of the sales
Windows and frames	_____	_____	_____	_____
Doors and linings	_____	_____	_____	_____
Furniture	_____	_____	_____	_____
Other, please specify _____	_____	_____	_____	_____
		100 %		100 %

2. At the moment your production can be described by... (tick the location of your company on the scale: exactly one end or somewhere in between)

Old production technology	1	2	3	4	5	6	7	New production technology
Complex technical solutions	1	2	3	4	5	6	7	Simple technical solutions
Guided by the storage situation	1	2	3	4	5	6	7	Guided by the order situation
Capacity exceeds the market potential	1	2	3	4	5	6	7	Capacity is lower than the market potential
Craftmanship	1	2	3	4	5	6	7	Automation
As much subcontracting as possible	1	2	3	4	5	6	7	As much own processing as possible
Mass production	1	2	3	4	5	6	7	Per order production
Big production series	1	2	3	4	5	6	7	Small production series
Cost minimisation	1	2	3	4	5	6	7	Product differentiation
Sudden changes in an order are difficult to realise	1	2	3	4	5	6	7	Sudden changes in an order can be handled flexibly

The most important customer groups

3. What are the shares of different customer groups of the sales of your company (%)?

	Windows	Doors	Furniture	Others	Total sales
Builders merchants	_____	_____	_____	_____	_____
Building contractors	_____	_____	_____	_____	_____
Renovation contractors	_____	_____	_____	_____	_____
Do it yourself stores	_____	_____	_____	_____	_____
Furniture chains	_____	_____	_____	_____	_____
Furniture stores	_____	_____	_____	_____	_____
Mail order sales	_____	_____	_____	_____	_____
Retail customers	_____	_____	_____	_____	_____
Other: _____	_____	_____	_____	_____	_____
	100 %	100 %	100 %	100 %	100 %

Appendix 1. The questionnaire. English translation of the questions analysed in this study.

Use of wood

4. What is the volume of wood your company buys per year and how is it divided into different wood species?

(Deliveries per year)		Species			
_____	Total	Redwood (pine)	Whitewood (spruce)	_____	_____
(Average delivery size))					
_____	_____ m^3	_____ m^3	_____ m^3	_____ m^3	_____ m^3

5. What is the value-added level of the wood you buy (total and per wood species, % of the volume)?

	Of total	Of species			
		Redwood (pine)	Whitewood (spruce)	_____	_____
Roundwood or logs					
Stammware					
Standard sawnwood					
Customer sawnwood					
Sawn-faced component pole					
Sawn-faced component					
Further processed pole					
Further processed component					
Ready-to-assemble component					
Other: _____					
	100 %	100 %	100 %	100 %	100 %

6. Which countries are the most important suppliers for your company (% of the volume)? What kind of changes do you expect in the future?

	Country	Share	Possible changes
1.	_____	(_____ %)	_____
2.	_____	(_____ %)	_____
3.	_____	(_____ %)	_____
4.	_____	(_____ %)	_____
5.	_____	(_____ %)	_____

7. During the next five years, production and wood use in your company will probably move to the direction of...

Using more components	1	2	3	4	5	6	7	Using more standard sawnwood
Using smaller delivery sizes	1	2	3	4	5	6	7	Using bigger delivery sizes
More individual sales and customised specifications	1	2	3	4	5	6	7	More standard sales and repeated orders
Using more numerous wood suppliers	1	2	3	4	5	6	7	Using fewer wood suppliers
Dealing with the supplies more directly	1	2	3	4	5	6	7	Dealing with the suppliers more through middlemen

Suppliers and deliveries

8. The following list describes some important features of suppliers and deliveries. How critical are those features for your operation (scale 1-5), and how would you evaluate the performance of your present suppliers in them (scale 0-10)?

	Not critical				Very critical	Performance (0-10)
Short delivery times	1	2	3	4	5	_____
Just in time -deliveries	1	2	3	4	5	_____
Ability to deliver components in specified knot quality	1	2	3	4	5	_____
Ability to deliver components in specified wane quality	1	2	3	4	5	_____
Ability to deliver components in specified lengths	1	2	3	4	5	_____
Ability to deliver components in specified moisture content	1	2	3	4	5	_____
Consistency of quality grading	1	2	3	4	5	_____
Long-term customer relationship with the sawmill	1	2	3	4	5	_____
Ability to deliver small orders	1	2	3	4	5	_____
Reliability of repeated standard deliveries	1	2	3	4	5	_____
Readiness for special service and special deliveries	1	2	3	4	5	_____
Flexibility in the terms of payment	1	2	3	4	5	_____
Well-performing direct buyer-seller relationships	1	2	3	4	5	_____
Ability to react to changes in your needs regarding wood material	1	2	3	4	5	_____
Expertise of importers at combining wood from different sawmills according to your needs	1	2	3	4	5	_____
Active personal communication	1	2	3	4	5	_____
Technical expertise of the supplier	1	2	3	4	5	_____
Price	1	2	3	4	5	_____

Business philosophy

9. Below are listed some basic factors that might be guiding business operations. How well do they describe the ways of operating at your company (thinking about your main business areas)?

	Not at all our way				Describes us perfectly
The starting point of our business is...					
Efficient utilisation of raw materials and machinery	1	2	3	4	5
Responding to the needs of certain end-use situations	1	2	3	4	5
Satisfying individual needs of each customer	1	2	3	4	5
When forming customer relationships, we focus on...					
All possible customer groups	1	2	3	4	5
Those customer groups that our product fit best for	1	2	3	4	5
Certain specified customers	1	2	3	4	5
Our customer relationships are by nature...					
Unselective and temporary	1	2	3	4	5
Based on long-term interaction	1	2	3	4	5
Co-operative, as a complementary part of our customer's own business	1	2	3	4	5
Our products...					
Fulfil the same requirements as do our competitors' products in general	1	2	3	4	5
Meet the functional requirements of certain end-use situations	1	2	3	4	5
Are made according to the requirements and specifications of individual customer	1	2	3	4	5
When buying wood, we take into consideration...					
All possible suppliers that we come across	1	2	3	4	5
Those supplier that meet the product-specific requirements	1	2	3	4	5
Certain specialised suppliers	1	2	3	4	5
The technical solutions in our production enable...					
Efficient and high-speed production process	1	2	3	4	5
Large selection of models and sizes of the products	1	2	3	4	5
Flexible manufacturing of special orders	1	2	3	4	5
Other manufacturers in our business...					
Are just competitors for us	1	2	3	4	5
Enable us to differentiate and focus	1	2	3	4	5
Participate networking and co-operation in production	1	2	3	4	5

Problems in wood material

(Extract from the technical detail questionnaire:)

10. We have had problems with...

	Often				Seldom
Dimensions	1	2	3	4	5
Lengths	1	2	3	4	5
Knot quality	1	2	3	4	5
-Sound knots	1	2	3	4	5
-Unsound knots	1	2	3	4	5
-Rotten knots	1	2	3	4	5
-Knot holes	1	2	3	4	5
Wane quality	1	2	3	4	5
Moisture content	1	2	3	4	5
Annual rings	1	2	3	4	5
Drying checks (significant)	1	2	3	4	5
Hair fissures (thin)	1	2	3	4	5
Deformation	1	2	3	4	5
Heartwood	1	2	3	4	5
Wood stored in water	1	2	3	4	5
Log blue stain	1	2	3	4	5
Resin/bark pockets	1	2	3	4	5
Reaction wood	1	2	3	4	5
Insect attacks	1	2	3	4	5

Appendix 2. List of the variables used in the study.

Original variables (157)

Identification and background			
1	INTERWNO	Number of interview questionnaire	
2	COUNTRYC	DK = 1 DE = 2 NL = 3 FIN = 4	{1,4}
3	EMPLOYEE	Number of employees	
4	TURNOVER	Turnover (mill. Ecu/year)	
5	POSITION	Position of the respondent	{1,5}
6	MAINPROD	1W 2WD 3D 4DWF 5F	{1,5}
7	WIPROD94	Production of window units 1994	
8	DOPROD94	Production of door units 1994	
9	FUPROD94	Production of furniture units 1994	
10	OTPROD94	Production of other units 1994	
11	WIPROD20	Production of window units 2000	
12	DOPROD20	Production of door units 2000	
13	FUPROD20	Production of furniture units 2000	
14	OTPROD20	Production of other units 2000	
15	WISHAR94	Share of sales, windows 1994	
16	DOSHAR94	Share of sales, doors 1994	{0,100}
17	FUSHAR94	Share of sales, furniture 1994	{0,100}
18	OTSHAR94	Share of sales, other 1994	{0,100}
19	BUILMERC	Building merchants' share of sales	{0,100}
20	BUILCONT	Building contractors' share of sales	{0,100}
21	RENOCONT	Renovation contractors' share of sales	{0,100}
22	DIYSTORE	DIY-stores' share of sales	{0,100}
23	FURCHAIN	Furniture chains' share of sales	{0,100}
24	FURSTORE	Furniture stores' share of sales	{0,100}
25	MAILORDE	Mail order companies' share of sales	{0,100}
26	RETAILCU	Retail customers' share of sales	{0,100}
27	OTHERCUS	Other customers' share of sales	{0,100}
Wood material used			
28	TOTALVOL	Total volume of wood used 1000 m^3/year	
29	DELIVNUM	Number of deliveries per year	
30	AVEDELIV	Average size of delivery m^3	
31	SPRUCVOL	Volume of spruce m^3 per year	
32	PINEVOLU	Volume of pine m^3 per year	
33	BIRCHVOL	Volume of birch m^3 per year	
34	MERANVOL	Volume of meranti m^3 per year	
35	HEMLOVOL	Volume of hemlock m^3 per year	
36	OREGOVOL	Volume of oregon pine m^3 per year	
37	OAKVOLUM	Volume of oak m^3 per year	
38	BEECHVOL	Volume of beech per year	
39	MERBAVOL	Volume of merbau m^3 per year	
40	IROKOVOL	Volume of iroko m^3 per year	
41	OTHERVOL	Volume of other m^3 per year	
42	ROUNDWOO	Share of roundwood of all purchases	{0,100}
43	STAMMWAR	Share of stammware of all purchases	{0,100}
44	STANDASW	Share of standard S-W of all purchases	{0,100}
45	CUSTOMSW	Share of customized S-W of all purchases	{0,100}
46	SFAPOLES	Share of S-F poles of all purchases	{0,100}
47	SFAAIHIO	Share of S-F aihios of all purchases	{0,100}
48	FPRPOLES	Share of F-P poles of all purchases	{0,100}
49	FPRAIHIO	Share of F-P aihios of all purchases	{0,100}
50	RTACOMPO	Share of RTA components of all purchases	{0,100}
51	OTHERWOO	Share of other wood of all purchases	{0,100}

52	DUTCHORI	Dutch origin		{1,5}
53	SWEDISHO	Swedish origin		{1,5}
54	FINNISHO	Finnish origin		{1,5}
55	AUSTRIAN	Austrian origin		{1,5}
56	RUSSIANO	Russian origin		{1,5}
57	NORWEGIA	Norwegian origin		{1,5}
58	INDONESI	Indonesian origin		{1,5}
59	MALESIAN	Malesian origin		{1,5}
60	FRANCOIS	French origin		{1,5}
61	CANADIAN	Canadian origin		{1,5}
62	UNITEDST	US origin		{1,5}
63	GERMANOR	German origin		{1,5}
64	POLISHOR	Polish origin		{1,5}
65	DANISHOR	Danish origin		{1,5}
66	OTHERORI	Other land origin		{1,5}
Production operations				
67	PRODTECH	1 = Old	7 = New	{1,7}
68	TECHSOLU	1 = Complex	7 = Simple	{1,7}
69	PRODGUID	1 = Storage	7 = Orders	{1,7}
70	CAPACITY	1 = Over	7 = Under	{1,7}
71	AUTOMATE	1 = Handicraft	7 = Automatization	{1,7}
72	SUBCONTR	1 = Subcontr.	7 = In Firm	{1,7}
73	COMMODIT	1 = Standard	7 = Customized	{1,7}
74	PRODSERI	1 = Large	7 = Small	{1,7}
75	COSTDIFF	1 = Cost minim.	7 = Differentiation	{1,7}
76	FLEXIBIL	1 = Difficult	7 = Flexible	{1,7}
Change in production and wood use				
77	FUTMATER	1 = More aihios	7 = More standard	{1,7}
78	FUTDELIV	1 = Small	7 = Large	{1,7}
79	FUTPRODU	1 = Specified	7 = Standard	{1,7}
80	FUTSUPPL	1 = More numerous	7 = Fewer	{7,1}
81	FUTCHANN	1 = More direct	7 = More middlemen	{1,7}
Business philosophy				
82	SPEFFICY	Starting point 3: efficiency		{1,5}
83	SPCERTAI	Starting point 2: end-use situation		{1,5}
84	SPSPECIF	Starting point 1: needs of indiv. cust.		{1,5}
85	CFGENERA	Customer focus 3: all possible		{1,5}
86	CFCERTAI	Customer focus 2: fit best to products		{1,5}
87	CFSPECIF	Customer focus 1: specified groups		{1,5}
88	CRTEMPOR	Cust. rel. 3: unselective & temporary		{1,5}
89	CRLONGTE	Cust. rel. 2: long-term standard		{1,5}
90	CRCOOPER	Cust. rel. 1: complementary co-oper.		{1,5}
91	PRGENERA	Products 3: same req.s as compet. pr.		{1,5}
92	PRCERTAI	Products 2: req.s of certain end-uses		{1,5}
93	PRSPECIF	Products 1: req.s of ind. customer		{1,5}
94	WSGENERA	Wood suppliers 3: all possible		{1,5}
95	WSCERTAI	Wood suppliers 2: meet req.s of prod.s		{1,5}
96	WSSPECIF	Wood suppliers 1: meet req.s of ind. cust.		{1,5}
97	TSEFFICY	Tech. solut. 3: efficient & high speed		{1,5}
98	TSSELMOD	Tech. solut. 2: selection of models		{1,5}
99	TSFLEXIB	Tech. solut. 1: flexible manufacturing		{1,5}
100	OMGENERA	Other manuf. 3: just competitors		{1,5}
101	OMDIFFER	Other manuf. 2: enable differentiat.		{1,5}
102	OMNETWOR	Other manuf. 1: part of network		{1,5}
Supplier choice criteria				
103	SUSHORTD	Short delivery times		{1,5}
104	SUJITDEL	JIT deliveries		{1,5}

105	SUKNOTQU	Ability, specified knot quality	{1,5}
106	SUWANEQU	Ability, specified wane quality	{1,5}
107	SUSPELEN	Ability, specified lengths	{1,5}
108	SUMOISTC	Ability, specified moisture content	{1,5}
109	SUCONSQU	Consistency of quality grading	{1,5}
110	SULONGTR	Long-term rel.ship with sawmill	{1,5}
111	SUSMALLO	Ability, small orders	{1,5}
112	SUREPPUR	Reliability, repeated purchases	{1,5}
113	SUSPESER	Readiness, special service	{1,5}
114	SUTERMOP	Flexibility, terms of payment	{1,5}
115	SUDIRREL	Activity, direct relationship	{1,5}
116	SUREACTC	Ability, react to changes in needs	{1,5}
117	SUIMPEXP	Expertise of importeur to combine	{1,5}
118	SUPERSCO	Active personal communication	{1,5}
119	SUTECEXP	Technical expertise of supplier	{1,5}
120	SUPPRICE	Price	{1,5}
Sawmill performance evaluation			
121	PESHORTD	Short delivery times, performance	{0,10}
122	PEJITDEL	JIT deliveries, performance	{0,10}
123	PEKNOTQU	Ability, specified knot quality, perf.	{0,10}
124	PEWANEQU	Ability, specified wane quality, perf.	{0,10}
125	PESPELEN	Ability, specified lengths, performance	{0,10}
126	PEMOISTC	Ability, specified moist. content, perf.	{0,10}
127	PECONSQU	Consistency of quality grading, perf.	{0,10}
128	PELONGTR	Long-term rel.ship with sawmill, perf.	{0,10}
129	PESMALLO	Ability, small orders, perf.	{0,10}
130	PEREPPUR	Reliability, repeated purchases, perf.	{0,10}
131	PESPESER	Readiness, special service, perf.	{0,10}
132	PETERMOP	Flexibility, terms of payment, perf.	{0,10}
133	PEDIRREL	Activity, direct relationship, perf.	{0,10}
134	PEREACTC	Ability, react to changes in needs, perf.	{0,10}
135	PEIMPEXP	Expertise of importeur to combine, perf.	{0,10}
136	PEPERSCO	Active personal communication, perf.	{0,10}
137	PETECEXP	Technical expertise of supplier, perf.	{0,10}
138	PERPRICE	Price, perf.	{0,10}
Problems in wood material			
139	DIMENSIO	Problems with dimensions	{1,5}
140	LENGTHPR	Problems with lengths	{1,5}
141	KNOTGENE	Problems with knot quality	{1,5}
142	SOUNDKNO	Problems with sound knots	{1,5}
143	DEADKNOT	Problems with unsound knots	{1,5}
144	ROTTKNOT	Problems with rotten knots	{1,5}
145	KNOTHOLE	Problems with knot holes	{1,5}
146	WANEQUAL	Problems with wane quality	{1,5}
147	MOISTCON	Problems with moisture content	{1,5}
148	ANNURING	Problems with annual rings	{1,5}
149	DRYCHECK	Problems with drying checks (big)	{1,5}
150	HAIRCHEC	Problems with hair fissures (thin)	{1,5}
151	DEFORMAT	Problems with deformation	{1,5}
152	HEARTWOO	Problems with heartwood	{1,5}
153	WATERSTO	Problems with wood stored in water	{1,5}
154	LOGBLUES	Problems with log blue stain	{1,5}
155	RESIBARK	Problems with resin/bark pockets	{1,5}
156	REACWOOD	Problems with reaction wood	{1,5}
157	INSECTAT	Problems with insect attacks	{1,5}

Calculated variables (45)

Wood material used		
158	VOLROUND	Volume of roundwood 1000 m³/year
159	VOLSTAMM	Volume of stammware 1000 m³/year
160	VOLSTAND	Volume of standard S-W 1000 m³/year
161	VOLCUSTO	Volume of customized S-W 1000 m³/year
162	VOLSPOLE	Volume of S-F poles 1000 m³/year
163	VOLSAIHI	Volume of S-F aihios 1000 m³/year
164	VOLFPOLE	Volume of F-P poles 1000 m³/year
165	VOLFAIHI	Volume of F-P aihios 1000 m³/year
166	VOLRTACO	Volume of RTA components 1000 m³/year
167	VOLOTHER	Volume of other wood 1000 units/year
168	VOLSPECS	Sum volume of value-added wood 1000 m³/year (162..166)
169	SOFTVOLU	Sum volume of softwood species used m³/year
170	HARDVOLU	Sum volume of hardwood species used m³/year
Background		
171	WINSALES	Window sales (mill. Ecu/year)
172	DOOSALES	Door sales (mill. Ecu/year)
173	FURSALES	Furniture sales (mill. Ecu/year)
174	OTHSALES	Other sales (mill. Ecu/year)
175	SBUILMER	Sales to builders' merchants (mill. Ecu/year)
176	SBUILCON	Sales to building contractors (mill. Ecu/year)
177	SRENOCON	Sales to renovation contractors (mill. Ecu/year)
178	SDIYSTOR	Sales to DIY stores (mill. Ecu/year)
179	SFURCHAI	Sales to furniture chains (mill. Ecu/year)
180	SFURSTOR	Sales to furniture stores (mill. Ecu/year)
181	SMAILORD	Sales to mail order firms (mill. Ecu/year)
182	SRETAILC	Sales to retail customers (mill. Ecu/year)
183	SOTHERCU	Sales to other customers (mill. Ecu/year)
Business philosophy		
184	BF1	Factor score: Late-industrialism of product philosophy
185	BF2	Factor score: Late-industrialism of customer philosophy
186	BF3	Factor score: Traditionalism of product philosophy
187	BF4	Factor score: Technical flexibility
188	BF5	Factor score: Advancement of customer philosophy
189	BG1	Business philosophy clustering in 4 groups
Production operations		
190	OF1	Factor score: Agility
191	OF2	Factor score: Technological emphasis
192	OG1	Production operations clustering in 4 groups
Supplier choice criteria		
193	SF1	Factor score: Appreciation of material precision
194	SF2	Factor score: Appreciation of delivery services
195	SF3	Factor score: Appreciation of personal contact
196	SG1	Supplier choice criteria clustering in 4 groups
Combined typology		
197	BXS1	Canonical variate score U1 for business philosophy
198	BXS2	Canonical variate score U2 for business philosophy
199	G1	Combined clustering in 5 groups
Sawmill performance evaluation		
200	PER1	Factor score: Personal contact performance
201	PER2	Factor score: Delivery services performance
202	PER3	Factor score: Wood material precision performance

Appendix 3. Wood material by species used.

	Volume in sample m³	% of sample	Number of users	Mean (Median) m³	Main product	Main user country
Scots pine	325612	83.1	116	2807 (721)	Furniture 74 % Win & door 26 %	DK 52 % GE 3 % NL 10 % FIN 35 %
Meranti	36408	9.3	41	888 (667)	Window (door)	NL 86 % GE 14 %
Norway spruce	6948	1.8	18	386 (100)	Fur 65 % Door+ 24 % Win 10 %	GE 37 % DK 29 % FIN 24 % NL 9 %
Merbau	4802	1.2	14	343 (200)	Win & door	Netherlands
Birch	4360	1.1	10	436 (406)	Furniture	Finland
Iroko	3424	0.9	16	214 (100)	Windows (doors)	Netherlands
Oak	2780	0.7	10	278 (280)	Furniture 92 % Win & door 8 %	Netherlands
Hemlock	2200	0.6	11	200 (200)	Win & door	NL, (GE)
Oregon pine	848	0.2	8	106 (100)	Win & door	NL, GE
Beech	666	0.2	10	66 (50)	Furniture (win)	NL, FIN, (GE)
Others (larch, alder, maple, tropical species)	3586	0.9	22	163 (60)	Win & door 91 % Furniture 9 %	NL 60 % GE 25 % DK 13 % FIN 2 %
Sum	391634	100				

Appendix 4. Correlation matrix of variables describing business philosophy, used in the factor analysis. Correlations significant beyond 0.05 level in bold.

N = 127
# of missing observations = 8
Limits: p = 0.001 0.298 p = 0.01 0.232 p = 0.05 0.179

SPEFFICY										
SPCERTAI	**0.48**									
SPSPECIF	0.03	0.02								
CFGENERA	0.11	**0.21**	0.11							
CFCERTAI	–0.02	0.06	0.01	**–0.35**						
CFSPECIF	0.03	–0.01	**–0.24**	0.00	**–0.19**					
CRLONGTE	0.04	–0.04	0.11	**–0.37**	**0.33**	**–0.26**				
CRCOOPER	**0.18**	0.02	0.12	–0.00	–0.18	**0.45**	**–0.18**			
PRGENERA	0.11	**0.32**	–0.08	**0.25**	–0.06	0.13	**–0.18**	0.03		
PRCERTAI	0.09	**0.19**	**0.22**	0.02	**0.30**	–0.14	0.17	0.00	0.13	
PRSPECIF	–0.02	**0.27**	**0.52**	**0.23**	–0.05	–0.02	–0.01	**0.18**	0.13	**0.18**
WSGENERA	–0.02	–0.16	0.00	0.11	**–0.25**	**0.22**	**–0.25**	0.09	0.04	–0.04
WSCERTAI	0.04	**0.19**	–0.07	0.07	0.10	0.03	0.08	0.04	**0.21**	**0.26**
WSSPECIF	0.09	0.09	0.02	0.10	–0.14	**0.35**	–0.08	**0.34**	–0.01	–0.10
TSEFFICY	**0.35**	**0.53**	0.09	**0.20**	**0.22**	–0.16	0.05	–0.04	0.06	**0.20**
TSSELMOD	0.14	**0.20**	0.15	**0.26**	–0.14	0.11	–0.14	0.04	–0.02	0.11
TSFLEXIB	–0.00	0.05	**0.18**	**0.20**	–0.17	**0.31**	**–0.22**	**0.25**	0.07	–0.06
OMGENERA	**0.23**	**0.22**	–0.16	**0.22**	–0.06	0.11	–0.12	–0.07	**0.31**	0.00
OMNETWOR	0.03	0.03	0.07	–0.13	0.17	–0.06	0.16	0.03	0.05	0.10
	SPEFFI	SPCERT	SPSPEC	CFGENE	CFCERT	CFSPEC	CRLONG	CRCOOP	PRGENE	PRCERT
WSGENERA	–0.01									
WSCERTAI	–0.03	–0.18								
WSSPECIF	**0.21**	0.08	**0.28**							
TSEFFICY	0.17	–0.04	0.02	0.01						
TSSELMOD	**0.23**	0.11	0.15	**0.34**	**0.19**					
TSFLEXIB	**0.34**	0.13	0.04	**0.42**	0.03	**0.55**				
OMGENERA	0.04	0.14	0.06	0.09	**0.18**	**0.27**	**0.27**			
OMNETWOR	0.09	0.10	–0.06	–0.05	0.08	**–0.21**	**–0.24**	**–0.34**		
	PRSPEC	WSGENE	WSCERT	WSSPEC	TSEFFI	TSSELM	TSFLEX	OMGENE	OMNETW	

Appendix 5. Transformation analysis (empirical factor image and its theoretical interpretation according to a priori expectations).

Exploratory empirical factor matrix

///	F1	F2	F3	F4	F5
SPEFFICY	0.042	0.121	0.537	0.022	0.034
SPCERTAI	0.093	0.009	0.850	–0.083	0.070
SPSPECIF	0.891	–0.037	–0.070	0.035	0.029
CFGENERA	0.173	–0.129	0.286	–0.227	–0.533
CFCERTAI	–0.013	–0.124	0.060	0.087	0.613
CFSPECIF	–0.233	0.652	–0.002	–0.131	–0.214
CRLONGTE	0.083	–0.133	–0.076	0.136	0.596
CRCOOPER	0.169	0.731	0.051	0.118	–0.144
PRGENERA	–0.056	0.030	0.376	–0.042	–0.203
PRCERTAI	0.252	–0.070	0.218	0.017	0.273
PRSPECIF	0.611	0.118	0.186	–0.183	–0.060
WSGENERA	–0.003	0.125	–0.115	–0.074	–0.329
WSCERTAI	–0.058	0.099	0.196	–0.151	0.183
WSSPECIF	0.076	0.499	0.061	–0.347	–0.015
TSEFFICY	0.151	–0.121	0.583	–0.093	0.154
TSSELMOD	0.211	0.107	0.154	–0.669	–0.049
TSFLEXIB	0.248	0.363	–0.027	–0.677	–0.145
OMGENERA	–0.146	–0.042	0.284	–0.434	–0.143
OMNETWOR	0.059	0.039	0.050	0.373	0.159

Restricted theoretical factor matrix

///	F1	F2	F3	F4	F5
SPEFFICY	0.000	0.000	1.000	0.000	0.000
SPCERTAI	0.000	0.000	1.000	0.000	0.000
SPSPECIF	1.000	0.000	0.000	0.000	0.000
CFGENERA	0.000	0.000	0.000	0.000	–1.000
CFCERTAI	0.000	0.000	0.000	0.000	1.000
CFSPECIF	0.000	1.000	0.000	0.000	0.000
CRLONGTE	0.000	0.000	0.000	0.000	1.000
CRCOOPER	0.000	1.000	0.000	0.000	0.000
PRGENERA	0.000	0.000	1.000	0.000	0.000
PRCERTAI	0.000	0.000	1.000	0.000	0.000
PRSPECIF	1.000	0.000	0.000	0.000	0.000
WSGENERA	0.000	0.000	0.000	0.000	–1.000
WSCERTAI	0.000	0.000	0.000	0.000	1.000
WSSPECIF	0.000	1.000	0.000	0.000	0.000
TSEFFICY	0.000	0.000	1.000	0.000	0.000
TSSELMOD	0.000	0.000	0.000	–1.000	0.000
TSFLEXIB	0.000	0.000	0.000	–1.000	0.000
OMGENERA	0.000	0.000	1.000	0.000	0.000
OMNETWOR	1.000	0.000	0.000	0.000	0.000

Transformation matrix

///	F1	F2	F3	F4	F5
F1	**0.967**	–0.067	0.033	–0.233	–0.067
F2	0.062	**0.993**	–0.051	–0.056	0.061
F3	0.001	0.060	**0.989**	0.136	–0.026
F4	0.241	0.029	–0.132	**0.960**	0.053
F5	0.049	–0.066	0.039	–0.060	**0.994**

Residual matrix

///	F1	F2	F3	F4	F5
SPEFFICY	0.056	0.148	–0.476	0.075	0.025
SPCERTAI	0.075	0.047	–0.143	0.009	0.037
SPSPECIF	–0.131	–0.102	–0.041	–0.183	–0.030
CFGENERA	0.079	–0.094	0.305	–0.180	0.431
CFCERTAI	0.031	–0.156	0.077	0.065	–0.394
CFSPECIF	–0.227	–0.327	–0.034	–0.096	–0.164
CRLONGTE	0.134	–0.177	–0.061	0.073	–0.412
CRCOOPER	0.230	–0.269	–0.003	0.048	–0.105
PRGENERA	–0.072	0.068	–0.634	0.034	–0.208
PRCERTAI	0.257	–0.091	–0.764	–0.025	0.245
PRSPECIF	–0.449	0.086	0.220	–0.296	–0.108
WSGENERA	–0.029	0.137	–0.123	–0.073	0.680
WSCERTAI	–0.077	0.098	0.214	–0.121	–0.821
WSSPECIF	0.020	–0.515	0.083	–0.370	–0.010
TSEFFICY	0.124	–0.108	–0.394	–0.048	0.115
TSSELMOD	0.047	0.085	0.240	0.327	–0.096
TSFLEXIB	0.092	0.332	0.047	0.277	–0.174
OMGENERA	–0.255	–0.018	–0.670	–0.333	–0.165
OMNETWOR	–0.843	0.038	0.006	0.339	0.175

Appendix 6. Correlation matrix of variables describing production operations, used in the factor analysis. Correlations significant beyond 0.05 level in bold.

N = 127
# of missing observations = 9
Limits: p = 0.001 0.299 p = 0.01 0.233 p = 0.05 0.18

PRODTECH							
PRODGUID	–0.06						
AUTOMATE	**0.49**	–0.08					
COMMODIT	0.01	**0.58**	–0.12				
PRODSERI	–0.14	**0.26**	**–0.24**	**0.42**			
COSTDIFF	**–0.20**	**0.30**	**–0.21**	**0.37**	**0.25**		
FLEXIBIL	–0.05	**0.27**	–0.08	**0.28**	0.18	**0.20**	
	PRODTE	PRODGU	AUTOMA	COMMOD	PRODSE	COSTDI	FLEXIB

Appendix 7. Correlation matrix of variables describing supplier choice criteria, used in the factor analysis. Correlations significant beyond 0.05 level in bold.

N = 127
# of missing observations = 5
Limits: p = 0.001 0.294 p = 0.01 0.229 p = 0.05 0.177

SUSHORTD									
SUJITDEL	**0.39**								
SUKNOTQU	**0.24**	0.14							
SUWANEQU	0.12	0.17	**0.56**						
SUSPELEN	0.13	0.03	**0.43**	**0.43**					
SUMOISTC	**0.20**	0.13	**0.57**	**0.44**	**0.49**				
SUCONSQU	0.12	0.02	**0.38**	**0.21**	0.11	**0.19**			
SULONGTR	**–0.18**	–0.12	0.01	**0.28**	0.10	0.15	0.11		
SUSMALLO	**0.40**	0.10	**0.36**	**0.24**	0.17	**0.21**	**0.18**	**–0.22**	
SUREPPUR	**0.31**	**0.20**	**0.38**	**0.28**	0.13	**0.24**	**0.47**	0.10	**0.22**
SUSPESER	**0.39**	**0.18**	0.09	–0.03	0.18	0.16	0.09	**–0.20**	**0.30**
SUDIRREL	**0.32**	0.08	0.12	0.05	0.11	0.15	–0.00	0.04	0.08
SUREACTC	**0.26**	**0.20**	0.15	**0.29**	**0.21**	**0.21**	0.14	–0.05	0.15
SUPERSCO	**0.31**	0.12	**0.31**	**0.27**	**0.27**	**0.42**	**0.19**	0.13	0.16
SUTECEXP	**0.42**	0.16	**0.39**	**0.31**	**0.28**	**0.48**	**0.40**	0.08	**0.36**
	SUSHOR	SUJITD	SUKNOT	SUWANE	SUSPEL	SUMOIS	SUCONS	SULONG	SUSMAL

SUSPESER	0.13					
SUDIRREL	0.15	**0.27**				
SUREACTC	0.17	**0.24**	**0.30**			
SUPERSCO	**0.39**	0.17	**0.49**	**0.20**		
SUTECEXP	**0.52**	**0.32**	**0.26**	**0.32**	**0.49**	
	SUREPP	SUSPES	SUDIRR	SUREAC	SUPERS	SUTECE

Appendix 8. Canonical correlations between business philosophy and production operations factor score variables.

	Canonical variate 1	Canonical variate 2
BF1: Late-industrialism of product philosophy	–0.482	0.206
BF2: Late-industrialism of customer philosophy	–0.532	–0.363
BF3: Traditionalism of product philosophy	–0.164	0.790
BF4 (neg.): Technical flexibility	0.682	–0.129
BF5: Advancement of customer philosophy	0.336	0.479
OF1: Agility	–0.985	0.174
OF2: Technological emphasis	0.225	0.974
Correlation	0.6214	0.2827
χ^2	61.710	8.9983
p	0	0.071
df	10	4

Appendix 9. Canonical correlations between production operations and supplier choice criteria factor score variables.

	Canonical variate 1	Canonical variate 2
SF1: Appr. of wood material precision	–0.306	–0.361
SF2: Appreciation of delivery services	0.928	–0.266
SF3: Appreciation of personal contact	0.220	0.830
OF1: Agility	0.923	0.385
OF2: Technological emphasis	–0.399	0.917
Correlation	0.4796	0.1043
χ^2	30.500	1.2250
p	0.000	0.652
df	6	2

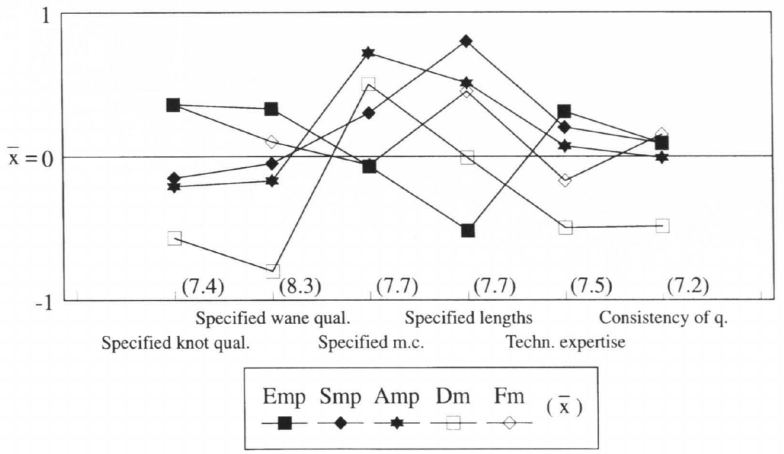
Appendix 10. Coefficient matrices for calculating the variate scores U and V for the canonical correlations between business philosophy and supplier choice criteria factor score variables.

U	%1	%2	%3
Constant	0.016	–0.003	0.007
BF1	–0.058	0.293	–0.670
BF2	–0.825	–0.480	–0.421
BF3	–0.199	0.621	–0.462
BF4	0.322	–0.751	–0.587
BF5	0.632	0.095	–0.385

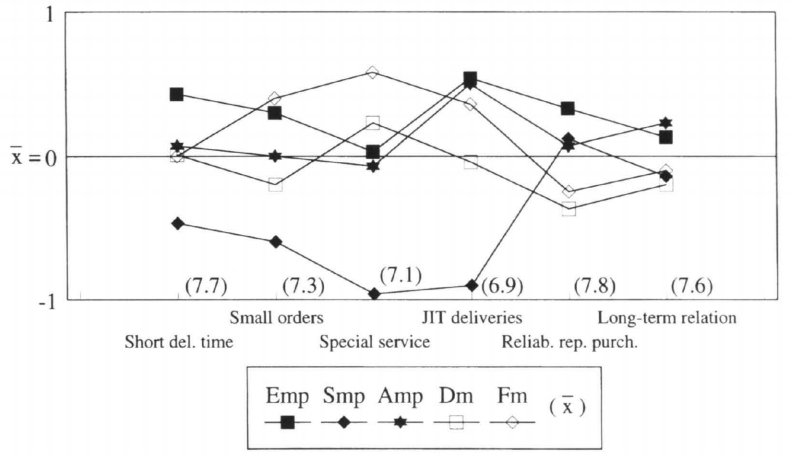
V	%1	%2	%3
Constant	0.034	–0.001	0.018
SF1	0.367	0.540	0.900
SF2	–1.201	0.057	0.341
SF3	–0.034	0.953	–0.732

Appendix 11. Satisfaction to sawmill performance by respondent companies by group on the scale 0–10 (deviance of group means from the sample mean).

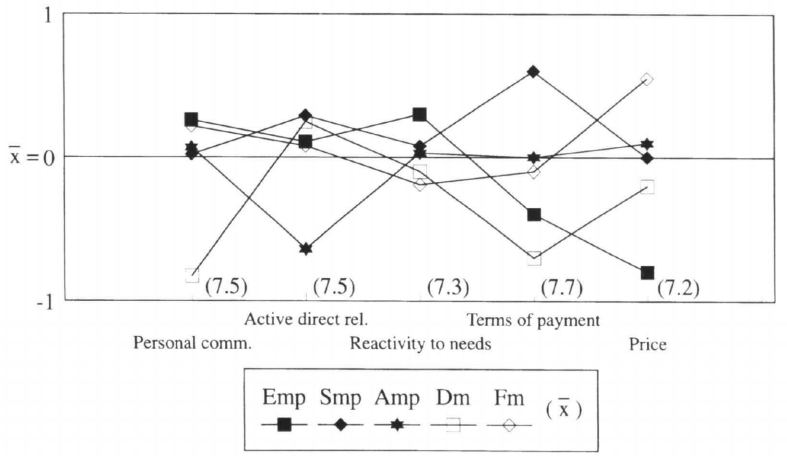
a) On technical aspects.



b) On delivery aspects.



c) On contact and price aspects.



Appendix 12. Correlation matrix of variables describing sawmill performance, used in the factor analysis. Correlations significant beyond 0.05 level in bold.

N = 127
# of missing observations = 19
Limits: p = 0.001 0.312 p = 0.01 0.244 p = 0.05 0.188

PESHORTD									
PEJITDEL	**0.49**								
PEKNOTQU	0.15	0.15							
PEWANEQU	0.12	0.07	**0.45**						
PESPELEN	0.11	0.08	**0.19**	–0.01					
PEMOISTC	0.02	**0.20**	0.02	0.00	**0.46**				
PECONSQU	**0.26**	0.18	**0.44**	0.09	**0.19**	0.10			
PELONGTR	**0.20**	0.05	**0.42**	0.20	0.15	–0.04	**0.38**		
PESMALLO	**0.35**	**0.38**	0.18	0.06	0.15	0.05	**0.28**	**0.40**	
PEREPPUR	**0.40**	**0.28**	**0.34**	**0.26**	0.12	0.08	**0.33**	**0.45**	**0.55**
PESPESER	0.17	**0.27**	0.14	–0.04	0.12	–0.11	0.12	0.12	**0.58**
PEDIRREL	**0.22**	–0.02	**0.38**	**0.28**	0.18	–0.02	**0.31**	**0.27**	**0.21**
PEREACTC	**0.31**	0.17	**0.27**	**0.20**	0.07	0.01	**0.48**	**0.28**	**0.44**
PEPERSCO	0.09	0.06	**0.33**	**0.32**	0.18	0.10	**0.34**	**0.27**	**0.32**
PETECEXP	**0.21**	**0.22**	**0.54**	**0.32**	**0.23**	0.10	**0.51**	**0.28**	**0.27**
	PESHOR	PEJITD	PEKNOT	PEWANE	PESPEL	PEMOIS	PECONS	PELONG	PESMAL

PESPESER	**0.33**				
PEDIRREL	**0.34**	0.17			
PEREACTC	**0.38**	**0.28**	**0.38**		
PEPERSCO	**0.39**	**0.45**	**0.28**	**0.29**	
PETECEXP	**0.44**	**0.21**	**0.26**	**0.41**	**0.60**
	PEREPP	PESPES	PEDIRR	PEREAC	PEPERS	PETECE

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