VAASAN YLIOPISTO

VESA TIENSUU

Concept Design as Managerial Challenge

The Model of Concept Design of II Generation New Product Development Process Research

ACTA WASAENSIA

No. 139

Business Administration 58
Marketing

UNIVERSITAS WASAENSIS 2005

Reviewers

Professor Mai Anttila
Helsinki School of Economics
P.O. Box 1210
FIN–00101 Helsinki
Finland

Professor Olavi Uusitalo
Tampere University of Technology
P.O. Box 527
FIN–33101 Tampere
Finland

To my

beloved son

Daniel

AKNOWLEDGEMENTS

Kurt Lewin, stressed the fact that the most important task of science is its contribution to the society (Grønhaug & Olson 1999). I.e., science is not created for other researchers only and research as such has no inherent value. Instead, science is a medium for creating better functional communities and societies.

This study focuses on pondering how quality of life could be improved with concept design. The objective, therefore, is to design new products which are better than before and develop the process of producing them.

It is my understanding that this study is multilevel and multidimensional "story" about concept design and that why a challenge to the reader. Therefore, it requires a lot from its reader. Here, I refer also to the strong scientific-philosophic tone of the study which is an integral part of it. In my research, I have travelled from the static world towards a dynamic reality with its properties. During the journey, I have asked questions about analysis and understanding of concept design as well as given some suggestions thereof. Based on comments I have received about my work, this fact seems to have received fairly little attention despite it being the 'tree trunk' of this study. Actual research results presented in Chapter 5 are leaves of the trunk only despite the fact that they (hopefully) are of great interest. Therefore, they are not a bunch of single facts but a complete thinking process instead.

The research process has been very arduous. It took more than 8 and a half years of time. It took 3.5 years to collect the empirical material only. From this viewpoint, it is naturally hopeful that my research would be of use at a more general level. Personally, the research process has offered me plenty of new know-how about my research subject that I have utilised in practical work with companies as well as when teaching innovative operations. The largest personal gain, however, has probably been the research process itself. I have learned new, important skills during the process that I may use in my daily work.

I wish to thank Marja Erikson, Arja Ropo and Antti Ainamo for guidance of my work. I am thankful for comments on my work by Mika Pantzar, Risto Tainio, Turkka Keinonen, Mai Anttila and Olavi Uusitalo. I would also like to thank Jaana Venkula, Antti Hassi and Väinö Partanen for their apposite remarks and our fruitful conversations. I also thank Taru Salonen and ETC – Network for the translation.

I would like to give especial thanks to my professor tutor Martti Laaksonen for his contribution in completion of my work. I had many strict coaches during my career in sports but Martti was perhaps the strictest of them all. However, Martti had the wisdom to give me some room to manoeuvre when it was necessary in order to leave room for creativity.

I would like to thank all the companies and people I worked with when collecting the empirical data for this research.

I would also like to thank my brother, student of Economic Sciences Valtteri Tiensuu and my friend Jarno Aaltonen for their contribution to advancement of my work.

Finally, I would like to thank the parties who have financed this research project. My thanks go to Finnish Foundation for Economic Education, Jenni and Antti Wihuri Foundation, University of Vaasa Rector Fund, Finnish Work Environment Fund and Finnish Furniture Foundation for their financial support which enabled completion of my work.

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Tiensuu, Vesa (2005). Concept design as managerial challenge – the model of concept design of II generation new product development process research. *Acta Wasaensia* No. 139, 245 p.

In the 21st century, competition between companies focuses mainly on who has the best products in terms of quality and design (Gorb 1990; Johne 1992). Success of a company is summed up by its ability to create concepts which are meaningful and desirable from the viewpoint of a customer. Competitiveness of a single company largely depends on its ability to develop products which are in some manner superior to those of its competitors.

Despite the fact that product development has been widely studied, we have as of yet relatively little knowledge about advancement of a product development process and problems therein (Dwyer & Mellor 1991; Wolfe 1994; Cheng & Van de Ven 1996). However, there is wide-spread need for more understanding. Success depends mainly on how a process is managed (cf. e.g., Poolton & Ismail 2000; Couglan & Brady 1995) and the management is based on understanding of a phenomenon. Loosely based on Van de Ven's (1986) questions, this research project approaches the phenomenon from the following perspectives: How do innovations develop over time, what kind of problems will likely be encountered during the process, how can these problems be solved?

Citing Wolfe (1994), purpose of this study is to discover factors explaining the series of events observed within the process. The better we can identify the logics of a chronologically advancing process, the better we will be able to understand the complicated and risky process.

This study focuses on the first steps of a product development process in which the importance of definition of properties of the new product and creation of its visual appearance are stressed. This stage is called concept design. The significance of concept design has not been well understood in the corporate world. However, according to several studies, concept quality largely defines success of a product (e.g., Burchill 1993; Wilson 1993; Cooper 1990; Cooper 1994; Khunara & Rosenthal 1998).

This study deals with concept design in the furniture industry. Traditionally, the furniture industry has been perceived as a difficult sector, because it combines aesthetics and industrial productivity. According to Tiensuu (1999), specific problem of the sector has been perceived to be its inability to create new and interesting product concepts.

This study presents an integrated multi-levelled explanations model about how the concept design process proceeds over time via several stages in several different sectors. The goal is to integrate various phenomena into an internally coherent unity. Thus, we will be able to proceed from chaotic 'fuzzy front end' towards concept management. Empirical cases show that teamwork is necessarily not the precondition for success of concept management, and necessarily not even a desirable model for this kind of challenge. Instead of that one can assume that there are other ways to organize collective work in creative processes. Process research on innovations is at a time of transition and moving towards procedual thinking. This study presents a suggestion on what second generation process research signifies.

Vesa Tiensuu, Department of Marketing, University of Vaasa, P.O. Box 700, FIN– 65101 Vaasa, Finland.

Key Words: Process research, NPD process, concept design, concept management, creativity, teamwork, tacit-knowledge, design, information management.

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1. PRODUCT DEVELOPMENT AND SUCCESS OF COMPANIES

Basic strategy of a company defines the manner in which the company plans to achieve its goals. When a strategy is chosen, the most important issue is achievement of a competitive edge and trying to retain any already achieved competitive edge (Porter 1989: 48). What strategic level conversations are all about is competing for customers with products. Success of a company is all about the ability to create concepts which are meaningful and desirable from the viewpoint of customers. A product concept is the point where the inner world of a company meets the needs of customers (Heskett 1991). In this competition, relative competitive edge is needed which is based on additional value produced to customers. At the present, competition is all about who has the best products (Gorb 1990; Johne 1992) and design (Oakley 1990). Companies that had knowledge of design coped notably better in Roy's (1990) statistical surveys than other companies as came to, e.g., level of capital income and return margin. Thus, design has been described as the only weapon left for differentiation of a product (Wasserman 1990).

The product-centred thinking also came up in Cooper's (1994) study questioning myths around business. According to Cooper, these myths include 1) the first one on the market is the winner, 2) analysis equals paralysis, 3) reputation of a company, strong brand and effective sales make almost every product a winner, 4) low price is a critical factor in success, 5) we do not have the time to study the market or test products, speed is the key issue, 6) if you are strong and powerful enough, you do not need synergies in order to win and 7) do not make attempts to define a product concept prior to development work.

However, according to Cooper's quantitative research, a notable part of success is due to an excellent high-quality product which creates actual value to customers[1]. Success is also due to "homework" that has lead to creation of a concept. The homework includes analyses of the market and purchase behaviour of consumers, concept definition and product testing. Other factors affecting success of a product according to Cooper include

[1] The concept success refers here mostly to the concept of economical succces. In the context of NPD the concept of succes may also mean e.g. quality of the design (e.g. design pizes), new technology or the new product fills the goals of business managers.

quality of launching and promotion as well as proper organisational design. Factors not connected with a product did, however, not have a notable effect on success (e.g., company reputation, customer service or effective sales). Cooper stressed the fact that in terms of profitability, having the best product is notably more important than speed of the product development process. Despite the fact that a strong brand and effective sales help, much more important is quality of the product itself. According to Cooper, low price is not the key to winning on the market; much more important is what the product offers in return to the customer's money.

Therefore, competitive edge of a single company largely refers to an ability to create products that are in some respect superior to those of competitors. In order to create a future for themselves, companies must develop new products and improve those already existing. Product development can thus be described as a key project for companies aiming at satisfaction of customers and long-term growth (Van de Ven 1986; Johne & Snelson 1988; Bart 1993; Deschamps & Nayak 1995; Griffin & Hauser 1996).

1.1. Management of product development as challenge

Despite extensive research on product development, percentage of successful product development has not increased at all during the last 30 years (Shepherd & Ahmed 2000). This is a notable problem, since there is a clear correlation between success of products and success of companies (c.f. e.g., Pavar et al. 1994).

Designing new products is a complicated process that is difficult to manage (Wagner & Hayash 1994). Despite the fact that the striving for logical and systematic design methods began as early as in the 1950s (Jones 1984: 9), there is still relatively little knowledge about advancement of the process and problems therein (Dwyer & Mellor 1991; Wolfe 1994; Cheng & Van de Ven 1996). According to Seth et al. (2001), innovations have been studied on a significant scale in the organisational level, but if the objective is to increase the efficiency of single product development processes, the research subject should be a single project and variables affecting its outcome. Therefore, Van de Ven

(1986) is surprised at how few scientific studies among the large number of studies made have paid attention to problems encountered in management of a product development process. A reason may be the fact that organisations are much easier to study than management of long-term processes.

According to Van de Ven (1986), researchers and managers should be able to answer three questions in order to be able to appropriately manage an innovative process:

- How do innovations develop over time?
- What kind of problems will likely be encountered during the process?
- How can these problems be solved?

With his questions, Van de Ven is trying to create a model or a theory that would explain the logics behind a product development process. According to Cheng and Van de Ven (1996), the two most common explanations for advancement of an innovative process (process advancing in stages with random order of events) do not create a valid explanation if chaotic properties are found within the process. They define chaos as a process consisting of non-linear and dynamic systems and in the early stages of a product development process, chaos is the typical state. Cheng and Van de Ven state that only with a definition of the logics connected with development of innovations will research be able to define a model or a system that can explain advancement of the process.

Citing Wolfe (1994), purpose of this study is to define the factors that explain the series of events observed during the process. *The better we are able to identify the logics of a chronological process advancing over time, the better we will be able to understand this complex and risky process.*

1.2. Concept design as product development challenge

The focus of this study lies on the first stages of the product development process which lead to definition of properties of a new product and creation of its visual appearance.

This process is here called concept design[2]. As the name suggests, the objective of concept design is to create an overall view of the product to be developed and its properties prior to actual development work[3]. A concept can also be seen as a pursued state or a vision of sorts (Powell 1993) which largely defines price of the product as well[4]. Concept management here refers mainly to design management. The concept of concept management, however, is more appropriate because many other factors in addition to design affect the creation of a product concept (cf. definition of concept below).

Concept design can also be seen in different way. For example Keinonen (2004) sees concept design as a future oriented design process. From this point of view, the purpose of concept design is to explore the future design and product concepts. Here, concept design does not refer to a stage similar to pre-planning (cf. e.g., Cross 1984) after which actual product design may begin[5]. Defining concept design as pre-planning of sorts is problematic in the sense that a concept under development often changes conceptually also in the product design stage (which has been seen in, e.g., Cross's model as a stage during which actual design work takes place)[6]. However, conceptually thinking the concept is no longer the same. Therefore, *the view presented here is that concept design covers all of the stages and actions which conceptually alter the product to be developed*[7]. However, this research does not deal with technical feasibility or development stage, even they are important for the success of the product.

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[2] Cf. Khunara and Rosenthal's (1998) front-end operations and Cooper's (1990) concept of homework.

[3] Concept design prolongs duration of the early stages of the product development process, but reduces the overall time used in the process (Cooper 1990; Burchill 1993; Fox 1993; Castro 1994).

[4] In a book presenting European Design Prize winners of 1997 edited by Thackara (1997: 423–424), Colin Mynott, former president of the Great Britain Council of Industrial Design, estimates that approximately 85% or more of the costs of a product are defined in the concept creation stage, whereas Fox (1995) states more moderately that studies show that more than 50% of the costs of a ready-made product are defined during the concept design stage.

[5] The idea of concept design presented here is commonly accepted view (cf. e.g. Stinson 1996; Lindell, 1991 Cooper 1994) in the literature of product development.

[6] Thus, concept design is followed (in some cases) by a development stage (cf. e.g., Stinson 1996; Cooper 1994; Lindell 1991).

[7] When concept design is perceived as a pre-planning stage of sorts, it refers to the product development practices of large international companies. These companies have the financial resources needed to develop several alternative concepts studied from different perspectives at the same time. One or two of these concepts are then chosen for the next stages, the product design

Based on the research material the process leading to a concept and its creation must be studied from a broader perspective than that normally used. Concept design does not signify a good idea only: instead, a concept is created in several stages and a successful concept requires successful realisation of each stage. Concept testing, which is often separated from the concept design process in scientific literature, can be seen as an essential part of the concept design process and there is no rational reason to regard is as a stage separate from concept design, since its only function is to promote development of a concept. Therefore, the prototype stage can, at least in the furniture industry, be understood as being a part of concept design. The product being developed may still be changed – even in a decisive manner based on some of the cases studied – conceptually at this stage[8]. Every product has a spesific concept. A product is a product when the process has proceeded until to launching stage. No changes are anymore done. The concept and the details of the concept are in them final form.

There are several definitions for a concept. According to Schmidt (1997), a concept can be perceived as a verbal, illustrated or physical description of a product in the language used by customers. According to him, a market-oriented product concept can be regarded as the objective of product development, since it describes needs of customers to which the product to be developed should offer answers. Ulrich and Eppinger (1995: 78) have a slightly broader definition of a product concept: an approximate description of the technology, working methods and product form required in order to answer the question as to how the product strives to satisfy the needs of customers. A more simple definition can be given for product concept: a verbal and/or visual description of the product to be developed and its properties. A good product concept may be defined simply as a product that increases or in some way improves quality of living of an individual, a community, a nation or the human kind. This can be achieved by, e.g., improved ecologic aspect,

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and development stage. This study analyses product development processes in small and medium-sized companies where resources are extremely limited. Thus, in the beginning of concept design, based on a more or less conscious and systematic research stage, a concept with the most potential is chosen from several alternatives. The objective is to refine a ready-made product from the chosen basic concept through a series of different development stages.

[8] It is likely that this is a special feature of design-centred sectors. One may assume that in many areas of industry, testing and trials in the prototype stage mainly aim at testing functionality of technical solutions at a point when the concept has already been 'set in ice' in a conceptual sense.

usability, design or durability. Productability is important as well, since it largely defines price of the product.

The significance of concept design has usually been poorly understood in western companies (Burchill, 1993; Bacon, 1994). E.g., according to a study by Cooper (1990), in a typical project 7.1% of the overall costs only were used in concept design whereas according to a study by Cooper in 1986, Japanese companies use 25% of their overall budget prior to the actual development stage. However, according to research on the issue, quality of a concept largely defines success of the product (e.g., Burchill 1993; Wilson 1993; Nonaka & Takeuchi 1995; Ulrich & Eppinger 1995; Cooper 1990; Cooper 1994; Khunara & Rosenthal 1998). Therefore, several researchers claim that investments to development of concept design offer much more benefits than investments to development of the latter stages. Most projects do not fail in the latter stages of the product development project but instead early on in the process (Zhang & Doll 2001)

Quality of concept design separates winners from losers. According to Cooper (1990), successful projects used twice as much money and 1.75 times more time measured as person work-hours in concept design than unsuccessful ones. Later on, Cooper (1994) has proven that projects that had done their homework well achieved a 43% higher success rate and were notably more profitable than projects that had done their homework poorly. In his part, Castro (1994) states that concept definition deserves much more attention and investments than it has traditionally received (cf. also Wagner & Hayash 1994).

Concept design does not exist in isolation. It is a part of product developmet process, which proceeds in certain organisational context in certain competition environment (Figure 1). Organizational context creates the "landscape" where the concept design process take a placea and there are several forces that influence the process: resources, strategic goals, limitations and technology (Figure 1).

The most important factor in the organizational context is the strategic goals of the company. Product development is a part of the overall strategy of a company and its purpose is to uphold or improve the company's competitive position in the market sector chosen (Omsen 1985). The challenge is to create product srategy, which creates the fit

between corporates overall goals and product development (Lindman 1997: 54). Product development strategy reflect the company's overall strategy (Tuomi-Nurmi 1984). From the viewpoint of product development, *implementation of a strategy refers to development of right kind of products in order to concretise the strategy chosen* (see in more detail in Appendix 1).

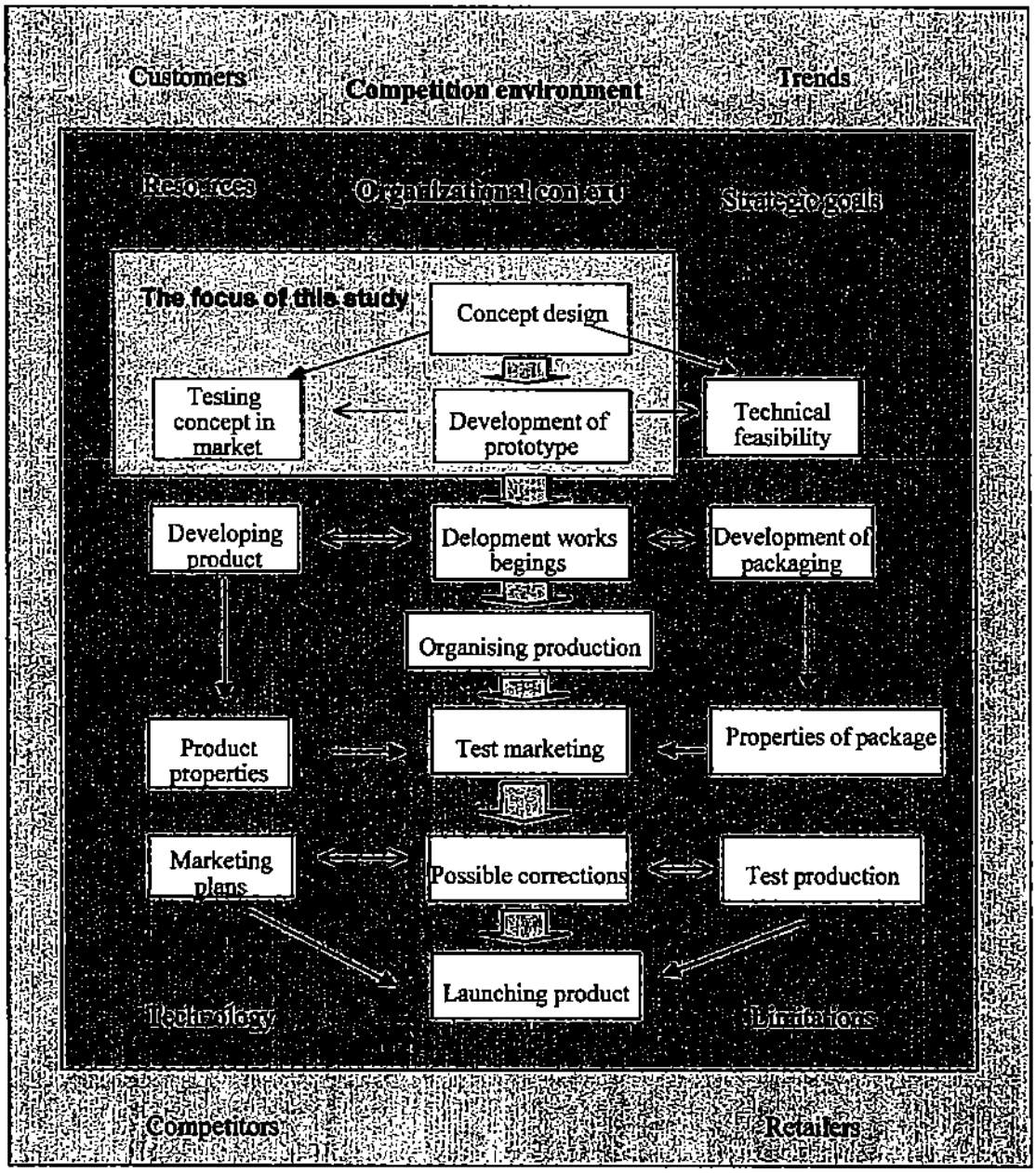

Figure 1. Concept design within product development process, organizational contex and competition environment. Source: modified model by Stinson (1996).

1.3. The empirical material of this study

The empirical material of this study is based on an analysis of companies in a furniture industry. Import of furniture to Finland has increased from 1995 to 2002 from approximately € 118 million to approximately € 303 million (statistics by Association of Finnish Furniture, Suomalainen Huonekalu Ry). Imported furniture have been able to answer to the expectations of Finnish consumers better than domestic furniture. Import has not increased in the lowest price segments only but in all price categories. Therefore, increased import rates are not necessarily due to a lack of price competition ability. The problem has rather been inability of the sector to create new and interesting product concepts. Significance of concept design is more pronounced in the furniture industry, since from a technical viewpoint, a piece of furniture in itself is a fairly simple product and the development stage after concept design does not usually cause problems.

Furniture business as a business filed has several, business spesific characteristics. Markets are very heterogeneous, and the needs of the customers are numerous (which emphazises the role of opportunity management). The role of brand creation is growing in order to distinguish the firm and its offering from the others[9]. Until these days, the role of technology is modest compared to the design as a competitive edge.

Design is the most important way to differentiate the new product from the existing ones in the field of furniture business. Thousands of furniture companies around the world have designed piece of furnitures over the last centuries; almost every possiabilities of the design have been allready explored. Furthermore, the customers are quite conservative in them decorating style. So called "wild" design is only seldom commercial success (Tiensuu 1999).[10] In furniture industry, the success of the new product depend largely from small

[9] There are several definitions of the concept of brand. E.g. Bick et al. (2003) defines corporate branding as those features and actions that distinguish an organisation from its competitors. It is a reflection of the organisation's ability to satisfy consumer's needs in a way which reducts the risk of making a wrong decison.

[10] From this point of view, design is more challenging task in the furniture business than for example in mobilephone business, where the product and its design is quite young, and customers seems to accept a wide range of design. The so called creativity economi seems to have more possiabilities than the so called early industry (cf. e.g., Kuosa 2004).

design nuances. This means that the concept design is very sensitive process to manage. To reach a competitive edge, a pluralistic view of demand and competitive environment as well as courage to invest in recognisable meanings are needed.

1.4. Research problem

There are several problems connected with creation of new concepts. First of all, research has not been able to create an overall view on what concept design means. Due to lack of understanding, concept design has been a 'black box' in between inputs and outputs of the early stages of the innovative process. In addition, research methods used in studying concept design as a process are being developed. Due to these facts, concept design is usually described with a concept of 'fuzzy front end'. This refers to incoherence and lack of control. This study aims at increasing understanding of the problems with advancement of the concept design process and thus increasing accuracy of product development and creation of conceptually superior products.

The first challenge with this study was description of the structure of the concept design process, i.e., conceptualisation of the process. The more accurate a 'map' we are able to create for the process, the better we will be able to understand it. A map refers to a description of process structure. A map thus created may according to Fiola and Huff (1992) be an important aid for executives in managing a dynamic and complex environment.

Another objective is development of the theory of simple NPD process models towards analysing of process content. This refers to identifying process logics which include both nature of the process and description of interaction during the process. The description of the process of creating a concept is a prerequisite for the latter objectives, since the logics of concept design are created by interaction of various elements of the process. According to Ferlie and McNulty (1997), process research is not able to produce formal prediction models but it is, nevertheless, able to identify models that are likely to be created in an organisation during the course of processes. *For concept design, this means*

that we are able to identify product development practices creating problems or leading to success by taking account the dynamic and nonlinear nature of the phenomenon.

The research question is: How can concept design be studied as a process and how can the process leading to development of a concept be conceptualised?

1.5. Research challenges

The study at hand is from the starting point conceptual-theoretical study because the objective of the research project was to increase control of the NPD process. This was pursued by increasing understanding of the phenomenon. This has required creation of new concepts and further development of already existing approaches.

In a way this study is action-analytical work. It is characterized by practical touch with problem based approach. The work is grounded at challenging and sensitive empirical material.

The challenge of this research was to 'tame' a complex and dynamic phenomenon into a conceptual form. Here, complexity refers to the fact that several different factors on different levels are at play within the phenomenon (e.g., processes). One must assume that concept design requires, e.g., a variety of information (e.g., needs of customers, trends, etc.) and skills (e.g., ability to analyse, ability to create). In addition, concept design is nearly always collective to some extent which creates a tension of its own. Dynamic nature refers to the fact that reality is in constant movement and static photographic samples do not really show the actual challenges connected with the phenomenon. Conceptualisation of the phenomenon to be studied requires adopting of a holistic point of view which, in its turn, requires pluralistic examination of the process[11].

[11] By concept holistic we refer here to the definition of Kaila (1963). According to his definition concept holistic mean an all-inclusive approach, where the most important factors are integrated as a holistic whole.

Concept design may be studied from various perspectives. Concept design does not mean creative ideas only, but the management of the process. From this point of view, concept design is a challenge of management. So the perspective chosen here is that of management. The perspective chosen enables extensive analysis of the empirical data, since it is not connected to any specific paradigm. Thus, the results may also expected to be a multi-layered story of the challenges of concept design.

This research rests on four basic pillars. The first pillar is choice of research subject. This study aims at proving that concept design is the basis for product development and its success has an impact on commercial success of a product and thus success of a company. The second pillar is the empirical research data that has been gathered with participating observation and action research during a period of 3.5 years. The researcher's personal participation in practical work was a central key in his striving to produce a new kind of understanding about the challenges of concept design. The empirical part consists of three strategic cases which increased understanding of concept design in different environments.[12] The third pillar consists of the procedual approach adopted in the research which enabled "sensiable" analysis and modelling of concept design. The fourth pillar has to do with the way the research studies the world. This study is not traditional in the sense that the phenomenon to be studied is not studied from a single perspective. In this study, concept design has been described and analysed from several different perspectives, and bridges between phenomena traditionally viewed as separate by the science community have been consciously sought.

A research project is often strictly limited to one perspective, which according to Lincoln and Guba (1985) was typical to the positivistic period and its belief in 'one truth', the formation of a deductive theory. According to Feurer and Chaharbagh (1995), however, resolving a research problem often requires a holistic approach combining several different perspectives. Concept design *should be studied as a whole so that the extent of*

[12] By strategic case here, we mean case where the phenomon under study forms a rich and deep roping material for the analys. This dimension of the strategic case make it possile to create a deeper understanding of the phenomon. Strategic case can be compared to so called tradiotinal case and exceptional case. The former describes the the cases as usual and the latter the cases of exceptional situation.

process is created by all the functions, actions and participants within a company which produce additional value or otherwise influence development of a product.

According to Lincoln and Guba (1985), inductive theory formation creates several theories which may be adapted to explanation of a phenomenon. This means that there is no one single major 'truth theory'. Pettigrew (1990) introduces this idea by stating that there is no single 'grand theory' explaining a change, since a process of change can be better described by loops than linear lines. Extensive lines are not descriptive of 'reality' since it is formed by a large number of small processes (for more information, cf. e.g., Venkula 1988: 7–18).

Product development as well as concept design have traditionally been described from a certain perspective, such as development of technology or from the perspective of a creative process. Explanatory power of research based on a single perspective is limited, since no process in actual life can be fully explained from a narrow perspective. This is the idea that brought on the basic tension of this study (Figure 2). In this study were found 5 basic tensions; Creativity v. analysis, ramdomness v. systematic way of acting, tacit v. explicit knowledge, physical v. mental reality and individualistic v. collective practices. This study suggests, that these tensions are the main challenge of concept management.

From this perspective, concept design can be described using a metaphor of the Rubik's cube. In the same manner as the cube, the story of development of the phenomenon consists of several small blocks which are to be set in their proper places. Concept design must be studied based on this logic. Concept design will become an understandable unity only when it is studied simultaneously from several perspectives. A holistic study of the phenomenon includes an assumption that the presented model is able to synthesise variables which are traditionally perceived as opposites to each other and which mold tensions in the process into a coherent unity.

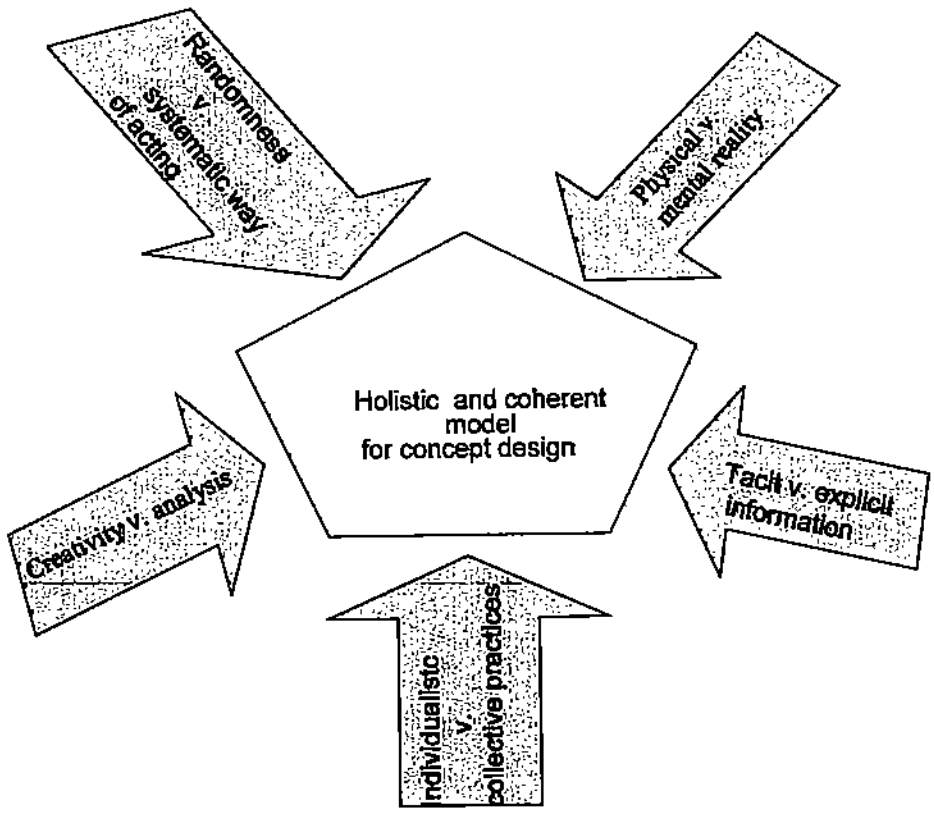

Figure 2. Basic research tensions.

Reality must be described and explained as several small events connected to each other instead of a large unity. That way, reality will be perceived by a reader as truthfully as possible. *Therefore, research results are a series of small analyses creating a coherent unity*. Thus, research results are several stories which explain advancement of the process and problems connected with it.

Scientific literature has presented several different models for concept design (Appendix 2). The models are often very detailed and therefore also fragmented. Analysis of the models is difficult, because researchers do not broadly explain the concepts or the models used. All in all, the models seem to be like check lists of sorts rather than scientific models. In addition, the models do not produce understanding on how concepts are created in practice. This study can be seen as explorative, since existing research offers little frame of reference in order to study the phenomenon at hand.

1.6. Research contribution

According to Senge (1990: 203), a phenomenon must always be studied from two perspectives. The first perspective is created by process thinking and the other by mental models connected with process management. One may assume that this type of frame of reference is functional also for this research project. One may also assume that the point of view developed by Senge can be enriched in accordance with the special properties of the phenomenon studied. Based on existing scientific literature, one may state that these special properties include, e.g., viewpoint of information and knowledge creation, creativity, and level of collectiveness of action models:

1. *From the informative perspective*, the basis for product development is either customers' needs, technology or company's strategic objectives[13] which are then transferred into product concepts. The informative perspective has been studied using the concept of uncertainty. In the concept design stage, there is no certainty as to what customers want, what the competitors are doing or what kind of technology should be used as the basis for the product (Zhang & Doll, 2001)[14]. One can assume that Hart (1999) has realised the essence of concept management when stating that NPD research must create understanding on how benefits important to the customer can be identified and transferred into a product.

   One may also assume that when studying concept design and creating a model thereof, one must take into account the management of the information (tacit and explicit information), and the interaction between physical and mental reality (for more information, e.g., Hassi 1998).

[13] Studies have presented that the starting point for product development should be a 'triangle' created by these factors (for more information, cf. e.g., Clark & Wheelright 1993; Gill et al. 1996).

[14] Reducing uncertainty is, therefore, one of the most central tasks of concept design (Moenaert et al., 1995) which is partially possible by gathering necessary information (if it is available) and analysing it. The challenge with processing information is interpretation of an uncertain and unclear environment and it is not self-evident that it will lead to the 'correct' result.

Accordign to Nonaka and Takeuchi (1995) *knowledge creation* mean the capability of a company to create new knowledge and embody it in products, services and systems. The current theoretical discussion of the knowledge creation has emphasized the role of tacit knowledge and the importance of the knowledge conversion process; from tacit to explicit and back to tacit (Kulkki 1996). Knowledge creation is a cruisal part of concept design since the challenge of concept design is to gain information, share it and refine it to the form of new product concept. This means a process, where old interpretations of meanings and actions are transformed into new interpretations of meanings and future actions (Kulkki 1996).

2. In scientific literature, product design has been often studied as *a creative activity* with more or less 'mystical' properties. According to Leiviskä (2001: 51), most of the current creativity theories emphasise significance of combination and reorganisation. However, creative work has been analyzed from several perspectives by different researchers (see. e.g. Ahola 1980) and there is no one dominant thruth.

3. *Teamwork* is perceived, at least potentially, as a more fruitful approach than an individual-centred approach. A collective problem-solving process is, however, not necessarily superb compared to achievements of an individual. Teamwork has also been criticised. Therefore, Goldschmidt (1995) notes that there are precious little studies proving that teamwork is more effective than the work of a single designer.

In addition to these issues, the management research should be able to create understanding on how the NPD process leading to creation of a concept proceeds in practice. These challenges require answering to several question, such as:

- How and on which levels does the process proceed?
- What kind of problems will be encountered during the process and how can they be solved?
- Where do concepts come from?

- How to transfer information into concepts?
- How can analysis and creativity be combined and how should their combination be managed?
- How is it possible to combine and manage tacit and explicit information?
- How should individual and collective working methods be combined into appropriate concept design management?

With these questions, an integrated explanations model moving on several levels on how the concept design model proceeds and how the sectors are connected is sought by ways of research. Therefore, concept design management requires a model combining the above-mentioned issues into a 'rational' and internally coherent unity. Thus, the study strives to deepen understanding about concept design management. The purpose of this study is recognize the the 'rules of the game' in order to act more appropriately.

1.7. The chosen approach of this study

The research has travelled from the static world towards a dynamic reality with its properties. During the journey, it has been questioned how concept design should be analysed and understood. This has, in a way, created the 'tree trunk' for the research.

When pondering how concept design should be studied, one must take into account the fact that concept design can be analysed from several different NPD perspectives (paradigm). One may assume that the results vary depending on the approach chosen. Chapter 2 deals with different ways of analysing product development and concept design. The functional approach dealt with in Chapter 2.1 describes concept design and creates a model thereof from the perspective of interaction between functions, whereas concurrent engineering described in Chapter 2.2 analyses the phenomenon mostly from the perspective of teamwork. In Chapter 2.3 the reader will be lead to the fairly muddled field of process research. The central question in process research deals with what a process actually means. Stage models described in Chapter 2.4 perceived product development to be a linear process advancing from one stage to another. Second

generation process research presented in Chapter 2.5 studies management of concept design as a complex, multi-levelled, dynamic unity which must be analyzed using a holistic approach. Chapter 2 shows that in order to be able to answer to the research questions set for this research project, one must assume a procedual approach (Figure 3). This choice and perspective has created the 'spectacles' through which the phenomenon to be studied has been analysed. *Despite the fact the this work deals with concept design, the main body of the work has been the II generation process researh;* What it means, how it can be applied to the research of concept design.

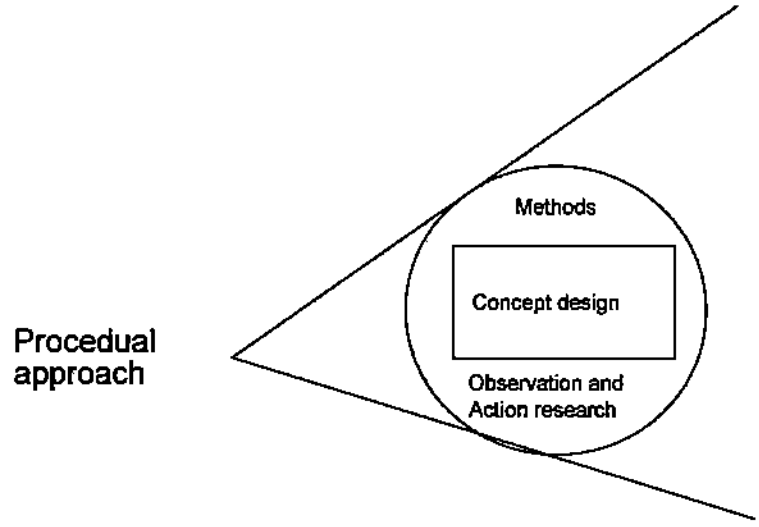

Figure 3. Research frame of reference.

1.8. The structure of the study

Chapter 2 describes development of description methods for the product development process. They are also descriptions on how the paradigms for product development research have been developed.

Chapter 3 describes research methods and their empirical application. The main focus has been on the qualitative case mathod and action research.

Chapter 4 presents the empirical data for this study based on a period of five months of participating observation in furniture factory x (project O) as well as three-year action research projects, projects F and V.

Chapter 5 presents a summary of research findings. In chapter 5.4. concept design process is studied as a conclusion from three perspectives; factual and mental processes and model of co-operation.

Chapter 6 presents the central research results and a model for concept management. Also second generation process research and its development are discussed. In addition, some final comments and furher investigation challenges are presented.

2. FROM FUNCTIONAL INTERACTION TO PROCESSES IN THE NEW PRODUCT DEVELOPMENT

The research tendencies perspectives represent certain types of assumptions about reality, referred to as paradigms (for more information, please see, e.g., Kuhn 1969; Lincoln & Guba 1985; Venkula 1994). A paradigm is a way of transforming complexity of 'the real world' into a manageable form (Patton 1994: 267). A paradigm refers to a model that guides actions based on underlying assumptions (Venkula 1994: 1); These background assumptions, ontological (how reality is expected to be organised), epistemological (what is important information) and methodological (how is information acquired) are different in each approach. I.e., paradigms organise the manner in which product development has been studied and explained.

2.1. Functionalistic product development

Previously, knowledge required for development of a product may have been accumulated to one person, e.g., a blacksmith. Even today, a single product developer in small and medium-sized companies may control the information and know-how required in development of a process, but as company sizes increase, marketing and product development are divided into separate departments and the problem here is co-operation between these departments. (Griffin & Hauser 1996). The significance of integration of working increases and the most central issue is management of unities (Van de Ven 1986; Rothwell & Whiston 1990).

An approach focusing on analysis of co-operation between different departments of a company may be called functionalistic. The objective is to improve product development by developing interaction between functions. The objective has been removal of problems encountered with a variety of integration methods, including, among others, different standards (Van Dierdonck 1990; Adler 1995), project teams and interactive interaction (Van Dierdonck 1990; Susman et al. 1992; Adler 1995; Griffin & Hauser 1996) and modern

information technology (Susman et al., 1992). Research on the functional approach may be divided into two main categories. The first includes studies that strive to establish a connection between two functions and create actions for developing the connection. These are divided into studies analysing relations between product development (including R&D and design) and marketing (e.g., Griffin & Hauser 1996; Souder & Moenaert 1992; Moenaert et al. 1994)[15], and those analysing relations between product development and production (e.g., Adler 1995; Ettlie 1995; Van Dierdonck 1990; Bergen et al. 1988; Dean et al. 1989).

A more demanding combination is created when integration between three functions, i.e., marketing, product development and production is studied. According to Griff and Hauser (1992) and Song et al. (1997), effective communications between these three functions will improve possibilities of creating successful products. It is imperative to note that integration required by effective co-operation varies in different stages of the process; co-operation between the three functions in each stage is not necessary or even desirable in terms of effectiveness (Song et al. 1998).

Study of interdependency is important for a number of reasons. According to Moenart et al. (1994), empirical studies suggest that disharmony between, e.g., marketing and product development departments is more a rule than an exception. According to Clark and Wheelright (1993: 159), it is not exceptional for product designers to develop conservative, classic and stylish products and marketing to focus on a youthful and sporty image[16].

The objective of development of interdependency between product development and production is to take into account the 'needs' of production. Integration of product

[15] Scientific literature has especially stressed the importance of co-operation between R&D and marketing: studies have shown it to improve success of products (e.g., Cooper & Kleinschmidt, 1987). For more information on interaction between R&D and marketing, please see e.g., Song & Parry (1993), Gupta & Wilemon (1988) and Song et al. (1996).

[16] In a multi-disciplined product development project, the task of marketing in addition to acquiring marketing information is distributing it for other departments to use (Bondra & Davis 1996). The problem, however, can easily be utilisation of information (Gupta & Wilemon 1988) due to dissimilar patterns of thought (Hendry 1989).

development and production speeds up the process (Van Dierdonck, 1990; Susman et al., 1992) and increases quality of products (Dierdonck 1990; Susman et al. 1992; Adler 1995). If production and product development are not integrated, costs may increase (Adler 1995; Van Dierdonck 1990).

The problem with the functional approach is coordination of the product development process. A product is a sum of actions within different functions which leads to product development being summed up in a certain manner. A product is 'tossed' from one department to another as presented in Figure 4. This may cause confusion with coordination of the unity and responsibility, for example[17].

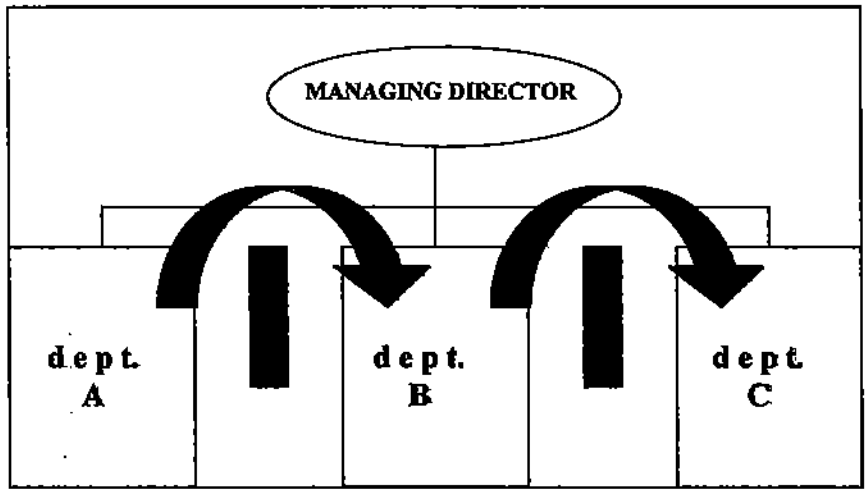

Figure 4. Functionalistic product development.

A process advancing stage by stage can be compared to a relay race and it can easily be a slow, rigid and ineffective method in product development (Eversheim et al. 1994; Gupta & Wilemon 1990). According to Eversheim et al (1997), in this model departments operate more or less independently, and thus needs and abilities of other functions are often left unmapped. The common trait for all studies based on functionality is that

[17] The consequence may be a so-called syndrome of 'Not Invented Here'. Katz and Allen (1998) define it as a phenomenon where a team believes to possess all the necessary information in their area which leads to rejection of information coming from outside the team.

problems within product development are not being sought from the unity but from separate parts therein. This approach stresses boundaries between areas of expertise instead of their integration which, however, is the essential prerequisite for effective product development (please see, e.g., Van De Ven 1986; Walker 1990).

In addition, one may assume that the absolute value of interaction has been exaggerated which indicates that the phenomenon is more complex than has been assumed up until now. According to Ruekert (1995), increased interaction is effective in some cases and ineffective in others. In his study, increased interaction between functions improved product quality and success in the market in all projects, but did not reduce the time used in the process or the resources needed.

2.2. Multi-disciplined product development teams

According to Ruekert (1995), the most notable changes in the area of product development regard the manner in which interaction between functions is organised. This has signified creation of multi-disciplined product development teams consisting of experts from various departments (for more information, please see, e.g., Swink et al. 1996a and 1996b; Clark & Wheelwright 1992). The objective has been elimination of functionalistic isolation (Peters 1988).

Several concepts are used when referring to approaches aiming at multi-disciplined teamwork, including 'heavy weight project team' (e.g., Clark & Wheelright 1992) and 'concurrent engineering' (CE). Due to its general nature, the term 'concurrent engineering' will be used here for the approach. The concept refers to an approach integrating all factors that have an impact on the final product concept: function, form, mechanisms, technology, sales, customers and disposal of a product (Giard & Lee 1994).

The most important characteristic of concurrent engineering is simultaneousness of different stages and division of responsibility between different functions (Figure 5). A product is not transferred from a function (F) to another; instead, experts from various departments

participate in its development from the very beginning. Thus, product development in a manner permeates all the functions. Circle M symbolises a customer and a market-centred approach. CE also changes the position of a designer: a designer will be able to participate in development of a product already in the early stages of the product development process instead of giving it a mere final cosmetic touch (Giard & Lee, 1994).

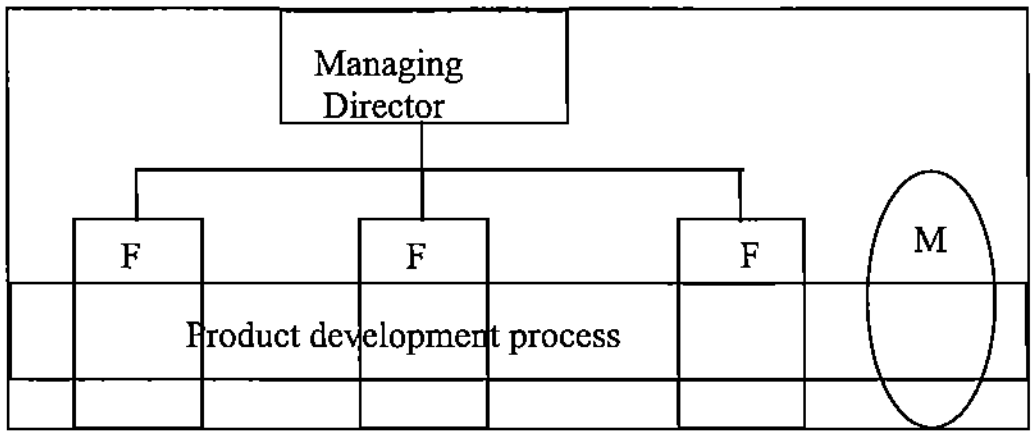

Figure 5. Heavy weight project team. Source: Clark & Wheelright (1992).

Scientific literature has discovered that multi-disciplined teams offer various benefits. According to Eversheim (1997) and Song et al. (1998), CE reduces the time used in the process, increases productability of a product and improves product quality. According to Whitney (1988), teams comprising of representatives of several functions are the most effective way known for removing obstacles to good design. According to Swink et al. (1996b), the strength of teams lies in the fact that no single department is able to possess all the information necessary for development of a new product: departments must integrate their expertise. These expectations are also backed up by empirical data. Based on a study by Cooper and Kleinschmidt (1987), use of multi-disciplined product development teams positively correlates with success of a project. Teams have been discovered to reach notable benefits in relation to, e.g., use of time (Rothwell & Whiston 1990; Clark & Wheelright 1992; Giard & Lee 1994; Cooper & Kleinschmidt 1994) as well as effectiveness and quality (Giard & Lee 1994).

Interest towards teams and participation of employees has increased at a fast pace in the corporate world (Yeatts & Hipskind, 1994) and researchers have for a long time argued that teams are critical organisational building blocks (Donello 1993). According to West (1996: 26), teams are used because there is a strong belief that in some circumstances people working for a joint goal create synergy and thus performance of a group surpasses that of an individual. Teamwork has been notably increased in product development already since the 1970s (Henke et al., 1993) and teamwork has more potential than work of individuals in isolation (Jackson, 1996: 53–57).

Practical functionality of teamwork has, however, stirred lively discussions. Many organisations have also noticed that teams do not always produce the desired results and advantages of teamwork are not self-evident (for more information, please see, e.g., Jackson 1996; Dunphy & Bryant 1996; Henken 1993). Teamwork may also cause paradoxes and conflicts between individuals, within teams and the organisation alike (Donnellon 1993).

2.3. Process research

There are at least three clearly differentiated tendencies within process research: 1) 'diffusion of innovation research' (DI), 2) 'organizational innovativeness research' (OI) and 3) 'process theory' (PT) (Wolfe 1994). According to Van de Ven and Huber (1990), the majority of process research focuses on process inputs and outputs using terms from the 'input-process-output' model. This type of research searches for inputs (x) in order to explain variations in outputs (y) (Mohr 1982: 37). However, Mohr points out that it is extremely difficult to find any explanatory relations in social reality (such as concept design).

Research on the change process itself poses the question as to how do organisational changes come into being, develop or are destroyed over time (Van de Ven & Huber 1990; Wolfe 1994). The objective is to describe advancement of the changes over time (Van de Ven 1992; Pettigrew 1997). The unit analysed is the innovative process itself (Wolfe 1994). The objective is to explain the mechanisms behind observed series of events.

These mechanisms cause changes. In addition, the unique circumstances under which these mechanisms will work are explained. (Tsouskas 1989) Process theories may also identify certain methods or courses of action which are effective under certain circumstances (Van de Ven & Poole 1990).

According to Wolfe (1994), differentiation of two generations of process research dealing with product development is beneficial: the first generation, so-called stage models, conceptualised innovations as linear series of stages developing over time whereas the second generation process research poses the question as to why and when do innovations proceed over time.

2.4. First generation process research

First generation process research regards the product development process as a linear series of consecutive chronological stages (Van de Ven 1986) which are connected to each other via change routines occurring in between the stages. This models refer to both conceptual and operational models stretching from creation of a product idea to launching of a new product (Cooper, 1990). For this research approach the term stage models is also used (for more information, please see, e.g., Rosenau, Jr. 1996; Rochford & Rudelius 1992; O'Connor 1994; Urban et al. 1987).

Stage models create a formal description of advancement of a process (Lindell 1991) and they have been assumed to be the road travelled by a 'normal' innovation (Van de Ven & Poole 1990). According to Lindell, stage models usually consist of six stages, the stages being: 1) definition of product properties, 2) definition of alternative solutions, 3) testing of material, components and structure, 4) creation of prototypes, 5) taking into account demands of production and marketing and 6) launching of product.

A variety of development types can be differentiated within the stage models (Figures 6 and 7). The first generation model types were created based on the need to make the chaotic product development project more easily manageable. The models created a certain metho-

dology of measuring and control which aimed at securing the project's appropriate advancement and securing that each stage would be completed in time. Product development was divided into pre-defined stages and the personnel and manager of these stages changed with each stage. There were 'gates' in between the stages where corporate management made a decision of stop, go, hold or redo (Cooper, 1990). The process did not proceed to the next stage until all of the demands of the current stage had been met (Imai et al. 1988). The process was technology-centred and strictly concentrated on physical design and development. For example, marketing was not at all included in the process. The system was, therefore, designed to solve technical, not commercial problems. (Cooper 1994.)

The next generations of model types already had many of the characteristics of modern product development, such as project teams exceeding departmental borders ('cross-functional teams') and coincidence of stages (Cooper 1994; Griffin & Hauser 1996). At the same time when the process was speeded up, its flexibility and the amount of shared information increased but process management, however, became more difficult due to, e.g., increased conflicts between teams (Imai et al. 1988).

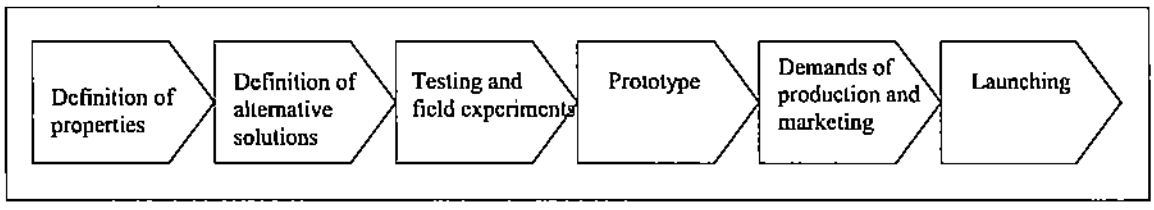

Figure 6. First generation linear product development process (Lindell, 1991).

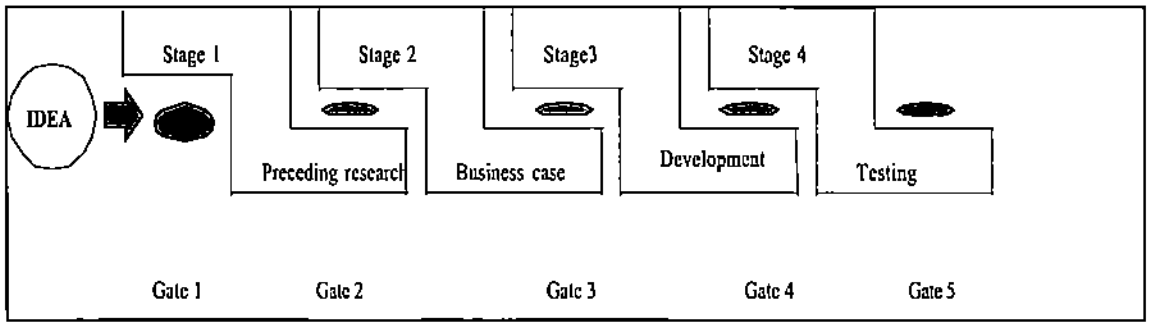

Figure 7. Third generation stage model (Cooper 1994).

According to a study by Booz-Allen and Hamilton (1982), companies that had adopted the formal product development model succeeded better than other companies. The reason may be that the normative model often outlined the chaotic product development process and thus facilitated organisation of product development. However, according to Rochford and Rudelius (1992), only a few empirical studies suggest that companies following the model in question succeed better than those not using the model.

The basic problem with stage models is their mechanical quality. The models assume the product development process to proceed in a linear manner from one stage to the next with the same formula. The product development process, however, only rarely if ever proceeds mechanically from one stage to the next and processes may not even necessarily include all of the stages included in the model. According to Cooper (1983), each product development process is different. There are no two processes alike. According to his study (1983), none of the seven product development processes he studied proceeded in the linear manner presented in scientific literature. Cooper continues that in a previous study by him (1979), detailed descriptions of three product development processes indicated that the process is notably more complicated than the models lead to assume. According to Pettigrew (1987), stage models fail to describe those mechanisms and processes according to which changes occur. Therefore, he stresses the importance of a more holistic approach.

2.5. Second generation process research

Attitude towards ability of the first generation process models being able to describe the reality of process development has been critical (Cooper 1983). Therefore, process research on product development is being transferred towards second generation process research (Wolfe 1994) by several researchers (e.g., Rogers 1983; Van de Ven 1986; Van de Ven, Angle & Poole 1989; Van de Ven & Rogers 1988). Despite the fact that the stage models have received plenty of criticism, their assumptions have been confirmed by conceptual language, research and corporate life (Myers & Rosenbloom 1996). One may

assume that despite the seemingly procedual research approach, current research deals with concept design using the old approaches.

Process research on product development is currently under transition. Second generation research does not as of yet comprise a united research tendency. So far, the methods used to describe the cyclic process advancing over time are still being developed (Wolfe 1994; Van de Ven & Poole 1989) and there is very little empirical research on product development from this perspective.

According to Wolfe (1994), *second generation process research refers to a deep-probing and longitudinal research with a striving to describe an innovative process advancing over time.* Van de Ven and Poole (1989, 1990) define it using a so-called accumulated model. In the same manner as this study, the model perceives the innovative process as a complex series of actions which may proceed over time in various ways.

A process has been defined on a general level as follows: a series of actions advancing over time (Venkula 1988, 1995; Van de Ven & Poole 1990; Pettigrew & Whipp 1991; Abbott 1992; Håkansson & Snohota 1995) that proceeds on horizontal-vertical dimensions (Galbraith 1982; Venkula 1995) and that has an objective (Venkula 1988). Final result of the process develops over time due to interaction between different factors within the process (Van de Ven & Poole 1990; Lindell 1991; Pettigrew & Whipp 1991; Venkula 1988 and 1995) and the sub processes may begin and develop over time with different pace (Venkula 1995).

Time has an important role in process research. According to Benass (1995), there is no sense in analysing a system of any kind only at a certain point over time because time is a critical dimension for a process. The past is alive today and it can change the future (Pettigrew 1997). The significance of time is also stressed by, e.g., Dawson (1997), Van de Ven & Poole (1990), Pettigrew (1990), Van de Ven & Huber (1990) and Van de Ven (1992).

Another concept important to second generation process research is *interaction* which refers to dynamics. A system is dynamic when it is created by a number of variables interacting with each other over time. According to Pettigrew (1997), process research can be described as the delta of a river which may include several small rivers connected to each other. They are also dependant on each other and shape the environment in the same manner as the environment shapes them. Interaction further refers to a third important concept, *a holistic approach.* The road to a holistic approach according to Pettigrew (1997) goes through interaction. Therefore, a frame of reference required in studying processes must combine interaction (dynamics) and a holistic approach which are in a manner prerequisites for each other.

Holistic management of interaction over time is enabled by a cyclic structure. A cyclic structure is one of the basic characteristics of second generation process research which separates it from the first generation models. One of the first cyclic process models is a 'chain-link model' by Kline and Rosenberg (1986) presented in Figure 8 in a form modified by Myers and Rosenbloom (1996).

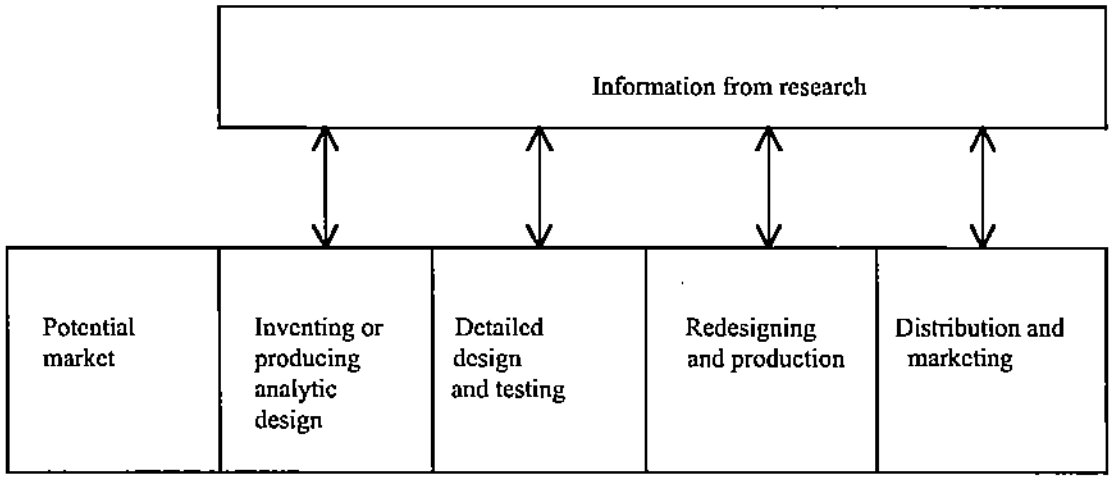

Figure 8. Kline and Rosenberg's (1986) chain-link model modified by Myers and Rosenbloom (1996).

The most important issues in the model above are the feedback loops which integrate different stages of the process. From this perspective, the innovative process is a complex

and chaotic combination of parallel and consecutive processes. The model may be evaluated as one of the first attempts to transfer from linear process models towards a more dynamic approach. The cyclic nature of the process may be better presented by utilising Venkula's (1988: 228) manner of describing a process (Figure 9) where the presented definition of a process is realised.

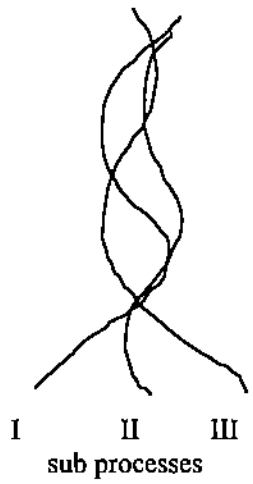

Figure 9. Cyclic nature of a process. Source: This figure utilises a description method for processes developed by Venkula (1988).

Therefore, a process is not created by placing variables in succession but instead by different factors of the process developing over time all the while in interaction with each other (cf. Senge 1990). This introduces a misunderstood point in an earlier study. According to Mohr (1982: 54), instead of the relations between variables, a process model refers to a series of events typical to variance theory as comes to relationships between the variables; if x, then y. According to the approach presented here, x and y describe different elements within a process which create the final result xy due to their mutual interaction. Based on the definition of process presented above, *logics within a process does not refer to logics of certain events from the perspective of a subject but instead the manner in which different elements of a process interact with each other.* Therefore, process logics is defined by the relations between these elements. Interaction during a process creates the prerequisites for creation of a new variable (Venkula 1988: 7–11). The new variable may be, e.g., a new product concept.

2.6. Summary and conclusions

The research perspectives presented in Chapter 2 have little to do with concept design (please see Table 1). Most of the research already conducted has focused on questions dealing with functional barriers (e.g., Adler 1995; Van Dierdonck 1990) or multi-disciplined product development teams (e.g., Clark & Wheelwright 1992; Swink et al. 1996a and 1996b). However, problems connected with advancement of a process cannot be solved with the functional approach, because it studies a natural process as items separated from each other.

So-called functional NPD models do not define whether the problems in interaction between functions deal with definition of product properties or actual development work. Most likely they can be perceived as dealing with both stages. This quite clearly demonstrates the weakness of the functional approach: lack of the dimension of time.

Multi-disciplined teams mainly solve problems connected with strong functional structures of large companies (Clark & Wheelwright 1992). Concurrent engineering does not merely describe or explain the problems connected with advancement of an innovative process. Therefore, it lacks explanatory power in explaining the processes leading to creation of a concept.

Therefore, according to Fox-Wolfgramm (1997), organisations may be analysed in a holistic manner by studying processes instead of separate organisational characteristics. Most of the process models on product development are studies on order of various stages. According to Iansit (1995), the objective of first generation process models has been development of project feasibility and integrated problem-solving within teams. The problem with those modells is the fact that it focuses on vertical dimension of the process only; the chronological order of stages. In the first generation process models, the first stage of the process, definition of product properties, corresponds to concept design. Despite the fact that according to Cooper (1990), stage models focus on definition of product characteristics they, however, do not show how the properties in question are

defined. A new kind of research approach is needed in order to analyse contents of stages and inner logics of a process.

According to Wolfe (1994), process research on product development is in the process of transferring towards second generation process research which refers to deep-probing and longitudinal research striving to describe an innovative process advancing over time. The objective is to describe more accurately the reality within an innovative process.

The most holistic view on second research process research has been given by the Minnesota Innovation Research Program (MIRP). A frame of reference created by MIRP includes the ideas, people, interaction, context and results in order to study a process advancing over time. The frame of reference defines an innovative process as an interactive process in order to realise ideas developed by people within an institutional context and the results of which are evaluated by people (Van de Ven & Poole 1990).

The frame of reference developed by MIRP is important in the sense that for the first time, participants have also been taken into account. Scientific literature on product development has a strong focus on technology and the significance of humans has not been recognised. Yet, several persons work in each product development process and products are always creations of humans.

However, the model analyses innovations from an organisational viewpoint. Therefore, the analysis unit of the model is an organisation instead of an innovative process. From the viewpoint of this study, the model is therefore unable to explain the process leading to creation of a concept. E.g., the model does not take into account the needs of customers or the company or development of technology.

The function of Chapter 2 of this study has been that of finding an approach that enables studying of concept design as a multi-leveled (complex), dynamic and holistic process. Thus, second generation process research has created the 'spectacles' through which the phenomenon at hand is studied. From the perspective of management, the question is how to control complexity and dynamics of concept design.

Second generation process research assumes that an innovative process is perceived as a complex series of actions which may proceed over time in various manners. The most important concepts are time, interaction (dynamics), complexity and a holistic approach. Concept design is thus perceived as a process proceeding over time over horizontal and vertical dimensions. Second generation process research may be summed up by two points:

1. Second generation process research refers to a deep-probing and longitudinal research tendency striving to describe an innovative process advancing over time (Wolfe 1994).
2. The process of concept design proceeds through a so-called accumulated model which perceives a process as a series of complex actions that can proceed over time in various manners (cf. Van de Ven & Pool 1989, 1990).

The goals of this study can summed up in following way:

1. A 'map' showing the elements dealt with in concept design is needed.
2. Logics for concept design must be found according to which these elements operate. Process logics presented above does not refer to logics between certain events from the perspective of a subject but instead the manner in which different elements of a process interact with each other.
3. A model must be created for concept design

Table 1. Product development research tendencies.

	Functional approach	**Multi-disciplined project teams**	**First generation process research**	**Second generation process research**
Descriptive method	Describes product development from perspective of interaction between functions	Describes product development as product development teams including specialists from various disciplines	Describes process as a linear series of stages	Describes process as a complex process with a horizontal dimension advancing over time
Important	Intensification of interaction between functions	Co-operation between representatives from various sectors within multi-disciplined teams	Linking of stages	Striving to describe and explain logics in advancement of an innovative project from a holistic perspective
Appearance on concept design	Not mentioned	Not mentioned	Mentions it as the first stage of process but no definition is given	Not mentioned
Appearance on creativity	Does not deal with	Does not deal with	Does not deal with	Does not deal with
Appearance on informative perspective	Does not deal with	Does not deal with	Does not deal with	Does not deal with
Handling of operations methods	Does not deal with	Does not deal with	Does not deal with	Does not deal with
Handling of collectiveness	Belief that increased interaction improves results of product development	Belief in power of teamwork	Does not deal with	Does not deal with
Problems	Lack of a holistic perspective. No explanation for the product development process itself	Main focus on development of requirements for product development activities. Does not explain the product development process itself	Mechanical approach, does not take into account horizontal dimension of process	Incomplete methods, only a few studies
Methods	Stabilised	Stabilised	Stabilised	Under development
Examples of studies	Galbraith 1982, Van Dierdonck 1990, 1994, Moenaert et al. 1994, Adler 1995, Griffin & Hauser 1996	Clark & Wheelright 1992, Trygg 1993, Ruekert 1995, Giard & Lee 1994, Whitney 1988, Swink et al. 1996	Coooper 1994, Griffin & Hauser 1996	Van de Ven & Poole 1990, Wolfe 1994, Van de Ven & Poole 1989, Benghozi 1990, Midler 1995, Tiensuu 1995

3. METHODOLOGICAL CHOICES ON EMPIRICAL MATERIAL

3.1. Qualitative research

Traditionally, research approaches have been methodologically roughly divided into quantitative and qualitative. However, according to Alasuutari, the methodological field of a study cannot be divided in this manner. Instead, one can distinguish two ideal models interpreting a study: on one hand, a natural historical testing approach and on the other, solving of a riddle. Solving of a riddle refers to creating an interpretation of the significance of the phenomenon studied based on produced leads and hints available. (Alasuutari 1993a: 23) This study borders on the latter option.

The most important choice of a researcher regards number of analysis units: whether research subject will be some factors within several organisations or several factors within some organisations (Orton, 1997). According to Monge (1990), the description of a process in process research must be detailed enough to offer adequate understanding of the series of events and their context. In qualitative research, large group of research units and statistic argumentation is not necessary or possible (Alasuutari 1993a: 30).

This study focuses on deep-probing analyses of three cases. According to Van de Ven and Huber (1990), observation of organisational transformation processes requires intensive work which limits the possibilities of a researcher to study more than a few cases at a time. Collection of the empirical data for this research project alone took 3.5 years and expansion of the material was not possible in terms of this research project. Concentration on three cases only enabled a more deep-probing analysis of the phenomenon than superficial studying of more cases.

According to Van de Ven (1987), qualitative research consists of four stages: 1) creation of a chronological list of events, 2) coding the list of chronological events according to categories of conceptual research, 3) analysis of process pattern, 4) creation of vocabulary to be used when describing the procedual pattern. This research project has mainly followed these instructions. The first stage may be perceived as a chronological

description of the process. This has been done in the empirical part of this study. The second stage deals with the first research question (description of process). This stage was important because no ready-made 'map' for conceptual design was available. In this study, the third stage was perceived to refer to analysing advancement of the process and logics thereof. The fourth stage refers to concepts connected with process logics described in Table 2.

3.2. Procedual case study

According to Van de Ven (1992), process research studies series of events within an organisational context which proceed over time. Miles and Huberman, in their part, state that material gathered during a long period of time makes it an effective tool for studying, e.g., processes. Thus, according to them, the study may go deeper than the questions of what and how many. In addition, the questions of how and why do issues happen in the way they do may be posed. Due to the richness and complexity of material for a qualitative study, it has great potential to reveal complexity of a phenomenon. (Miles & Huberman, 1994: 1)

According to Alasuutari, the data for a qualitative study should be handled as a unity which is expected to shed light on the structure of an internally logical unity. The most important task is creation of an explanatory model as the framework inside which all pieces of the puzzle will settle into a logical order. (Alasuutari, 1993a: 28–29; Alasuutari, 1993b: 38) A holistic approach has been adopted for this study, since concept design creates an understandable unity only when studied as a unity.

Van de Ven (1987) has separated 1) the concepts of change and 2) processes of change and states that a change is an empirical observation of changes discovered over time. According to him, processes of change cannot directly be observed but they rather consist of conceptual conclusions on chronological order of perceived changes.

Table 2. Concepts used in research and their operationalisation.

Concept	Description of concept	How does concept show in empirical material
Concept design	A process during which a concept is created for a product.	As a process during which information affecting definition of product properties was gathered in the cases. The process continues through the various stages during the concept will be refined into its final form.
Conceptualisation of concept design	Description of various process elements.	As process starting points, stages and sub processes.
Logics of concept design	Formed by interaction between various process elements.	As courses of action used in process.
Dynamics of concept design	Refers to interaction between various process stages and the problems with dynamics of the stages.	As complexity and dynamics of process.
Systematic approach	A more or less logical thinking project for solutions of problems encountered when creating a concept.	A vision on how a product can be 'built' into a concrete object.
Randomness	Advancement of process in a random manner, as opposed to pre-planned.	As random operations based on a thinking of 'I believe that...'.
Design information	Information gathered from various sources based on which a product concept is defined.	As various information gathered from various sources which enabled actions.
Creativity	A process during which the gathered information is interpreted and based on which product properties are defined.	As combination of design information in order to achieve desired final result.
Management of complexity	Management of information gathered and product properties derived.	In the manner in which a functional product or product family unity was created in the cases.
Process of simplification	Organising chaos.	As simplification.
Evolution process	Refers to development of a concept, especially a design concept, over time.	As a process during which concepts were developed into their final form.
Controlled collectiveness	The relation between decision-making and participation.	In the manner in which participants participated in development of products.

In this study, the concept design process is divided into several stages. Despite the fact that the stages defined have been classified by the researcher, division of the process into stages is essential because it divides the otherwise chaotic reality into a more easily understandable form. The analysis is 'authentic' in the sense that concept design is created by actions clearly separated from each other, whereas they can be classified as belonging to a certain stage. The important issue in separating actions into stages is nature of the actions (cf. e.g., gathering information, defining product properties and concretization). The empirical material has also been classified this way.

In practice, actions are so tightly connected to each other that their classification into stages is difficult. However, this does not pose a problem, since in second generation process research, which is the approach adopted for this study, it is natural that the stages partially overlap and they necessarily cannot or need not be separated. Relations between the stages may be described by a metaphor of a Russian doll presented by Gummesson (1998: 55): a Russian doll consists of several dolls that fit one within the other. The situation for the stages of a concept design process is similar. The logics identified within a concept design process are visible in several places in the empirical material, since the logics in a manner permeate the stages. The research results presented in Chapter 5 are thus based on a holistic analysis of the research data.

3.3. Action research

The most notable difference between action research and traditional case research methods is that in action research, an observer becomes a participant (Ottoson, 1996) who with his or her actions strives to change the prevailing practices and create new scientific data through reflection (Ellis & Kiely 2000)[18]. Aaltola and Syrjälä (1999: 14–18) make an important observation when noting that *the result of action research is*

[18] There are several different views on roots of action research. According to Vinte (1994), the roots of action research lie in ethnographic research where researchers lived in foreign cultures. According to Demetrio (2000), however, the roots lie in Deweyan's pragmatism created in order to unite theory and practice. The term action research is often regarded as being coined by Kurt Lewin (Cunningham 1995).

not a certain course of action better than before, for example, but a process understood in a new manner[19]. According to them, the prevailing idea with action research is above all the manner of approaching a research subject, not a certain research method as such. Action research can be regarded as a loose research strategy approach which largely receives its content from its target. Action research may include features of many different research approaches. In addition, a research project may include characteristics of action research without being purely an action research study. (Heikkinen & Jyrkämä 1999: 35–55) Therefore, Tillotson (2000) states that there is no one single procedure that should be followed when performing action research. This study combines traditional case study and action research. Objective behind the first case was to create a basis for the action research projects to be realised later on. The essential objective for the realised action research projects, projects F and V, was to find new ways to work within a concept design. At the same time, the researcher strived to acquire new views about the concept design process which has not been extensively studied.

3.3.1. From observer to participant

According to Ottoson (1996), the fact that most of the information on public product development research has not been gathered until the end of the actual process is noteworthy. This means that a notable part of important information is lost in the process. Statistic study of reconstructed processes does not shed any light on how to create successful new innovations. In action research, a researcher participates in a complex psycho-dynamic and cultural process where there is continuous dialogue between the researcher and the research subject. It is extremely important for a researcher to be in the middle of the everyday process and live together with other humans participating in the process: thus, it is possible to note all the small steps that occur during the process. Humans have a notable impact on the final result of all projects despite the fact that in scientific literature humans have mainly been regarded as objects. Action research offers

[19] According to Westbrook (1995), the difference between a consultant and an action researcher is that the former is mainly interested in the final result, whereas for a researcher the process that leads to the final result is at least as important as the final result itself.

a unique perspective to product development which cannot be acquired any other way. (Ottoson 1996) Despite the fact that varying studies are conduced under the name of action research and action research may refer to a variety of issues, there is at least one trait common to all action research studies: *the basic principle is that those who have experienced a phenomenon themselves are the best candidates to study it* (DePoy & Hartman 1999).

Feurer and Chaharbagh (1995) have indeed discovered that understanding of the dynamic and complex process of creation and implementation of a strategy, such as the product development process, requires more than passive observation. It requires active participation in an actual process and a striving to create a more profound understanding of the 'hidden' variables. This is an important observation on the part of Feurer and Chaharbagh. When the research subject is a dynamic process advancing over time, the research methods must be adapted to the research target. Observation from outside or research questionnaires are well suited for solving certain kinds of research problems, but not for revealing the 'secret' behind a living process.

The first case studied, project O, was realised through participating observation. Despite the fact that the case revealed some issues, it was clear already when the case study was being written that many issues classified as important remained partially 'unravelled' despite an intensive period of five months of research. The researcher was unable to describe all the activities connected with development of a concept. The main reason was that some of the events remained outside of the observation of the researcher (e.g., phone conversations between managing director and pattern maker).

According to Ellis and Kiely (2000), lately, need for research methods that are dynamic and flexible and able to capture the complex and ever-changing reality has arisen. In action research, working with managers enables creation of profound understanding which cannot be achieved by more objective methods (Westbrook 1995). By being in the middle of events, a researcher hopes to acquire more information of a more profound nature than merely by looking in from the outside (Vinten 1994). Schein (1999: 10) notes that Kurt Lewin was right when stating that an organisation cannot be understood before

making an attempt to change it. This issue clearly came up in both of the action research projects where the objective was also doing things in a new manner. Crises experienced during the projects taught how important it is to be able to analyse a living development project in situations under pressure.

3.3.2. Degree of participation

According to Feurer and Chaharbagh (1995), the degree of participation by a researcher may be described with various levels:

- Supernatural development
- Empirical correspondence
- Direct observation
- Participating observation
- Action research

The first two items on the list above refer to a researcher describing and analysing the research subject without first-hand empirical observations. Data is collected via second-hand sources and new information is created through reflection or combination of data. In direct observation, a researcher strives to observe the phenomenon studied as accurately as possible without personally affecting it. In participating observation, a researcher has an active role as a team member or an observer of actions of a team. In the former case, a researcher performs tasks issued by the team but has no direct impact on how the group performs. In the latter case, a researcher creates understanding on how the team works. An action researcher takes participation one step further. An action researcher not only participates in working of a team but actively controls and affects the group's working method. (Feurer & Chaharbagh 1995.)

However, according to Feurer and Chaharbagh (1995), the possibilities of an action researcher to identify phenomena lying in the background are limited. According to them, a new definition is required in order to enable experimental work within an organisation

but at the same time retain one's independence in order to produce new information. They call this method responsible observation. *In this form of participation, a researcher does not become a member of an organisation and independence of the researcher prevents objectives of the organisation from overriding research objectives.* The role of the author of this study as researcher is best described by Feurer and Chaharbagh's definition of an action researcher. The primary objective of the researcher was not creation of new ways of working but critical analysis and interpretation of actions. Whereas the most important objective of a consultant is to create a successful final result, the objective of a researcher is to learn. This can also be seen in the empirical descriptions of projects F and V where several problematic areas have been introduced.

The concept of control creates an important aspect in action research. According to Avison et al. (2001), organisations rarely give outside researchers full authorisation in implementation of projects. Authorisation of the researcher in both of the action research projects included in this study was limited. Authorisation was limited in project F by, e.g., the administrative organisation as well as the project executive team and the guidance team. In project V, operations were significantly controlled by the ordering organisation.

3.4. Strategic product development projects

Product development represents core expertise of a company and mirror its expertise. It was difficult to find the first company to co-operate in performing of the empirical part of this research project and only the third company asked agreed to co-operate.

Project O was an interesting research subject in the sense that the company had been Finland's fourth largest furniture factory manufacturing furniture for homes in the 1980s but did not fit into the twenty largest companies measured in turnover in 1996. In addition, the factory is one of the ones with most tradition among Finnish companies and the history of the company includes successes of both design and commercial nature.

Depending on the classification method, the company can be described as a small or a medium-sized furniture factory. The size of the company is also presented in the research report. The questions arisen are in a certain way different than they would have been had the research been made in a large corporation, such as Isku or Asko. The size of the company was suitable in terms of the research questions, because large companies easily get trapped in their corporate structure and hierarchic distribution of tasks which was not an interesting issue to study from the perspective of the research questions for this research project. Based on a study by Tiensuu (1999), the company represents a fairly typical small Finnish furniture factory where the managing director is also in charge of designing new pieces of furniture.

Project F started with the objective of studying how a systematic and networked product development project can be implemented based on a customer-centred approach. The researcher transferred as a Project Manager for project F in the summer of 1999. The project included 11 small furniture factories mainly from the Finnish province of Päijät-Häme. Objective of the project was to produce scientific research information, increase level of know-how within the companies and create new products.

Project V began when a Finnish distribution chain had the need to create a so-called profile line. A decision was made to make the project similar to project F, because results of project F had been perceived as good. From the point of view of scientific research, the project was interesting, since compared to project F, it had a completely new dimension: an actual customer.

Each project represents in a certain manner an extreme example of product development in the furniture industry. The first case is an example of a furniture factory where the managing director analyses the market and has a central role in designing products. The case may be described as a project of very little information and tight restrictions. Project F can be described by plenty of information, pluralism and creativity. The amount of information and number of perspectives were larger in project V than in project O (less than in project F) and the role of control was more notable than in project F. Each case shows in its way how difficult it is to reach the desired objective. By analysing these

'extreme examples', the objective is to create an idea of the role of critical elements in a comprehensive designing process.

3.5. Gathering research data

According to Wolfe (1994), several different approaches and sources of information may be used when studying a product development process. These approaches may include e.g. financial situation of the organisation, strategy of the organisation (Dean, 1987), properties of innovation, organisational structure, resources, structure of business sector, dependability on outside groups, decision-making (Van de Ven & Poole 1989), social and political relations and internal processes within the organisation (Dean 1987; Dyer & Page 1988).

According to Marshall and Rossmann (1995: 78), the most important methods of gathering information for a qualitative study are 1) participation, 2) direct observation, 3) deep-probing interviews and 4) documents. All of the four methods were used in this study. The most important method of gathering information in this study was direct observation and participation and the views achieved through these methods were complemented by deep-probing interviews.

According to Van de Ven and Poole (1990), most studies have been case histories studying already occurred events which have been made when the final result has already been known. According to them, this invariably causes distortion of the research results. Real-time observation is the only way to understand how changes take place (Van de Ven, 1992). Since most of the data for this study has been gathered with real-time observation, one may assume that the process was described differently than it would have been described had the material been gathered by, e.g., a couple of interviews. In order to solve the research problem, the only choice was spending a longer period of time observing actions in practice. It was only this way that the concept design process could be described with an accuracy enabling analysis of the logics behind concept design.

Empirical data regarding the first case was gathered during five months spent in a company located in Lahti, Finland. During this period, the researcher participated in several everyday routines of the company, product development meetings, coffee table conversations and product reviews. In addition to this, the researcher conducted several specifying interviews with persons participating in product development in one manner or another. The interviews conducted were mainly open interviews or partially constructed themed interviews on product development of project O. The research objective was to find out what each person had done, who had made the decisions, in which order had issues occurred, why had issues occurred the way they had and what problems had been encountered. The deep-probing interviews lasted between thirty minutes to an hour. The view created by the deep-probing interviews was in most cases complemented by additional questions presented at a later date or by observational participation. The objective was to create an overall view and therefore, the researcher conducted interviews with several persons on the same issue.

The researcher specified his research subject within the company to one product development process (project O). The choice was based on two issues. On one hand, study of two or more cases with the accuracy desired would have been very difficult and on the other hand, due to the small size of the company only one notable product development project was ongoing. Despite the fact that the researcher spent five months with the company, many of the issues connected with concept design remained on a very general level. The reason was that the design process mainly occurred in the managing director's own 'mental world'. There were no documents in writing available for the process and as far as the researcher knows, the managing director conducted only a few conversations with the personnel. Emphasis of the empirical part lies in concrete events. Thinking had only a minor share.

Attitude towards an outsider observer was dual within the company. Attitude of the production side was especially in the early stages suspicious and the atmosphere was marked with a fear that trade secrets of the company would be disclosed to outside parties. However, their attitude somewhat changed over time as the personnel of the

production side noticed that the researcher already had fairly much knowledge about the product development project for furniture.

The most important participants in projects F and V were the researcher and the design manager[20]. Them observations and experience had a central role when writing the research report. However, all of the most important participants of the process were interviewed. The objective with the interviews was to offer other participants a possibility to reveal their views. Significance of the researcher's personal experience came up in that he was able to ask the 'right' questions which an outsider may not have been able to bring up.

Documented data was also available for both of the projects, but this data was not especially significant as comes to the research questions. The empirical parts of this study are a synthesis of the researcher's personal experience and the interviews conducted. The most notable challenge with the empiric data was limiting it. The cases in question lasted for three years (project F two years and project V one year).

3.6. Research background

Ainamo (1996: 86–87) notes that complete objectiveness is not possible and no researcher is completely devoid of ideological background expectations. According to Ainamo, each researcher has their own historical background affecting the way how they perceive issues or phenomena. Ainamo refers to his family working in a sector connected with his research.

In the same way, the author of this study has gathered knowledge based on experience via his family from the furniture industry. Father of the author has operated for several

[20] The design manager (designer in project V) had major role because in this way it was possible to create a story of two voice. From this perspective we took out the benefit of the fact, that the design manager/ designer had the ability of analytic thinking and responsiability of the creation process of the concept in both project (see Bond et al. (2004) about persons with significant role in the product development process)

decades in the furniture industry and they have conducted dozens of discussions on the issue. Therefore, the author's master thesis already dealt with product development of furniture in a company where his father operated as the upholstery department product manager being in charge of operations of the department.

Therefore, already in the beginning of this research project, the author had some knowledge of the furniture industry and product development thereof as well as the case company. In addition, he had certain preconceived attitudes. The conversational connection with, e.g., his father caused the fact that he never fell into the pitfall of the omnipotent power of creativity or got stuck in a fragmented idea of the nature of product development. It was clear from the very early stages of the research process that the research subject is a complex and dynamic process.

According to Aaltola and Syrjälä (1999: 11), science has been gradually formed in connection with practical actions arising from the questions, needs and practices therein. Practical problems stimulate the thinking process and making of observations as well as knowledge and questions connected with it are increased based on them. The first research case offered answers to certain questions but also created new questions for which answers were sought with the latter cases.

Kiviniemi (1999: 72) emphasises the fact that despite the emphasis on data, a researcher is not, even in the early stages of a research process, a 'tabula rasa', an empty board, with no perspective but instead the theoretical viewpoints and gradually conceptualised views on the nature of the phenomenon studied by the researcher, for example, partially direct the course of a research project. A study on the starting points of the Finnish furniture industry in the 21st century published by the author of this study in 1999 also affected the author's views on the problems in the concept design process. During the above-mentioned research project, the author found out that the largest problems in the industry were actions based on a feeling of 'I believe that...', i.e., based on what the participants feel, random nature of the process and inadequate co-operation with professional designers. In addition to theory and project O, these observations created an important aspect in realisation of projects F and V.

3.7. Dialogue between theory and empirical data

According to Dawson (1997), as examples of the 'real world', procedual case studies are able to tell a story of their own on advancement of changes. However, Pettigrew (1997) reminds us that the objective of process research is not to create a case history but a case study probing deeper than a case history. The first distinguishing factor is search for a process pattern. The second is finding a mechanism causing change. Thirdly, recognition of an inductive pattern must go hand in hand with deductive analysis. (Pettigrew 1997).

Glaser and Strauss (1967) were the first to present an alternative for deductive theory testing. According to Orton (1997), increasing number of researchers currently use an iterative 'grounded theory' in their research. This refers to a mix of deductive and inductive methodology. According to most researchers, research is a function of both inductive and deductive analysis (Orton, 1997). It is characteristic for a procedual approach to have continuous interaction between academic presumptions (based on previous research) and detailed empirical descriptions (Dawson 1997).

For the research questions of this study, previous research offered a fairly small amount of suggestions as to how the research project should be organised or what should be sought from the empirical material. Despite the fact that the author of this study had acquainted himself fairly deeply with existing research prior to beginning the empirical research stage, no accurate research plan had been compiled at that point. The intention was to let the empirical material 'speak'. The only guideline was the objective of studying advancement of the concept design process over time. The explorative strategy chosen was successful in the sense that the questions arisen from the empirical material have hardly been handled in scientific literature. Orton (1997) states that a researcher utilising the iterative grounded theory suspects a researcher who gives an accurate research plan of whether the researcher has posed questions that are difficult enough. Accepting academic presumptions when forming research questions may cause the researcher to fail to see the messages produced by the material.

Heikkinen and Jyrkämä (1999: 39) state that an action researcher may not necessarily even know in the beginning of a research project all of the questions that have to be answered during the course of the research project. Action research may discover unexpected reactions or problems that have not been observed before (Grønhaug & Olson 1999). According to Kiviniemi (1999: 69–71), one may regard action research as gradual conceptualisation of the phenomenon studied. The phenomena studied influence the existing theories and fields of phenomena to which a researcher must pay attention. He also states that gradual clarification of the research subject offers the researcher more suggestions as to which theoretical views he or she should use. Thus, a researcher strives to learn from experience and make conclusions that will help in redeveloping the prevailing theories (Avison 2001).

During the research project at hand it became apparent that the cases brought out several issues which could not have been anticipated based on theory. In addition, transfers from case to case also changed the perspectives of the researcher. E.g., based on existing research (Tiensuu 1999) and project F, it seemed that one of the basic problems in design management was the ability of a designer to design products suitable for the market in accordance with the limitations given, but project V revealed that in addition to the above-mentioned issue, securing a designer the possibility to aesthetic self-expression is important.

3.8. Research validity and reliability

Traditionally, validity of research has been evaluated using the following perspectives (Yin 1989: 40–41): *internal validity* refers to the possible impact of a third party, such as a researcher, on the findings, *external validity* deals with the question as to whether research results may be generalised to apply to situations outside of the cases studied, *structural validity* refers to operationalisation of the concepts used or ability of instruments used to measure the theoretical subject studied and *reliability* answers to the question as to whether someone else could reach the same conclusions with the same data.

However, Lincoln and Cuba (1985: 289–327) argument that the above-mentioned factors do not create the best criteria possible for measuring quality of qualitative research and present the following questions as the alternative approach[21]:

1. **Reliability**. How reliable are the research findings and with what criteria can they be evaluated?
2. **Generalization**. How high degree of transferability do the findings have (external validity)?
3. **Repeatability**. How can we be adequately sure that the same results would be acquired with the same research setting in the same context (reliability)?
4. **Objectivity**. How sure can we be that the results depict the reality instead of prejudices of the researcher?

3.8.1. Reliability

The first question deals with reliability of findings, and several tactics were used to assure reliability in this study. A general problem with case studies is the willingness of interviewees to offer socially desirable answers or answers that flatter themselves. With this research project, this problem may have been more minor than usually, since the researcher worked almost on a daily basis in the company for five months and was involved in almost all aspects of the action research projects. Therefore, there was little possibility to pad out the truth. According to Pettigrew (1990), it is possible by direct observation to find out what people tell in interviews as opposed to how the actually act. Therefore, one may assume that problems with product development have been better introduced than they would have been if the material had been gathered using some other method. The number of problems found does not necessarily indicate negative issues but more likely indicates the fact that the view adopted on product development activity in previous studies has been overly polished.

[21] For more information, please see Marshall and Rossmann (1995: 143–148)

For the data regarding the process, the method used in this research project was triangulation, examination of a phenomenon from several perspectives (Pettigrew 1990; Yin 1989; Glaser & Straus 1967). In project O, personnel from different levels of the organisation were interviewed: the managing director, the production manager, the main representative of the company's personnel working at the assembly line, the pattern maker, the manufacturer of veneer and the production planners. In addition, the empirical part of the study was sent to be checked by personnel of the company[22]. In project F, interviews were conducted with the head of design, the chairperson of the executive team and the three designers who were chosen for latter stages of the project. In project V, the designer and two members of the executive team were interviewed. Descriptions for the second and third case were checked by the designer (design manager) who worked in both of the projects. According to Marshall and Rossmann (1995: 143), a deep-probing description of data taking into account complexity and interaction must be valid. Alasuutari (1993: 29, 215) states that local explanation of empirical data is always the core of research:

> *"An explanation model must be as valid as possible in relation to the empirical material it is based on. Each explanation model must be coherent, have a logical internal structure and be backed up by as many clues as possible discovered via analysis of the data. .... A qualitative analysis requires an absolute approach unlike a statistical analysis. All issues treated as reliable and regarded as part of the data to be explained must be clarified so that they do not contradict with the interpretation given".*

The major problems as comes to reliability of results were questions about product semantics. Due to tacit information, analysis of product semantics (symbolic meanings behind a product) is dependent on the researcher. Therefore, interpretations may also be faulty.

[22] This is important because according to Kiviniemi (1999, 77–78), an analysis of material and compilation of a research report can be characterised as a personal construction of the researcher on the phenomenon studied, and the researcher should offer room for interpretations and views of other participants in the research report.

3.8.2. Generalization

Usually, generalization of results is regarded as a problematic area in qualitative research. According to Alasuutari (1993: 205), the problem can usually be solved by the researcher striving to show that the analysis tells about something else than the data. Alasuutari calls this proportioning. The term refers to a striving to proportion the results as parts of more extensive unities (Alasuutari 1993: 210–211; Marshall & Rossmann 1995: 144). According to Alasuutari (1993: 209), the research subject generally chosen in qualitative research is a phenomenon in which generalization is not a problem whereas the essential issue is explanation of the phenomenon, making it understandable. The objective of this research project was making concept design a understandable unity. This can be achieved by describing concept design and identifying the logics therein.

According to Alasuutari (1993: 203–222), a study may present assumptions as to which extent a local explanation is valid as a more general explanation model for other phenomena in real life. As comes to external validity, a researcher may refer to a theoretical frame of reference and introduce theoretical research parameters based on which the possibility of generalization may be evaluated (Alasuutari 1993: 217; Marshall & Rossmann 1995: 144). This is the reason why the results presented in Chapter 5 have been evaluated by comparing them to previous research. However, previous research has not described the project from the perspective of second generation process research. In addition, process logics is a fairly unexplored field of research. Therefore, it is important to pose the question as to what is the level of generalization of results received in one company or how can they be adapted to a more extensive field?

A possibility to solve this general problem is a method described by Leonard-Barton (1990). This method includes comparing of results of one deep-probing case study against other case studies: can the findings be confirmed by other studies? Despite the fact that this method enables generalization of findings by a single researcher, Leonard-Barton reminds us of the problems connected with it: one must choose cases that can be sensibly compared to other cases.

A study by Tiensuu (1999) included interviews with five (5) notable Finnish designers (Matti Halme, Risto Halme, Mathias Ingman, Ilmari Lappalainen and Kimmo Varjoranta). The interviews mapped issues that came up in this study, e.g., problems encountered during the process. Based on the interviews with the designers and the cases in this study, one can argue that the elements in a product development project are the same in companies of all sectors but the manner in which these elements are handled depends on the situation in question. However, there are differences between sectors, and the model developed in this study cannot be applied as such to product development in other sectors (cf. e.g., significance of packaging in the sector in question).

Similarities can be found from the field of sports. Lactic acid will be secreted in the legs of each 400 metre sprinter in the final stretch but their bodies, however, react to the lactic acid in their own way. The stages of a race are the same for all 400 metre sprinters and all of the sprinters will have lactic acid in their system on the final stretch. However, the way in which their bodies react to the increased amount of lactic acid is individual, depending on the practicing methods they have used. Each sprinter is subject to the same physical laws but at the same time each of them is an individual unity consisting of physical properties. Eskola (1994: 42) has come to similar conclusions in his research:

> *"However, laws and rules are not perceived to define actions in a mechanical way. Quite the opposite: an individual or a participant takes the law and rule into account based on a logical system... relations between actions, law and logics can also be analysed by studying how a law is taken into account depending on the actions with the same logics."*

And what is the situation if a certain sector of product development has not been taken into account (e.g., needs of customers)? The situation is still the same as in a 400 metres race. Even if a runner is not aware of the significance of 'lactic acid enduringness' and has failed to prepare for the race with practicing methods that increase tolerance of lactic acid, the increased amount of lactic acid in the final stretch will affect this runner all the same. The situation is same in product development. E.g., if chain of distribution has not been taken into account in a product development process and products not suited for the distribution chain have been developed, this spells trouble (for more information, please see, e.g., Välimaa et al. 1994: 17).

3.8.3. Repeatability

The third item deals with reliability of research, i.e., whether the results presented for a study could be repeated should the research be conducted again with the same methods. According to Uusitalo (1996: 25), a variety of research projects can be conducted with the same research subject and even the same research problem depending on the researcher's interests, point of view and methodological approach. Research findings can be confirmed, but it is likely that other kind of results could be found from the material as well. Results are largely dependent on the target of the researcher's interest and the 'spectacles' he or she uses when interpreting the material. It is clear for action research projects that projects would have proceeded in another manner had they been managed by another person and the results would have been different.

3.8.4. Objectivity

The fourth item deals with objectivity of research. According to Van de Ven and Huber (1990), a long-term process of gathering information increases some of the inherent weaknesses of field observation methods:

> *"If you sense a social system, you are a part of it. If you are a part of it, you will affect it. If you affect it, you will not be able to observe the system in its natural state and can only report of a disturbed process".*

According to Pettigrew (1990), in addition to being a technical operation, research is a social process but a researcher should not, however, become 'overly socialised' and 'go native'. However, Marshall and Rossmann (1995: 145) ascertain that 'immersion' to a situation offers a researcher the possibility to hear, see and experience reality in practice in the same way as any person. Therefore, Dawson (1997) further notes that when researching a phenomenon, there is no other alternative than to 'get one's hands dirty'.

The view of the relation between knowledge and reality assumed by Pettigrew is called naive realism. This kind of pattern of thought is dualistic in the sense that knowledge and

a knowing subject are assumed to be two separate things. This so-called Cartesian dualism was the ontological basis for science in the positivistic period. (Heikkinen & Jyrkämä 1999: 46–49) According to Quigley (2000), ever since the statement 'knowledge is power' uttered by Francis Bacon in the 18th century, a certain type of knowledge acquired from certain sources has been regarded as more important and correct than other knowledge. Therefore, in many connections, action research has been defined as an approach that is dependant on values and is subjective. Action research questions the ideals of objectivity supported by positivistic science. Traditionally, scientific knowledge has been regarded as an objective depiction of reality which is basically the same regardless of whom analyses it. In research, this pattern of thought has become concrete in the researcher's persona being muted somewhere in the background where it cannot be seen. Here, action research is different in its starting points – it studies reality with the human context in mind and takes into account construction of social reality as a historical process where researchers and the horizon described by them is one factor to be taken into account. (Heikkinen & Jyrkämä 1999: 46–49) It is obvious that the results of this study have been coloured by the 'spectacles' worn by the researcher.

The researcher tried to consciously reduce the possibility of his own preconceptions affecting the research results by using certain techniques. In order to verify the observations made, the material gathered was partly analysed in co-operation with the interviewees and during the interviews, the interviewees were asked whether the researcher had understood what they had said correctly and often additional questions were asked. Deviating from the traditional objectivity of a researcher, Lincoln and Guba (1985) emphasise the question 'can the results be verified by others?'. According to Marshall and Rossmann (1995), that way they transfer the emphasis from evaluation of the characteristics inherent to a researcher (objectivity) to evaluation of the material. Thus, the qualitative criterion is formed by whether the material confirms the findings and leads to implications. The cases that are the basis for this study have been described as accurately as possible in order for allow room for evaluation of 'objectivity' of the results.

4. EMPIRICAL RESEARCH DATA

The empirical material of this study consists of three independent product development project (see appendix 3). In the first project (project O) the challenge was to develop a new bookcase for a small furniture factory. The project was managed by the managing director of the company with selveral participants, a trainee designer, a pattern maker and a production manager. Empirical data was gathered during year 1997. During this time the researcher participated in everyday routines of the company. In addition to this, the researcher conducted several specifying interviews with persons participating in product development in one manner or another.

The second project (project F) was an action research project, where the researcher worked as a project manager. The project was mainly a training and development project. The purpose was to introduce new ideas to SMEs in the furniture sector. The main challenge was the attempt to systematize the concept design process. During the project 3 product families were also produced. The project was planned by the researcher and the head of the Institute for Design Resarch. The project were implemented during 1999–2001.

The third project (project V) was also action research project lead by a finnish retail chain. The challenge of this project was to find out how to manage a new product development project with retail chain. The project produced one product family. The researcher worked also in this project as a project manager. The project was planned by the researcher and the designer of the project (the design manager of project F). The project was implemented during 2001–2002.

4.1. Project O

Products complying with the idea of a chequered pattern consisting of squares that was the basic idea for project O have been in the international market for the past ten years.

However, the idea has landed in Finland only in the past few years. The first project O was a traditional bookcase consisting of squares with no drawers or other accessories. In order to create a more personal look, however, a variety of complementing parts were designed, such as drawers and doors with intarsia patterns as well as coloured background boards the size of one square. The background boards also supported the structure of the bookcase and offered consumers the possibility to create a unique product for themselves, since the boards could be placed in any part of the bookcase. In addition, glass doors with frames were manufactured for the bookcase. However, since according to the company framed doors were mainly favoured by more elderly customers, a glass door without frames was also designed for younger customers.

In addition, a space for a television set was also desired in the bookcase. There was discussion within the company as to whether customers would like to place their television sets in a bookcase or on a separate television platform. Finally, the company made a decision to use a cabinet with a rolling door for a television set enabling both options, since the cabinet with a rolling door may be used as separate platform for a television set and a VCR or be included as a part of bookcase O. The latter solution, however, caused notable changes to be made in structure and appearance of the bookcase.

The most important issue when designing bookcase O was the possibility to manufacture it as far as possible with the company's own equipment as large series in order to keep the price reasonable. Another important factor in designing was appearance of the bookcase: dimensions, wood quality, veneer and colours as well as combinations thereof.

Reseach stage

The following is an analysis of the factors affecting definition of product properties for project O. The managing director's view on the properties of the product were influenced by several factors interacting with each other. These are described in Figure 10. However, instead of information received by research, the analyses were made by the managing director who had the main responsiablity of design.

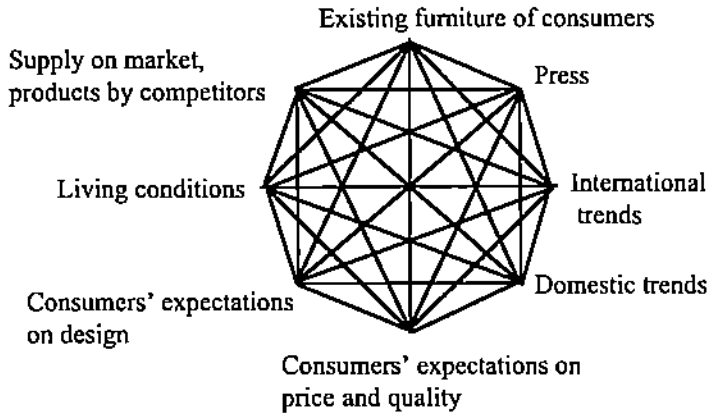

Figure 10. Factors affecting managing director's view of the market.

Strategic questions

After having been transferred to a new owner, the company was experiencing a notable transformation process. According to the managing director, the company's essence and its future would be defined in connection with development of the chain of distribution and product selection. The strategy was to control development of products, the chain of distribution as well as advertising and development of image in a centralized manner so that the company, its products and image created thereof would correspond with each other. The responsibility for development of the unity lay with the managing director:

> *"Anything to do with product strategy, the image, has to be basically created by me. I've got to do it, I can't let anyone else do it."* (managing director)

The owner and managing director of the company wanted furniture manufactured by the company to be of high quality and in the higher price categories which referred to continuing the company's tradition of a traditional strategy focusing on quality. One reason for this was that the company was renowned among distributors and consumers as a producer of this kind of furniture and the managing director perceived that there was demand on the market for this kind of furniture. Notable increase in turnover was not included in the short-term strategy of the company.

The strategy chosen caused some problems. In the 1980s, production equipment not necessarily suitable for production of less than 100 pieces had been acquired, and this number of pieces was fairly large given the demand for fairly costly products of the company. Therefore, the company strived to create a general cost level as low as possible and the organisation was reduced by completely deleting so-called mid-level management and by reducing the capacity problems by standardising the product line. It was perceived that this way business could be made profitable even with notable production undercapacity.

Market situation

The company competed in the higher price segment especially with K Oy. In addition to bookcase F, competitors of project O included imported Portuguese and Spanish bookcases which were very similar but more affordable in terms of price than bookcase O. In addition, the competition with these imported bookcases was increased by the fact that they were sold in stores of the company's most important single retailer.

Needs of customers

When designing bookcase O, the company's managing director based his views on a couple of basic assumptions about the nature of the market. According to his view:

> *"Behaviour of consumers has changed after the depression. During the depression they used to buy cheap products, coated with melamine, manufactured abroad. Now they might want quality, more pronounced appearance. When financial resources and their minds have changed, they'll rather buy a product of better quality instead of a cheap one and spend a little more money".*

The strategy of the company as comes to studying customer preferences was to display the products in adequately many stores and later on gather feedback from retailers.

> *"Product development cannot continue if products haven't been launched in adequately many places and adequately many answers to different questions and comments from customers gotten. We need to study behaviour of customers, find out what sells and what doesn't. At present, project O is displayed in two or three stores only. It's hard to say anything about bookcase O. First send products to the stores and then salespersons after them."* (managing director)

The method used in the company when mapping customers' needs was mainly due to lack of means of mapping. The company had difficulties in acquiring relevant information about the needs of customers and the attitude towards market research on consumers was reserved. For example, in the autumn of 1996, the company ordered a market research with final consumers as the target group and the consensus was that the company received little benefits from the research. Information received in an artificial interview situation was perceived as unreliable and was suspected to lead product development astray. Thus, the company saw it as sensible to mainly follow the company's own views in product development. The managing director emphasised this:

> *"Product development stems from needs in the sense that we have the need to use our machinery, acquire turnover. On the other hand, people need furniture. Where can we make these needs meet. We've got retailers as well with halls and space in their stores for good products and the need to turn the products into money."*

Target group

Another assumption about the market was that customers within the chosen target group were presumably living spaciously and thus the products were quite large in size. The target group of project O was chosen based on strategy and traditions of the company, the managing director's view on the market and his personal preferences. Price level of the product was perceived as largely decisive in terms of prospective buyers. Thus, the price level of the product was defined based on a classification presented in a business sector report by the Finnish Ministry for Trade and Industry (Kauppa- ja teollisuusministeriön toimialaraportti 1996) as high and mid-level (top part) price segments. The perceived target group was educated and well-paid customers.

Trends

Designing of the bookcase was affected by trends prevalent in both Finnish and international market, especially those in the furniture trade fair in Milan, which were studied by the company. Hints as to in what direction the Finnish market could be headed were sought from international trade fairs. Colours for bookcase O was an idea imported from abroad.

Distribution channel

In project O, the relation between the company and the distribution channel was dual. On one hand, the company strived to find a distribution channel that would fit its strategy. A project of mapping retailers was started within the company with the objective to create a distribution network supporting the company's high-quality image. After mapping and careful consideration, certain co-operation partners were chosen for the company in the spring of 1997.

In the designing process, the company strived to take into account the demands of the existing distribution channel as well. When information about a need was received from the single largest retailer of the company, the feedback immediately affected development of the bookcase. In practice, this meant taking a new bookcase height into production. The responsibility for gathering information on the market was borne by a sales representative and his or her ability to find relevant information was important. This required a change in the tasks of the sales representative and the skills required from the person performing the task.

> *"Sales of furniture is not just about selling but also gathering information, chewing and analysing it and distributing it to the factory. The factory should be able to receive the information and take actions required. The less intermediates we have, the more correct information we'll receive."*
> (managing director)

As of such, sales representatives had not been able to distribute the necessary information and sales representatives had been replaced quite often. Therefore, the managing director took gradually more responsibility for customer relations. The problem with queries directed to retailers was conflicting nature of received information. Therefore, the company pondered which parts of the information received to use in product development.

> *"When you organise the information in the right way and are able to use it in the right way, by understanding what's essential so that it won't lead you astray instead... but to whose whistle do we jump if a customer from Juupajoki* (a small Finnish town), *I mean a retailer, complains about some product, informs us of a need and then we really begin to design things here based on that comment, then somebody might ask how much has this retailer in Juupajoki sold. Then we find out that he actually hasn't sold anything in two years. But we begin directing our product development based on some random bit of information anyway."* (managing director)

Production

Productional limitations had a notable impact in guiding design of the product. The production system of the company was such that round forms could not be created which notably limited design of the product. The tools left for the managing director were choice of dimensions, materials and colours and combinations thereof in order to acquire the desired result. Needs of production guided design in other ways as well. The objective was:

> *"for it to be manufactured with the current production equipment as far as possible, in large series. This automatically means that the price will be reasonable."* (managing director)

Purchasing

One factor affecting the price of bookcase O was purchasing. During product design, management of materials was an important element, since the share of materials costs of the price of the final product was notable. By changing the veneer supplier, the share of

raw material costs was reduced from 45% to 30%. In addition, veneer quality was increased which improved the bookcase's competitive ability as comes to price and quality. There were certain problems in designing the product because components available had not been mapped and there was no knowledge of which kind of parts, from where and at which prices were available. Lack of information about various component alternatives (handles, legs) slowed down and hindered development of the bookcase.

> *"Product development is raw work, one must know the materials and components as well as where they are available. Purchasing is very important."* (managing director)

Creation of product concept

Despite the fact that during the designing stages of project O, the company strived to evaluate what kind of bookcases persons included in the target group were looking for, the product was developed starting from the viewpoint of production. Since other manufacturers also offered bookcases consisting of squares, the company sought for ways to differentiate the product. The company strived to defeat the competition and find a market slot for bookcase O by differentiating products of the series with intarsia patterns and trendy coloured background boards (please see chapter on definition and concretization of product properties).

The solution consisting of elements chosen for bookcase O enabled its expansion when needed and creation of a variety of assemblies. By combining the different elements in various ways, the bookcase could be turned into several bookcases differing in appearance and size that could not immediately be recognised as the same bookcase (e.g., simplified versus decorative style). Therefore, bookcase O was potentially able to satisfy needs of a variety of consumers.

Despite the fact that the managing director had some kind of a view on what the finished bookcase should be like when the designing project for bookcase O began, the development process was somewhat bouncing in nature. Plans for adding, e.g., doors and

drawers to the bookcase were presented from the very beginning, but problems in their instalment suggested that the solutions had not been thoroughly thought out. Thus, bookcase O was developed step by step based on what seemed good after each version.

> *"When we were manufacturing bookcase O, we suddenly came up with the idea of doing something like that and changed it and manufactured it again."* (production)

A trait very well describing the actions was travelling the road of trial and error. According to production:

> *"there are so many new models that we don't have time to think them over thoroughly".*

Feasibility of solutions was tested in practice by manufacturing a variety of prototypes. The experiments regarded both technical solutions and appearance. Technical development of decisions made by the managing director was left to production. In practice, this lead to the need to make many changes to many technical solutions later on which caused delays in launching of the product.

The continuous changes made to the product caused problems in production as well: figuring out technical realization for the new solutions as well as continuous changing of production adjustments slowed down the product development process and incurred additional costs. In addition, the size of production series could not be defined due to the continuous changes which led to the fact that the lead times promised to retailers could not be met.

> *"Time and resources have an impact on how systematic our actions are."* (production)

The process leading to definition of product properties is difficult to describe, since specification of the properties largely occurred in the mind of the managing director. The managing director's view on the market, future visions for the company and possibilities of production affected definition of product properties.

> *"Of course I get influences from the environment all the time. They are created somewhere in my subconscious mind or based on some external stimuli and then I make decisions based on them. And then there's all the information I see and hear that must sit well with what the company is able to do with the equipment we have and still be profitable and that's pretty much it."* (managing director)

Based on products developed, the managing director was fond of fairly large and sturdy furniture which also affected design of bookcase O. Originally, bookcase O was fairly large and sturdy. As comes to its form language, the basic bookcase was a simplified product stressing the vertical façade. Due to the intarsia patterns, in latter stages of the development process, bookcase O could be regarded as a fairly ornamental bookcase and the new structural solutions enhanced the horizontal façade. Despite the fact that technical possibilities were taken into account on a general level when designing the bookcase, design solutions guided the process.

> *"Technical solutions are the production department's problem. There are two people responsible for production there plus A, that is three people who are in charge of product calculations, raw material issues and product development."* (managing director)

In the early stages of product design, a trained designer was also involved. The most important task of the designer was to define the colours to be used in the bookcase. Later on, the employment agreement between the designer and the company was terminated and product design was mainly left to the managing director. The idea of putting legs under the bookcase was entertained many times. Therefore, the designer created several alternative sketches for possible legs. The managing director, however, made a decision to discard the legs because they 'made the bookcase look like an elephant on high heels'.

The most central issue in designing bookcase O was development of the basic frame (dimensions). Everything else was constructed on this basis. The important factors considered were price, appearance and productability. All of these factors affected each other.

> *"A basic frame and alternatives based on it. We must test and then test some more."* (managing director)

> *"Appearance and price are important. No unnecessary machining requiring unnecessary work."* (pattern maker)

Concretization of product properties

In the case of project O, concretization of product properties mainly referred to the pattern maker starting to implement the views of the managing director by creating concrete bookcase versions. When a new prototype was finished, the managing director usually wished to change the product in some way.

> *"The managing director has supplied ideas and I've implemented them the way I see fit. Then I've shown the product to the managing director and gotten comments and manufactured again. If there is more work, I'll draw pictures so that the others know what to do. I dimension it to the picture, put in places of holes and then it goes to be lacquered or dyed and then to assembly. Everything's in my head according to what I draw. But the managing director finally decides what we'll do."* (pattern maker)

Production manager described the process as follows:

> *"The managing director explains to the pattern maker what he wants and the pattern maker begins to mould the product, and then he gets together with the managing director to see whether the result is what was desired. Then they change it again."*

The form of the bookcase had changed as the managing director had evaluated it in real conditions, i.e., vision of the desired final result had been specified when he had been able to perceive a visually concrete product. Since realisation of the bookcase did not correspond to the managing director's view about the desired result in the beginning, several prototypes of the bookcase were manufactured. Changes were also made while the pattern maker was working. In addition, changes were made when the view of the managing director about the desired result was changed or when certain solutions proved to be too difficult to realise technically. Concretization of product properties also referred to definition of structural solutions required for the product. They defined the way in which the bookcase 'stood'. Simultaneously, several colours were tested in the painting shop.

> *"We've been creating it little by little. First we had one complete frame which we began to shorten and lengthen. We made different heights of bookcases as we saw them finished. But that's the way it's always been for the 15 years I've worked here. It starts from a little idea that we change and then we create the final result."* (pattern maker)

> *"Few people have the ability to perceive what a product looks like in the flesh. Even experienced designers have the same problem all the time. The faster we make a prototype, the surer it will be changed. The second proto is usually close to the objective. It's mainly a question of dimensions."* (production)

Since the danger in product design is becoming blind to your own work, it was perceived important in the company that several persons evaluated the results in various stages of the process.

> *"Your eye gets used to something and the longer you look at the product, the more bearable it becomes. This adds to the number of miscalculations when you can no longer tell whether a product is good or bad."* (production)

Product properties

Dimensions and structure

Definition of dimensions had a central role in creation of the product's visual appearance. For project O, the dimensions had an especially central role, since the basic bookcase consisted mostly of straight boards and their dimensions.

> *"Bookcase O is a simple model, so there's not much to it."* (pattern maker)

> *"Appearance comes from dimensions and most of all from veneer and colours. The quality of wood and colours. It's created by their combination."* (managing director)

The prevailing idea behind bookcase O was it being a strong and sturdy bookcase. The reason was that according to representatives of the company, many bookcases on the market lost their posture over time and the shelves bent under the weight of books. The

objective was to achieve adequate sturdiness of the bookcase by using a structure consisting of squares and fairly thick (25 mm) shelf boards. When defining size of each square in the bookcase, it was perceived important that a size A4 office file would fit inside the square in terms of both height and depth.

The dimensions chosen (thickness of boards) caused problems due to use of chipboard thicker than normal. The problems were caused by so-called fluffy chipboard which is created when the rough chips inside the chipboard are not pressed tight enough when manufacturing the boards. 'Fluffy' is usually gathered around the edges of a board and this phenomenon is most common in thick boards.

Vertical height of the bookcase was based on a 32 mm drill division used in production of the company, and the drill hole division played a part in definition of the height of the entire bookcase as well as dimensions of doors. The reason behind using the drill division in question was the objective of making production costs as low as possible. The dimensions were defined based on what looked good in the eyes of the designers (managing director and pattern maker). The bookcase was manufactured in three different heights.

> *"The bookcase was dimensioned for a division of 32 mm, that is the division used in our drills. It is full of holes with a division of 32 mm, that is the heights were chosen because having the same division makes manufacturing all of our doors and drawers easier. The dimensions are largely based on that issue. That was done in the very early stages. After we finished the frame, we began to design the doors. For height, our starting point was that with this division and where the side of the case is cut off so that it is roughly a good height."* (pattern maker)

The original dimensions planned for the bookcase had to be changed when the company found difficulties in using hinges:

> *"In the first prototype, the hinges didn't fit into our line of holes. We had to move the line of holes by 10 mm, and all of these issues must be taken into account in placing the holes so that hinges and shelves fit and everything matches."* (pattern maker)

Later on, the appearance of the bookcase was changed by the need to fit in a television set in the bookcase. Placement of a television set to the bookcase very radically changed the original product concept. Due to the television platform, the bookcase was developed instead of the original idea with squares towards a more 'normal' bookcase with long shelves. The company decided to use a solution of rolling doors where a television set may be 'hidden' behind doors if necessary. Later on, a cabinet 10 cm wider was included in addition to the original narrow cabinet for a television set in order to make room for larger television sets which are more common nowadays. This required implementation of yet another shelf width.

> *"When there is a TV set in every house, I guess it's the first thing you must be able to place in your bookcase. And where to put it. If you put it behind a door, the doors will always be open and poking to some direction. If the door mechanism is the kind that goes inside the frame, it is a extravagant mechanism which will never work properly. So, quite naturally we come to the conclusion that since rolling doors have been used in office furniture for 20 years already, I guess it's a natural solution."* (managing director)

Problems in defining product properties were due to reconciling design objectives and manufacturability. The managing director had decided that the bookcase would not include any so-called level solution where the shelves and long vertical sides are on separate levels. Due to factors connected with appearance of the bookcase, the managing director wished the shelves to be on the same level with vertical boards in the same way as with shelf T. This had apparently been possible with hand-made shelf T but the same accuracy could not be achieved in serial production. The fact that boards travelled on production lines for distances of up to 200 meters caused problems, because even the smallest of differences in cross-measures or warping of the background boards would push the shelves outwards. When shelves were pushed outwards, it detrimentally affected the appearance of the bookcase and retailers had given negative feedback about the issue. Thus, the issue in question had to be rethought.

> *"Technical solutions and appearance slap each other on the side of the head."* (production manager)

The problem was solved by adding more shelves in order to keep the vertical and horizontal boards on the same level. Finally, bookcase O had ten different sizes of different shelves depending on whether the shelf would include a door and a background board, a door or a background board only, neither of the two or the same alternatives with two widths of cabinets with rolling doors for television sets. With these decisions made, the company was able to achieve the objectives as comes to appearance. However, at the same time production control became much more challenging due to the large number of parts.

Material

A decision was made to use genuine materials of natural colours for the series O without any etching. The use of etched wood was to some extent perceived as fooling customers. However, use of unetched surface veneer often caused problems due to 'tanning'. Unetched veneer will become brown when exposed to direct sunlight causing changes in colour which may be embarrassing especially when only some of the shelves are exposed to sunlight.

Due to the unetched veneer, the factory also had difficulties in delivering buyers shelves of exactly the same kind they had seen at the retailer store. The problem was especially caused by cherrywood veneer which often formed a so-called pyramid pattern. These patterns are different in each piece of veneer. A buyer would, for example, order a bookcase without the pyramid pattern from a retailer and receive one with a pyramid pattern instead. The pyramid patterns could have been covered by etching but the managing director did not wish to use that alternative. The objective was to stick with 'authenticity' of material. The problem was more notable with cherrywood veneer than with other materials, since the appearance of the pyramid patterns (inherent to cherrywood veneer) could not be anticipated in advance and in some cases the finished bookcases could even look ugly. On the other hand, the pattern brought an original touch to the bookcase, since other manufacturers do not offer products with similar patterns.

> *"We went with the idea that we won't dye anything to look like cherrywood, beech is beech and cherry is cherry."* (managing director)

The objective was to differentiate the products from those of the competitors, since only a few domestic manufacturers used authentic materials in their products. E.g., most of the bookcases sold as cherrywood are actually dyed beech. The idea was to choose a material differing from those used in other bookcase series of the company as the material for series O: bookcase V was manufactured of beech or birch. Shelf N was manufactured of beech. The major material chosen for bookcase O was cherry:

> *"It must be co-ordinated so that the same kind of veneer isn't used in all products. Instead, we must try as many materials as possible and learn from them all."* (managing director)

The materials chosen for the bookcase were both light and dark wood: cherrywood, mahogany and oak. A version manufactured of beech is also being designed, since beech has been a very popular material in the past few years and the company thinks that consumers wish to complement their current furniture with products manufactured of beech.

> *"But what to choose in addition to cherry, that's interesting, now we went with the dark end to mahogany, to the light end to oak, we might as well have chosen to go from the idea that the light end is birch or ash, and the dark end teak or whatever."* (managing director)

Intarsia pattern

In the opinion of the designer, the bookcase was not sufficiently differentiated from other similar bookcases and thus, so-called intarsia patterns were used in order to make it more unique. The production designer crated a sketch for the patterns but the pattern depicted was very hard to produce. Therefore, the veneer maker further developed the pattern on his free time. Due to his work, the veneer pattern used in the bookcase was created. The surface veneer pattern of the bookcase looks like a star, a heart, a shamrock or a butterfly. Formation of the pattern depends on the direction to which the veneer is cut and what kind of a

pattern there is on the veneer. The patterns were mainly created by mistake. However, a professional is able to find suitable pieces of veneer beforehand. The problem with serial production was that the pattern to be created depends on the quality of the veneer making conscious production of a certain pattern difficult. Serial production of a bookcase with intarsia patterns was problematic in other ways as well, since there was only one person within the company who is able to make the patterns, and when this person fell ill, for example, production had to be completely stopped.

Coloured background boards

In addition to the intarsia pattern, the appearance of the bookcase was differentiated from other bookcases by adding a few background boards the size of one square which supported the bookcase at the same time. The background boards were red, blue or grey in colour. The colours were chosen by the managing director. The basis for the choices made was estimated applicability of the colours to a variety of interior decoration solutions as well as to the other parts of the bookcase. Gray was perceived to be a trendy colour and the other colours were perceived to give some colour to otherwise grey homes. Several meetings were held in order to define the colours to be used, and representatives of production sometimes participated in these meetings in addition to the managing director and designer. The colours were chosen by using colour charts from which the colours most pleasing to the eye of the managing director were chosen.

Handles

It was difficult to choose the correct and suitable handles for the different kinds of doors used in the bookshelf. The pattern maker had developed several versions of handles: round ones, ones with knobs, short ones and grooved ones suitable for the glass doors without frames. None of the alternatives were perceived as good enough. In the first stages, short wooden handles manufactured of surplus wood were installed in the series O television set cabinet with a rolling door. The hole division of 32 mm used for the

bookcase made finding of suitable handles difficult, since English and American models using a different system of measurement had to be eliminated from the alternatives to be bought ready-made. The handles had to be chosen from European ones. The handles suitable for the cabinet with a rolling door were pondered as follows, for example:

> *"The managing director, the person responsible for production and I went to the production facilities to look at the first ready-made series of the bookcase's TV cabinet with rolling door. We were wondering about the handle and its position. We wondered whether the cabinet with the rolling door should have one wide handle or two separate ones. One small handle was out of the question because the handle had to be used to raise the entire rolling door. With two handles, the question was how to place them. At the same time, we were thinking that if there'd be only one larger handle, it'd have to be a part of the product so that it wouldn't look like a separate handle. We came to the conclusion that we can't save money with the handles and handles in a piece of furniture falling in this price category must be in sync with the price."*

An especial problem was finding handles suitable for the doors with intarsia patterns. Regardless of size of a handle, it 'broke' the intarsia pattern and seemed 'unnatural' in a visual sense. Currently, the doors are completely devoid of handles and instead equipped with a pump device which opens the door when the correct spot on the door is pressed. For the pump feature to function correctly, its counterpart must be installed in the correct place. This may cause problems in the future with consumers. Thus, the final opening mechanism for the doors has not yet been found.

Bookcase delivered in parts or ready-assembled

The company pondered whether to assemble the bookcases at the factory and deliver them ready-assembled or whether to deliver them in parts. Assembly at the factory would have diminished the number of reclamations but this alternative was nevertheless discarded, since it would have required a new vertical board in addition to the one already in the bookcase to support the bookcase. Appearance of the bookcase would have been changed and the change would have caused additional costs and the company was reluctant to transfer the additional costs to the price of the product.

Therefore, a decision was made to make bookcase O a bookcase with as few parts as possible so that customers would be able to easily assemble it themselves. Starting in the designing stage, the company strived to place themselves in the position of a customer and to make the bookcase as simple and as easy to assemble as possible. Assembly of all of the products was also tested at the factory:

> *"We must make it such that even a person who hasn't seen it before is able to assemble it."* (pattern maker)

Co-operation

Product development within the company was at the same time both tightly controlled by the managing director and collective (Figure 11). The managing director personally controlled the process by working in co-operation with persons responsible for production and the pattern maker who carried out the ideas suggested by the managing director and also revised them. The pattern maker, in his part, worked in co-operation with both the persons responsible for production and units connected with production (veneer-makers, pressing, carpenters, painting and lacquering). Final decisions were, however, always made by the managing director:

> *"Somebody has to take on responsibility and be the authority. There has to be a dictator who as an autocrat dictates what's to be done. If everybody starts to design bookcases of their own, we'll soon have 14 different bookcases. It's a good thing that there's been nobody else who wants to interfere with product development in the same way as me. What comes to product strategy, the image, that's basically for me to create. There must be a person who co-ordinates this thing*".

The company's product development network of sorts consisted of the following: the pattern maker coordinated technical development of the product by gathering information on the possibilities for and limitations to various work stages from manufacturer of veneer, press operator, carpenters, painters and lacquerers. He mediated the acquired information to the managing director who made the decisions.

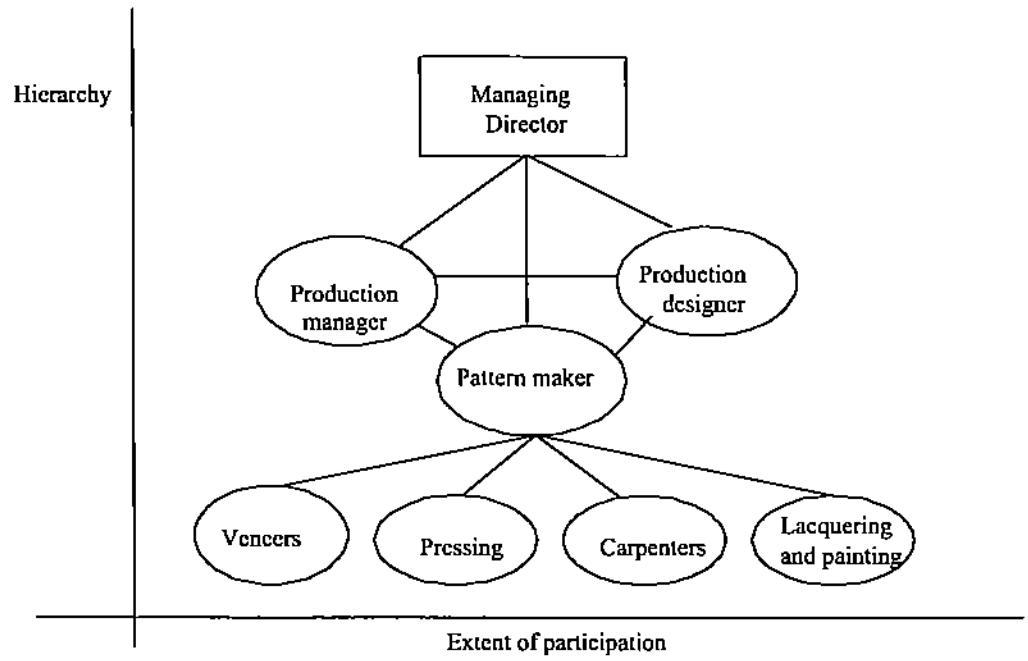

Figure 11. Collectiveness and control in product development.

A notable part of technical development of the product occurred at so-called grass root level despite the fact that the managing director made the final decisions. According to the managing director, different work stages for products should be planned and developed where they were manufactured. The managing director operated as the manager of the development process integrating information from various workers and making decisions based on the information.

Results of product development

The result of the product development process is a bookcase system with modifiability as one of its essential properties. Due to modifiability and the visual objectives, the number of parts needed became quite high (cf. number of shelves) causing problems in production management. The factor separating the bookcase from other products on the market is the customer's possibility to choose coloured background boards or drawers

with intarsia patterns for the shelves. Special properties include opening mechanism of drawers and doors. Doors have springs attached to them and they will open when a certain point is pressed. Due to the modifiability, the company basically sells three different bookcases under the product name O. According to the company, sales of project O has started almost as expected. In addition, the bookcase participated in a competition arranged by a Finnish interior decoration magazine Avotakka where the best piece of furniture of the year was selected being the third and thus being the best board product.

4.2. Project F

Project F was a training and development project for the furniture industry with a concrete objective of creating one or more product families to be launched on the market. Project F was planned by the Institute for Design Research in the autumn of 1998.

The project was planned to last for two years, starting in the spring of 1999 and ending in the spring of 2001. The project started in June 1999 when the project was presented to companies from area of Päijät -Häme. After the presentation, companies willing to participate enrolled in the project. The project was actually started in August 1999. The most central ideas behind the project were introduction of new ideas to small and medium-sized furniture industry companies and promotion of networking of companies both in product development and in marketing. The project was mainly realised using method 'learning by doing', i.e., new methods were learned during an actual product development project.

Objective of the project was to go through with the companies a concept design process as systematic as possible. Another objective was to reduce possible risks leading to failure during the process. Planning of the process was mainly based on conclusions made based on the first case study as well as a reviews of scientific literature on the issue.

The objective of training was to create an attitude of readiness to view product development from a slightly different perspective than before. The most central issue was increasing level of abstractness. Based on conversations conducted, products were studied in the companies on a very concrete level. Thus, materials, colours and dimensions were studied. There was little talk about product design. The important element in training of the project was launching of the concept of so-called mental quality. Thus, the purpose of product development is to gather information that consumers are able to understand and that 'rings a bell' when they see it. This was also essential in terms of successfulness of the project, because it was perceived that one cannot operate with concrete concepts like materials or dimensions when it comes to one or more product families. Instead, one must find concepts on a more general level to describe the entire product family. This concept of a more general level was the quality of design.

The most important task of research made in the early stages was to predict what kind of quality of design consumers were expecting. The next task was transferring this information into the form of a product specification for designers to work on. It was also important to find a way to transfer the information mediated by the specification to a designer so that the designer would not only understand what it was all about but also internalize the message of the specification.

Excursions abroad were an important part of the project. During these excursions, the participants familiarised themselves with cultures of foreign countries and the products produced in these countries as well as the manner in which foreign competitors presented their products. This was an important part of the project, because from the very beginning one of the project's objectives was to get into the international market. In addition, it was of paramount importance to study why foreign competitors continuously increased their import to Finland. The third reason for the importance of the excursions abroad was the fact that the furniture industry globalises at a fast pace at present. Due to financing conditions of the project, it was not possible for the designers to participate in these excursions. During the project, visits to trade fairs in Köln (twice), Milan, High Point (United States) and Singapore were made. The significance of the excursions abroad was introduced by the following comment, for example:

> *"My opinion is that the reports about the excursions abroad were very important. It is true that all of the participants in the executive team fluently discussed these issues and what they should be. And the terminology was actually developed within the executive team and partially with these factories so that we were talking about the same issues. I'm positive that without the excursions, the companies would not have had enough belief in the project, because they would've thought that the language used is too difficult from the very beginning to the finish."* (design manager)

Research stage

The project was started with extensive research briefly described in Table 3. The objective of the research was securing that starting point of product development was customer-centred and content was created for the product specification to be handed over to the designers. In this project, the research stage was especially significant, because small and medium-sized companies of the sector have not used much information in their actions. The connecting thought with the research was striving to study the phenomenon simultaneously from several perspectives in order to secure that the project was advancing to the correct direction. This stage was realised mainly by the project manager, although he received assistance from personnel of the Institute for Design Research.

Table 3. Project F research arsenal.

Research	Research description
Analysis of timeline	Development of Finnish and Italian design during the last thirty years was studied. Research material consisted of interior decoration magazines from both countries. Research objective was to compare the relation between Finnish and Italian design as well as anticipate future trends.
Focus group interviews	The research project utilised group interviews in which brands of competitors were studied using projective methods as well as different pieces of furniture used in normal homes were reviewed. In addition, experiences of consumers on use of furniture and living at home were studied. Design expectations of consumers were also probed.
Analysis of distribution chain	Research objective was to map views within distribution chains on strengths and weaknesses of current products as well as listen to views within distribution chains about products in the future.
Analyses of Swedish and German markets	Objective of these analyses was to map special properties of and similarities between the markets in question mainly in terms of design, materials and colours.
Quantitative research in Finland, Sweden and Germany	The research was realised with approximately 450 consumers in three countries. Partially, the research aimed at securing qualitative research results as comes to brand identity, part of the research consisted of questions about concrete product properties.
Research on segmentation	A graduation thesis made by a student of Lahti Polytechnic with the objective of studying whether life situation or age correlate with buying.
Furniture industry trade fairs in Köln and Milan	Product selection of both trade fairs was systematically studied and a summary of current and future trends was made based on the product selections.

Choice of designers

Seven designers were chosen for the project during the spring of 2000. Designers were recruited by the design manager and the project manager. When developing a designer profile, the most attention was paid to future talents, despite the fact that more experienced designers were also included in the group. The project was presented to designers as an invitation competition of sorts with the best three qualifying for the actual project. The exceptionally large number of designers was due to the fact that risk of failure of the project was to be minimised, i.e., in all likelihood at least one designer out of seven would succeed.

"When looking back, it's true that the choice of the first designers was extremely important for the project. We had to be able to choose the correct types to be briefed in order to achieve results, if you don't have strong knowledge about know-how of the designers so that you'll be able to simply choose them directly." (design manager)

"It was interesting because there were old experienced persons and then less experienced and then completely new ones. Differences between sexes were very clear, that is men made it more like their own and women used a more soft approach which proved to be the better approach in further studies." (chairperson of executive team)

Product specification

The product specification stage lasted for approximately two months. In order to compile a specification, the entrepreneurs were divided into three groups, since based on previous experience it was believed that 11 people is too large a group for this kind of work. The specification was prepared in groups of four or three. The project manager was in charge of managing the groups. Each meeting was carefully prepared beforehand. In practice, the specification was produced by a small group consisting of the project manager and the design manager. There were several reasons for this approach, the most important being the fact that the entrepreneurs participating in the project were not very skilled in working with others and the result was often a uncomfortable silence. Another reason was the fact that the entrepreneurs did not necessarily possess the know-how needed in order to interpret research results. Thirdly, they were not used to creating a specification for a designer. Fourthly, the entrepreneurs had great difficulties in viewing creation of a specification from the perspective of project F or brand F. All in all, one can state that creation of a specification in co-operation proved to be extremely difficult.

"No, no, we can't do it. I consider it to be an extremely difficult task. If we think that we make a briefing which defines a rough division as to in which sector we want to be and then we start to make more subtle work, then we're talking about quite delicate and small issues and those people aren't used to talking this language. They'll see it as much more roughly divided issue, that is they lack the ability to deal with the subtlety. That's why there should be professionals doing it in reality, as was done in the end." (design manager)

> *"These factory owners wanted to always understand issues from their viewpoint, that is from a productional viewpoint and based on their personal opinions of what it should be like."* (design manager)

Here, product specification refers to a written definition of a product concept compiled in order to direct designers into a certain direction. In a manner, the specification created the limits inside which the designers had to work. One may estimate that 95% of specification content was more or less based on research conducted previously. The objective when creating the specification was to create one suggestion despite the fact the project objective was creation of three product families. The reason for this approach was the fact that the executive team felt that sketches to be made by the designers would in any case notably differ from each other despite them being made based on the same specification. The specification consisted of the following items:

a) Three fourfold tables describing positioning of brand F
b) Photographs describing target group (one A3 sheet)
c) Pictures describing feeling of the brand (one A3 sheet)
d) Core of brand
e) What we are doing
f) Brand description utilising projective research
g) Definition of quality of design and feeling for product family
h) Definition of concrete product family properties

The first fourfold tables describing placement of brand F were created as early as in the autumn of 1999 when approximate guidelines for the product development project were sought in a training session. The dimensions of the fourfold tables were created by the project manager, but the entrepreneurs defined positions of competitors and themselves. The guidelines were further specified during the spring of 2000, but no notable changes were made.

An item used in the specification was visual material divided into two sub categories. Objective of the first category was to describe project target group using pictures. For this purpose, the project manager gathered a variety of photographs of persons possibly

belonging in the target group from magazines. In the end, there were approximately 60 photographs. The project manager and the design manager limited these to approximately 25 possible options of which the entrepreneurs chose five by voting. After preliminary voting, group discussions were conducted on each photograph. The other category was designed to define feeling of the product family using special pictures. These pictures were chosen in the same manner as the photographs described above.

The core of the brand was difficult to define despite the fact that certain aids formalising the searching process were used. The objective was to define the core of the brand with one or at the most two sentences. This was done because the more compact the form in which the brand could be described, the more crystallised the brand objective would be. Finally, a decision was made to describe the core of the brand with two sentences supporting each other. These sentences were coined in co-operation with the entrepreneurs.

The objective for brand F was directly taken from previous research which showed that there was a clear need in the market for a certain type of brand.

The brand was also described by projective methods designed in order to offer the designers a broader idea about the essence of the brand. In the same manner as above, this description was almost completely based on previous research.

Definition of quality of design for the brand or its feeling was the most important and at the same time the most difficult part of the briefing despite the fact that research offered a notable amount of desired words for this sector as well. This item was based almost completely on the focus group interviews.

Concrete product properties were the last item of the specification; the executive team wanted to leave this as open as possible despite the project manager's dissenting opinion. The underlying reason for the decision was that the executive team did not wish the designers to get stuck in a certain detail. Instead, during the entire process, importance of the product family feeling was stressed to the designers. In addition, it was perceived that

the time to work with concrete product properties would not be until the pattern model stage. An objective of the specification was to adequately guide designing to the direction perceived as correct by the executive team, but still leave room for creativity of the designers. Based on a decision made by the executive team to which the project manager issued an dissenting opinion, the research used as the basis for the specification was not shown to the designers at this stage. There were several reasons for this decision: it was feared that the information would be mediated to outsiders from a group this large and the executive team was of the opinion that too much information would only confuse the designers.

> *"The briefing offered outlines and those who understood them correctly would no doubt be able to reach it with their own personal touch, that is we weren't being very strict. We gave the general outline as to for whom to create the product. This means that based on the offered briefing, the fact to whom this was meant was quite well realised despite the fact that we gave them freedom of creation."* (chairperson of executive team)

> *"The normal way to offer a briefing for a task is to give a brochure or brochures of a ready-made product and say that this is the feeling we want. Let's change something here, develop it so that it is suitable for us. But that's not the right way to do it. A new product line, so that they are really new. In that case, the briefing must be such that the verbal expressions or some graphs offer the correct image of it. When you're creating unities, you can't describe them with concrete product properties."* (design manager)

It had been stated in several connections that the briefing method used was new and unfamiliar to all the parties included. The reason behind offering more profound work instructions than 'usual' was the fact that according to research made by the project manager (Tiensuu, 1999), one of the problems within product development in the furniture industry is specifically connected with assignment of tasks. According to designers, entrepreneurs are unable to offer a proper definition of tasks and according to entrepreneurs, designers do what ever they please despite being given instructions. The consensus was that the created specification was good which was probably partly due to the fact that the entrepreneurs felt that they had been able to participate in its creation. The designers, in their part, were happy with the fact that they felt the briefing to be a thoroughly thought out unity based on research.

Comments on the briefing:

> *"This was a whole new way of briefing a designer. The briefing very well described our objectives. The objective chosen was very close to it and what was interesting was that you could do two versions of it, that is U and V. R was in a way a sideline for the whole thing, it was a kind of extension of the project which wasn't much affected by briefings or anything.*[23]*"* (chairperson of executive team),
>
> *"I think the briefing was very thorough. Some research had been conducted beforehand. There were facts and then the pictures. In my opinion, it mediated pretty well the feeling that was desired. And all the other basic issues, starting points and objectives and I think it was well though out beforehand. And the persons who had created the briefing seemed to be aware of what should be done, all in all it was a good starting point and I had a good feeling when starting work."* (designer A),
>
> *"It was very different compared to all briefings I'd received before but it gave a good impression of what was desired. The target group was quite well defined. We didn't have any complaints, it wasn't too strictly limited."* (designer B) and
>
> *"All in all, I found it interesting to start this project, because I felt the issues were well thought out... I think it was good that we really begin to make a frame of sorts and not just start from images that it would be nice to have something like that."* (designer C)

Most of the designers felt that the specification offered them tools in order to start their designing. According to designers A and B, the single issue within the specification that most directed their work was the feeling – and the target group photographs.

> *"Maybe the mood, the pictures about the feeling and the feeling they depicted. That was after all the most important thing and maybe even the hardest part of the work to create the feeling."* (designer A),
>
> *"I think the pictures affected the most. The atmosphere, the feeling, and that's what I basically used as my starting point."* (designer B),
>
> *"The use of pictures was all right. They were maybe a little bit unorganised in that it was a bit loose at that stage, that suddenly we're seeking a nice pleasant atmosphere on a general level which of course is one objective but the setup could've been more accurate."* (designer C)

[23] U refers to designer B, V to designer A and R to designer C.

> *"I think the pictures set them off to the right direction but I could say in the very beginning that if we look at the people who saw it, the manufacturing factory owners didn't necessarily understand it. They probably didn't need to but they didn't fully understand it. There're very few who are able to understand it."* (design manager)

When creating the specification, one of the most important objectives was creation of a coherent unity, i.e., the objective was for different parts of the specification to support each other. The objective was to create some sort of an overall impression for the designers when they had read through the entire specification. This was of significance because the specification was constructed in a way that its different items complemented each other.

> *"All of it created the unity, they can't be used by themselves or else it'll be incomplete."* (chairperson of executive team)

Already before the briefing was issued, the executive team pondered how the designers would understand it. The executive team was afraid of the fact that people interpret information in very different ways. This was the major reason as to why the briefing was offered in the form of a competition to several designers.

> *"The research showed the way but the interpretation was nevertheless always personal. That's why it should include a graph or a picture or something with a possibility to choose from those that clearly answer the question, that is go back to creation of the questions which is of paramount importance."* (design manager)

> *"All in all, one problem when creating the briefing was that there were maybe too many qualitative words or what are they called and we did eliminate some of them. The meaning of qualitative words can be interpreted in different ways. If we talk using terms, a term can be interpreted in may ways and besides, there isn't even any common vocabulary and that makes it difficult to work up it. I believe that each and every designer that received this briefing interpreted it in their own way yet again."* (design manager)

The designers approved for the actual project seemed to have caught the idea of what the project was aiming at after their initial puzzlement. Designer C needed more views from the participating companies. This aspect had been mapped in the early stages of the

project but the executive team was reluctant to include it in the briefing so as not to confuse the designers with too much information.

> *"It was difficult for me to understand it in the same way. It was difficult in the beginning. But when I began to understand what was said, it was easy from there on."* (designer A),
>
> *"I didn't have any feeling of not having understood."* (designer B) and
>
> *"I needed more views from the factory owners or somehow more views from the manufacturers, that we are used to doing things this way and we do this that way and not at all because I would've had to commit or gotten stuck to it but quite the opposite. Just to think it from the viewpoint of what would be the next stage. What comes next."* (designer C)

A factor affecting development and further elaboration of the specification was the excursions abroad during which at least views of the executive team on project objectives were specified.

> *"A notable thing affecting the briefing were these excursions that supported the notion that the briefings offered."* (design manager)

Testing and choice of first sketches

When the first sketches were finished, first reaction of the executive team was that of relief. There were clearly potential suggestions included. After having given the specification, two training sessions had been offered to the designers where they had the possibility to present more questions. However, designers A and B only participated in these sessions. This caused a certain degree of worry with the project manager and therefore, he phoned the five other designers in order to ask whether they had a clear view of what they should do. All designers assured they had a clear view of what to do.

Three of the sketches were computer-generated, the rest were hand-made. The first party to evaluate the sketches was the project executive team which estimated sketches by

designer E to be far too 'elegant' and 'tight' compared to the specification[24]. The computer-generated sketches by designers D, F and G were evaluated as being quite far from the feeling of the specification. Nobody was quite able to get a hold of the sketch by designer C. The sketch by designer B was evaluated as fairly commercial and the sketch by designer A was evaluated as being superior to the others.

> *"Our starting point was, after all, that we made the choice based on whether the person is able to picture a large unity and to create the feeling for the unity. That way, we'll end up with more concrete product development where we get some meat over the bones. This first stage could've been more vivid and only create the warm feeling or the image. If we look at this as a unity, the basis for the choice was a bit difficult in the sense that we automatically eliminated even quite adequate works based on the presentation method and tightness of the presentation."* (design manager)

> *"If we look at the designers, I think we eliminated those designers who are technically or functionally oriented. They hadn't been able to see and interpret the idea that we're searching for something else entirely. They were trying to invent a new perpetual motion machine."* (design manager)

> *"Some of the designers didn't listen at the briefing at all but instead did what they wished and were eliminated. Those who listened to the briefing and understood it, because the briefing was not traditional, succeeded better and were chosen for the continuation."* (chairperson of executive team)

> *"You could clearly see who had understood the briefing and who hadn't. And for those who had, their sketches were positive surprises."* (chairperson of executive team)

When the process continued, the concepts were presented to the entrepreneurs as well. The designers personally presented their work. After the presentations, the works were evaluated. Based on these evaluation methods, two sketches were perceived as better than the others (concept A and concept B). The evaluation concentrated on commercialism of each concept and how well the concepts corresponded to the feeling of the specification. In addition, designers A and B were the only ones who participated in the 'training sessions' organised in the spring of 2000 where possible questions by the designers were answered and objectives of the product specification were further specified.

[24] Later on, it became apparent that the designer in question had practically left the product specification unanalysed.

The product concepts were tested in Finland, Sweden and Germany in August of that year. The size of the sample was approximately 550 persons. Objective of concept testing was to produce information to support decision-making. According to research results, product concept A was clearly superior to the others in all countries. Product concept B was as clearly the second in all countries. As comes to the rest of the concepts, there was plenty of distribution. What is notable is success of concept D in Germany. This concept had been labelled as masculine by the executive team. Further analysis showed that most of the persons who had opted for the product concept in question were male.

Based on the research and opinions of the participating companies alike, concept A had clearly 'won' the competition. On the same grounds, concept B was clearly the second option. As for the third concept to be chosen, the situation was difficult. Here, after long conversations and thinking, the executive team saw it best to suggest concept C to the companies participating in the project despite the fact that it did not receive much support in the research and evaluations of the entrepreneurs on the concept were not very positive.

According to the executive team, evaluations received by concept C were essentially influenced by the presentation method of the concept which was evaluated as weak and unfavourable for the products. However, the executive team saw some potential in the concept and therefore, concept C was suggested as the third concept. In addition, the concept was evaluated as being suitably different from the other two concepts chosen. In addition, the third concept stirred a lively discussion about whether a third concept is required at all and whether belief and resources of the entrepreneurs will be adequate for development of a product family to whom nobody actually believed in as of yet. According to the opinion of the executive team, the decision was justified in the sense that a group so large required many product families in order for everyone to have a product of their own in the future and the product family was expected to develop to a potentially profitable direction in the latter stages of the project. In addition, the concept's new and fresh approach to interior decoration and living pleased the executive team. Companies participating in project F approved the executive team's suggestion as such.

> *"Actually, I wanted the third one, because the two works chosen were so conventional. And I guess I could see inside R's work better than many others. And that's why the choice was clear to me. Being familiar with the field, that is these manufacturers, I'd say that the more 'rustic', the more cosy, they would choose it based on that only. It's like they aren't listening at the briefing at all. And that's the reason why I wanted the third one."* (design manager)

> *"I think that's the most problematic situation when everybody tries to solve these, make choices based on their own images and not necessarily based on the briefing. If you aren't necessarily familiar with the language of the briefing, how can you make the choice? And that can be seen already in many stages of the project, the fact that entrepreneurs always think of these things from the viewpoint of their companies which isn't bad since they are entrepreneurs".* (design manager)

> *"Then there was the fact that you could see among the manufacturers that they weren't sure of what they were looking for themselves but then there was the briefing you gave me and it showed there."* (designer A)

> *"I think the choice was in accordance with the information given because we did base it on research results one of which were the manufacturers and one were the consumers and that was a pretty easy choice. Only one was a bit more complicated. It was actually pressure from the part of the design manager that affected and it was the only one different in the way that it used the original briefing."* (chairperson of executive team)

Despite the original reaction of relief of the executive team as comes to the sketches, the consensus was that not even the concepts chosen had quite hit the bull's eye.

> *"If you were to evaluate them really roughly, not one of them was actually an answer to our question, that is the feeling. None of them was right on the spot."* (design manager)

From a scale of 1 to 10, designer A scored her own work as comes to similarity to the briefing as 8.5. The design manager scored Designer A's work as an 8, the chairperson of the executive team as a 9 and the project manager as a 9+. Designer B scored her work as an 8, the design manager as an 8.5, the chairperson of the executive team as an 8 and the project manager as an 8.5. As for designer C, the design manager gave the work a 9+, the chairperson of the executive team a 1 and the project manager a 7+. Designer c scored her work as an 9-. According to the project manager, the work by designer C was a good

answer to an important issue in the specification but completely ignored another important issue.

> *"9 for A, 8 for B and 1 for C."* (chairperson of executive group)
>
> *"9+ for C, because it had depth that I spotted right away. 8.5 for B and 8 for A."* (design manager)
>
> *"I think 8.5 is good in the sense that it left me a good feeling. And looking at it in retrospect and evaluating the entire process, there's that, that's why it wasn't as high as it could've been. I get like the feeling that I can't do the kind of pictures they were looking for."* (designer A)
>
> *"I'd give it an 8. They were looking for new kind of elements for homes and then something other than a sofa, an armchair and a table. That's why I couldn't find a natural alternative. The traditional kind with an armchair and a sofa. The sketch, I think the feeling was pretty well realised there. I could even give it a 9 but I wouldn't give a 10."* (designer B)
>
> *"I was pretty satisfied, I'd imagine somewhere in the range of 8 to 9, but closer to a 9. Maybe in retrospect with the criticism I guess I received, and there was the thing that it wasn't understood after all, maybe it should've been a bit more accurate and I don't know, more specific... That maybe I concentrated too much on the feeling. There should've maybe been some details too."* (designer C)

Despite the fact that the purpose with the product briefing was to guide the work of the designers to the desired direction, it seems that personal desires, style (personal touch) affected the result as much as the briefing.

> *"I have the view that despite the fact that the briefing clearly asked for a feeling defined with various tools, the designer's own desires and habits were more important, that is bringing in their own view overrode the briefing unfortunately almost completely with those who didn't participate in either of the further briefing sessions."* (design manager)
>
> *"I think there's maybe 60% of my own and 40% from the briefing."* (designer A)
>
> *"When I draw, I create a different feeling. My personal touch shows quite strongly in it. Of course the briefing had a large impact on what it became. I'd say it's fifty-fifty."* (designer B)

> *"Yeah, both affected of course but what was the relation? Personal touch, well in a way that because I wanted to specifically start from that I tried to seek it I understood it in the briefing in a way that the first sketch was mainly to search for the feeling. And then I let my personal touch specifically show because that was from my viewpoint the way that I used to express the feeling but, well, the basis was specifically the briefing that they wanted a home and warmth and feeling. I feel, like, I feel that the division is really even but maybe it's anyway that way around that, help, no my own personality shows in it quite strongly that maybe it overrides the briefing as a kind of an initial spark that let's say 40—60 or something like that, 35—65."* (designer C)

The concepts chosen supported each other well in the sense that they were very different from each other.

> *"I think it's pretty descriptive that we had one that was a bit more romantic and then we had one neutral one and then one a bit more modern. Now we're talking about the most recent x (in the briefing we're making) and my opinion is that the overall look of x corresponds best with R's work."* (design manager)

Concept development

Further development of the concept took place in the autumn of 2000 in such a manner that by the beginning of October each designer had to give their version of expansion of the product family to other parts of a home. In addition, the designers had to draw so-called manufacturing pictures for each product based on which factories would be able to manufacture pattern models during the spring of 2001. Deadline for work of the designers was the end of the year 2000, since the objective was to present the product families as manufacturing pictures to the entrepreneurs in the beginning of January 2001. Working was made more difficult by the fact that the creator of concept C moved temporarily to the United States and had to discuss the work with the design manager via e-mail.

In order to develop the concepts, two workshops of two days were held with the two designers in Finland and the project executive team. Based on previous experience, a larger group was considered to be too difficult to manage. A design manager who was a

member of the executive team was named as the person in charge of design with uniformity of design for each product family and their development to their final form as his responsibilities. During the meetings, the product specification was reviewed, discussions on colour world and design for the product families were conducted as well as results of the excursion to a trade fair in the United States were reviewed.

> *"I'd go from the idea that if we have an extensive process like this that lasts for almost two years, we can't tie all of the participants in it because it is... Well, it's such an extensive project that that's an impossibility. That's why we need the executive team."* (design manager)

There was disagreement within the executive team as to how the group should prepare for the workshop, what should be done during it and how the workshop actions should be organised. The major problem with the workshop was lack of a united view within the executive team about the direction into which the product concepts should be developed. Therefore, 'mixed messages' were sent to the designers which caused puzzlement among the designers.

> *"The significance of the executive team lies in it having a clear vision of what we're doing and implementing realisation of the original briefing during the entire process. I think it included a designer, a researcher and a manufacturer. Then we may ask whether that was too many people anyway. The more men were involved, the more conflicts were created. In my opinion, the weakness of the executive team was that it had too many members. There were too many people giving advice on the issue and then there's the other thing that the executive team should've had a much clearer distribution of responsibilities as to who does and what."* (design manager)

During the workshop, many discussions on possibilities for mass production and the requirements set by mass production for design were conducted. Based on these conversations, a decision was made to use parts of the same length as comes to board products in each of the product families. This decision was thought to assist in achieving a so-called correct price. This issue was deemed important because the products in question would be manufactured by one factory. Thus, the number of products required by mass production could be achieved. The prevailing idea was to construct all board products in each product family based on the same frame so that the look characteristic to

each product family could be created by a so-called change of faces. However, the executive team feared that the products would become too similar should the dimensions be the same. The advantages offered by mass production, however, were deemed as an objective worth the risk. In addition, it was perceived that by the so-called change of faces each product family could be differentiated as a product of their own even with the same frame dimensions.

> *"So, I began to create a plan of rational production which meant that the frames of container products would be modulated so that we'd be able to achieve simple structures. This had no impact to R and neither to U. The most notable impact it probably had to work of V."* (design manager)

Despite the fact that all of the designers were initially opposed to the idea of modulation, it caused minimal changes to work of designers B and C. In retrospect, the work of designer A suffered most from standardisation of certain dimensions causing, e.g., deletion of a product that had been included in the original sketch which had been perceived as an extremely interesting idea by the entrepreneurs.

> *"The fact that they didn't fit well with the basic format, that was unfortunately the whole point of the idea. We deleted it with our own work. We made them too similar. It disappeared completely when it didn't fit into the unity and it was quite funny and I'm sure would've been fantastic when realised. The thing is that the views of the manufacturer were far too overpowering here. Maybe the idea of being able to produce all three lines with the same basic structure was too ambitious. Maybe we should've given a little more freedom. Originally, we had very good objects which we spoiled ourselves with this decision. That is, they didn't have enough freedom to make their own lines, we set too many limitations. "* (chairperson of executive team)

> *"For them to be manufactured as mass production meant that we had to make them fit into the same scale and with the same frames, all, U, R and me. And well that thing I think I deleted it myself. It didn't fit into the dimensions offered by K anymore. And on the other hand, they no longer fit into the feeling, they still fit into it after the first stage but not after the second, but maybe I destroyed it myself anyway."* (designer A)

> *"It was a very difficult idea for me that there were three different furniture series chosen and then the dimensions should've been forced as the same. I think it was extremely difficult but then it seemed it went quite well when*

we struggled with it for a while. That's what we both of course wanted, to retain our personal appearance, we didn't want to let it go." (designer B)

"I don't see anything bad with the modules... But I think we could've made it more clear at some stage, that now it was a bit distracting, this accurate idea of making all the listings now. I don't think it influenced the form a lot. But it did bother, it made me tired so that maybe I could've gone deeper in some other area, it didn't actually have an impact on the design language but maybe the details." (designer C)

When discussing design in the workshops in autumn of 2000, the group had some problems. Each had slightly different views on how the concepts should be further developed. The factory owners stressed importance of issues dealing with manufacturing and introduced their views. The project manager strived to underline the spirit of the specification and the research results leading to the specification as well as how the concepts should be developed in order to make them more accurately correspond to the specification. Work of designer A especially inspired a variety of opinions. After long conversations, the designers stated that they were quite baffled as to what they should do. Finally, the executive team reached a decision to give the design manager the responsibility for this issue.

"When you argued and lots of ideas were presented and then when I wasn't quite sure as to whether I'm on the right path. That whether I'd gotten the idea of what they want, that had I understood it in the same way. I don't know whether this was due to me or due to the creators of the briefing." (designer A)

"Well, of course I had a slightly conflicting feelings then". (designer B)

"Actually, we needed to specify as to how to concretise the plans based on the image drawing. And we tried to analyse them like what do these mean, these various gadgets and products. And this lead to at least V getting so many different instructions on how to make the cabinets. I mean clear instructions on to draw like this and then they're good. There was this stuff here and that stuff there and U fluently passed the whole issue." (design manager)

"There were so many people explaining things there that this reorganisation occurred after Tampere after which I was given... I got angry then when I asked who does who's in charge of design here? After that I was given the authorisation. For those final models, well there were a hundred and one people giving advice as to how it should be. The

> *executive team also lost sight of what we're doing, what the briefing had been. And there were strong dissenting views as to how to do it. In any case, the situation was out of control in the sense that there were too many people giving instructions."* (design manager)

> *"There were too many opinions at play. That is, the so-called fine-tuning stage of the model development wasn't successful in my opinion. There were too may opinions at play and for example V took the approach that she had 200 drawings when she came in and she put them all on the table and they were just becoming worse than the original. She'd been listening to everybody's opinions. She listened to every word we said and then she tried to make changes that pleased all of us. In some stage we decided that K should take care of designing, design management, since none of us had adequate training in designing in order to see straight."* (chairperson of executive team)

The problems were mainly due to the fact that design of furniture is extremely detailed work and even the smallest of changes in 'tuning level' of a product may completely change the feeling of the product. Thus, management of the design process was extremely difficult.

One of the major problems during this stage was the fact that the parties spoke different languages and used different terms.

> *"The researcher and the designer or designers speak quite different language from that of the manufacturers. The terminology used is completely different and I suspect that this the world of designing is completely different. That is, the world of images the designers use is completely different than what happens inside their heads. That must be one of the mysteries. "* (design manager)

> *"There's one thing that it isn't an order, you must think what others are trying to communicate and then apply it to your own plan in the right way. Whether the manufacturer understands why he couldn't get his idea through. But a designer can't work like being ordered instructed thoroughly what to do and draw like this. That is, information is communicated using different methods and you must be able to use it in the process in the right way. This is actually the problem and it is not an easy job.* "You could say that weaknesses of the project may have been lack of briefing for the designers and lack of co-operation." (design manager)

> *"I think the role was mainly that I was a translator. That is, I listened to what others had to say and then I actually said to the girls when the boys had left that this is what they meant but you must now use your brains and apply this information. That for god's sake don't do exactly what they told because they aren't designers. This was my role and I drew clarifying graphs or something so that they would understand what we were talking about."* (design manager)

Despite the fact that the product families were based on the same task given (the product specification), the executive team saw unique traits in each product family. One of the most important tasks in this stage was considered to be differentiation of the product families. Concept B was considered to be a clear Scandinavian product family where nothing more than fine-tuning in order to find the correct feeling was needed. As for concept C, clear traits of the feeling prevalent in an interior decoration store called R.O.O.M., located in the centre of Stockholm, Sweden, were seen and thus the executive team gave the designer clear instructions to further develop the product family into a 'Roomish' direction. Most problems were met with concept A despite the fact that the product family in question had been by far the most popular in the research conducted. Objective of the executive team was to develop concept A into a sort of romantic product family where richness of design and a certain nostalgic feeling would show. Working name of the product family was 'American Pie'. The executive team desired to attach to the product family certain influences received from the trade fair in the United States, because the executive team felt that these traits would offer new kind of additional value to Finnish customers.

> *"If we're talking about the rough classification under which we must work, the fact that we make a division to three clearly separated from each other within this rough pipe, there's the degree of difficulty. The fine division is difficult and then we use these working names in order to manage the unity which in some way describe what's in it."* (design manager)

> *"I'd go with the fact that all of these fit within the briefing given. And the fact how big differences we'll be able to make with them, that's a difference large enough for me for these factory owners to also understand what it's all about."* (design manager)

> *"The feeling after the very first sketches and even after the work was done was that the fear, in my opinion, was that these are too close. And our*

problem was that them (designers A and B) *were too close and R was so far away. And now due to the trade fair trips and others, this distribution was created and it was approved by everybody. This V became warmer and richer, U remained the same and R's work got... Let's say that the first picture about the feeling wasn't understood by everybody but I think that it was realised based on the picture in the latter stages and the degree of warmth in the picture came out too."* (design manager)

"Well, it had a quite radical impact to my part. Well, first of all, I didn't feel good when you were so romantic like Americans. Then we started to go for this massive romantic feeling and I didn't have that in it at first. And then I kind of understood you too literally, there was miscommunication. But the furniture became softer and maybe a bit more nostalgic and romantic the whole series anyway and I think it was too traditional. Well, they irritated me a lot at first. I didn't want to create a new series from the beginning, I couldn't do it based on the old one but I had to make it more massive and change the colours a bit. In a way, I had to do it all over again. But despite the fact that it irritated me a bit, I was able to get along with it and got inspired as well". (designer A)

"I was very happy with it (the R.O.O.M. definition) *because... I'd say that the Swedish kind of way of making the sort of straight-forward design to be used by real people and that's good about R.O.O.M. and Swedish things in general and actually I was really happy about the comment and I knew you'd understood or if you'd started to call me American Pie I would've been very worried about the direction you're trying to make me go or that you hadn't understood me."* (designer C)

With designer A, problems were caused especially by the excursion to a trade fair in the United States during which the executive team had gotten new ideas they wished to apply to the work of designer A.

"The first sketches were so rich and let's say Finnish looking furniture. They weren't so romantic. There was additional warmth due to the colours but a romantic touch was also added after the visit to the US. The ideas we brought home from the US notably changed the degree of warmth, and added cosiness and a rustic feeling." (design manager)

"Well, V herself was not necessarily keen on going to the direction of American Pie. I think she would've wanted to keep the sofa as sort of a divan and keep the thing like that. (design manager)

"The ideas brought home from the US partially mixed it up and I think it was too strongly realised there, in that work. But it wasn't ruined but the

unity wasn't really like controlled in my opinion. Well, what is good is the world of colours. That was realised well." (design manager)

"I'd see it like being an additional kick to that kind of a world of colours for evaluation of significance or how the colours affect creation of the feeling. That was it's most important contribution. Well, the other thing, the meaning of richness of design in creation of an overall look. You could say that the cupboard by V got a two-sided dimensioning difference which gave it more rhythm and then another thing about moulding the overall look where we tried to leave out clearly thin materials." (design manager)

"When we came home from there, we came with new ideas and we weren't able to communicate them in the right way. The problem was also that V herself hadn't been with us. V hadn't seen the environment herself and we were incapable of communicating it to her." (chairperson of executive team)

"I felt like I knew what to do or I thought I'd understood it correctly but then in Hämeenlinna, well it went awry what I had done. There we had a breach in communications or lack of understanding between us the executive team." (designer A)

"Sometimes I did have a conflicting feeling, when I decided that it should be like this with me for example the colours. But then I did like, I listened to K the most, and that clarified my thinking." (designer A)

"There was no certainty in it. If we think it the other way round, well R didn't change actually anything in it, she just did it based on the image she had in her head." (design manager)

The major problem with this stage was the fact that the executive team was unaware as to the reasons why consumers preferred certain concepts or as to what issues consumers liked or did not like. The original plan was to use qualitative methods in testing the products as well but this plan was not carried out.

Pattern models

The most difficult moment during the project occurred in January 2001 when manufacturing pictures created by the designers were presented to the companies. Lack

of quality of the manufacturing pictures lead to the companies temporarily loosing faith in the project. Due to this, some of the companies abandoned the project.

> *"The presentation method wasn't at all clear. I took me some time to interpret them. For us to be able to sell these suggestions to the manufacturers, we would've needed sales pictures. That is, the manufacturers couldn't imagine based on the presented pictures what they really look like."* (design manager)

Based on the presentations, the products were divided among the companies in order to create pattern models. Two of the companies failed to choose a product, and therefore, nine companies began to manufacture the products. A consultant hired especially for the task was in charge of manufacturing the pattern models. The pattern models were finished by mid-April after which they were photographed for research purposes. At this stage, fatigue was evident in the companies, among the designers and among hired parties. Based on the original plan created by the project manager, manufacturing would have occurred in two stages in order to assure completion of products prior to the end of the project period. However, the executive team deemed this unnecessary and felt that adequately good models could be created the first time.

> *"I think the manufacturers knew what they were doing but I should've been more involved in the work. After all, I never visited the factories during that time and then K gave me some messages as to what they were like."* (designer A)

> *"I though 'Help, what'll happen to them now when this is the most important stage when we should see that everything goes just right.' So I got the feeling that I was standing on thin air with nothing to grab on, that it ended in the middle of everything the project. If it had continued for six months more we would've been able to make them all really good. I think the feeling is pretty near to that of the sketches."* (designer B)

> *"I even visited the factory and we worked it over and they showed, they were surprisingly good and then we worked especially with the upholsterer some small details in it, to make them a bit clearer. The chair stage included the joint meeting. First of all it felt difficult, like 'Poor girl, what have you meant with this thing here? And you know, we can't do it like this. Now we must think of something else.' Then when we started to think about it, then I noticed that the factory owner got excited, 'I see, well, that's what you meant. Well, then we could do it like this.'."* (designer C)

Creation of the pattern models was not completely successful in that some design problems remained in some of the products. The underlying reason was the fact that manufacturing of such a large number of pattern models (25 pieces) simultaneously took all of the attention and the designers did not participate in the development as desired. On the other hand, one must take into account the fact that only rarely are models ready after the first attempt. When the pattern models were finished, the project manager and the design manager reviewed each of the companies and analysed each of the products separately in order to give suggestions for improvements.

> *"The women didn't necessarily understand what is the technology when manufacturing. And these ergonomic issues with backs of chairs and such, that were convincing from a designer's point of view, that they were too wild compared to the objectives of the briefing."* (design manager)

> *"There were still pretty many problems with dimensions, it's a lot, a lot is due to the designer's expertise but we must keep in mind that it was the first prototype that it's normal. There wasn't enough time to be used. And I'm sure there weren't enough enthusiasm on the part of the factories."* (design manager)

Final concepts

The final product concepts were finished in April 2001 when the pattern models manufactured in different companies were gathered together for photography. Despite the fact that the project as a whole lasted for two years, the participants actually did not had an impression of what they were doing until the spring of 2001.

> *"Then we've had the various product pictures for the prototype but they don't necessarily actually tell anything, in the way that they are technical pictures of single pieces of furniture. The next stage where the single prototypes are ready, then you may be able to sense some feeling but the real realisation of a concept is not revealed until all of the pieces of furniture have been gathered together in the way signified by the concept. The photography stage was the one in which the few pieces of furniture were set in a way that would correspond to the first feeling picture, we had to construct colour temperatures, lights, props and everything according to it, and then we were able for the first time in a photograph show the objective of the concept. We begin from matters of the spiritual world and*

> *end up to creation of an unity with various pieces of furniture, but the unity is created with this overall look of the space, that is it'll include a wall and limiting space with a colour and it'll include light, shadows and other colours used to create the feeling."* (design manager)

The milieu created was, however, artificial in the sense that it looked good only as a photograph. The pattern models did not yet stand up to closer examination due to lack of finishing.

> *"We photographed the milieus so that the products showed their best qualities and none of them could stand up to closer examination. But they looked like fine high-quality products."* (design manager)

A milieu photograph of a living room was taken for each product family for quantitative product testing. The objective was to create photographs as similar as possible to those used in concept testing. The underlying reason was the fact that during concept testing, concept A especially was perceived good and now the executive team wished to hold on to the achieved feeling. Design of the milieus for concepts B and C were created by the design manager, the project manager and a professional photographer. As for concept A, the designer was involved in the process. All participants deemed the concepts as highly successful and enthusiasm of the entrepreneurs for the project increased again.

For the photo shoot, three different milieus were staged in a photography shop in which various prop items were gathered in order to create the feeling desired. The objective was to create a milieu as similar as possible to the first sketches. Another important objective was comparison of the photographs for research purposes. It was fairly difficult to reach these objectives, since the number of pattern models finished was not the one originally agreed upon and number of prop items and their quality was quite limited. Of the designers, only designer A was present at the photo shoot. The designers were quite happy with the final concept, except for designer C.

> *"I had a problem with it, I think that if I'd been there personally, it maybe would've looked a bit different. I would've specifically created somehow the feeling. There was something like, it wasn't so rich, of course there were my forms, that is the furniture in pretty much the same way. But there were some technical things and then there I think that my placement idea*

> *had maybe not been understood the additional items or props were wrong in the way that I think it didn't express the Roomish feeling the feeling I was seeking for with the unity. I think that in a way the prop items should've been left out completely or then it should've been done more carefully because it didn't correspond with the picture in a way, where we started from which was one of the objectives that whether the feeling is present or not."* (designer C)

Evaluations of the executive team for the final concept photographs compared to the briefing did not deviate much from those given to the original sketches. The design manager gave designer A's concept a grade of 8.5 for correspondence to the briefing, the project manager a 9+ and the foreperson of the executive team a 7, the designer herself evaluated her work as a 9. The concept by designer B received a grade of 8 from the design manager, an 8.5 from the project manager and the chairperson of the executive team and the designer herself evaluated her work as a 9-. Corresponding evaluations for the concept by designer C were 9+, 9+ and the designer herself evaluated her work between a 7 and an 8.

> *"If we judge the final results, then A went a bit overboard with the divan, that is it wasn't as complete a unity as the works by B or C, for example. The divan seemed more modern and clear, maybe a bit more Scandinavian than the container unit. It was maybe a bit too heavy."* (design manager)

> *"In comparison to the briefing I would've given C a higher grade if we could've gotten the simple shelves ready, with which we would've been able to strongly work up the issue, that it was left a bit incomplete. But, well, if I offer a rough image, I wouldn't change the first evaluations very much, that it went with the old division. I'd give C, A and B 9, 8.5 and 8, respectively. But I'd say that there were many essential plans that weren't realised as a prototype, that in retrospect they could've been much more juicy and tempting unities if they'd been realised."* (design manager)

> *"Roughly, the work of C got more meat on its bones than the first picture let to believe. A's result maybe deviated most from the first sketch. In B's work, the changes and maybe the weaknesses too remained. In my opinion, it wasn't developed in the same way or changed like the others. It was pretty much the same as what the picture let to believe. Actually, nothing changed in it."* (design manager)

> *"Reasonably good taking into account the starting points. I mean that it looked much worse at some point, the models. But the final result was reasonably good. But, in my opinion, they weren't like the original that is*

the first sketch, we didn't get quite close to them, especially with A. 7.5... I think it's a normal result or better than normal. Nothing went necessarily awry but it wasn't a bull's eye. It was the fine-tuning that didn't work. There were too many cooks there and that spoiled the broth. You must always remember that when you're developing something, no matter what, there must be one strong person and the others must support him. Not everybody can be strong persons. Not everybody can be design managers. The task of a design manager is an issue that should be handled like very delicately so that you don't suffocate the original idea." (chairperson of executive team)

"Well, it's something in the range of a 9. The feeling was found that we were looking for. Because in the briefing you talked sometimes about fresh and I think that someone else too understood the freshness as too overpowering or took it too seriously, in these sketches, the same way as I did in the beginning but then in a way the freshness was adequately left to the background. That the feeling that was aimed at was realised much better there". (designer A)

"If you think about the briefing, the first output was much colder than the final one. It was much more dismal, cold and modern. It didn't have the feeling that we were after. It went a bit overboard, that you maybe didn't get the warm feeling to stick enough and specifically the cosiness". (designer A)

"I don't think that's the reason (the excursion to the United States), *I think it would've been found anyway because there're lots of references to let's say rustic furniture. It's not that only but more like something like new something extra. I think it should change so that the first sketch can't be the best, I think the whole thing went correctly."* (designer A)

"Well, it can't be worse than an 8 I think compared to the briefing. Actually, compared to the briefing it could be worse but compared to the sketch it could be something like a 9-. It could be that's my opinion. When I draw, it becomes like a different feeling." (designer B)

"The thing that wasn't realised was the dining room set. I think I with the container furniture and the dining set I probably lost something in the process. Then it would be a 7 or an 8. With the container furniture business, for example, there was something with the instructions and there I was making the things alone, that maybe I didn't get enough feedback after all, that I didn't get any kicks to take it far enough, that then it would've looked like something when ready that there was maybe still something there and the same thing with the table, for example, we didn't exactly have time to go through it with the manufacturer... But I'm currently having a sort of a special situation, that I claim and believe that

> *if I'd been here, I would've stuck more tightly to it and gone to the workshop to work it out."* (designer C)

According to the designers, instructions and the briefing became somewhat more important as the design process proceeded than they were with the first sketch.

> *"In the final the share of the briefing was maybe bigger, fifty-fifty."* (designer A)

> *"Let's say 50% of the briefing and then 25% instructions and then 25% of my own."* (designer B)

> *"My view on design was my personal by at least 60%, briefing remained as the weakest since instructions were given along the way 15%, 25% instructions."* (designer C)

Concept testing

Most important objective of consumer testing was to measure degree of commercialism of the concepts. Based on research, market potential for the product families, especially product family A (both design and choices of materials), was extremely promising.

> *"Choices of the consumers were actually in accordance with our first sketches with the ready-made products too, so in that sense we have succeeded pretty well."* (chairperson of executive team)

When the product photographs were finished, they were also shown to several (6) representatives of distribution chains or store owners. The objective was to assure commercialism of the products as well as explore possible sales channels. Research results showed that product family C, especially, had market potential especially in chains with most stores in the Helsinki metropolitan area. The most important result, however, was that all three product families were placed as the best alternative in two places, and the executive team perceived that as an indication of the fact that the project had been able to develop three equally strong unities despite the fact that in the sketch stage concept A was by far most popular.

> *"The query with store owners clearly answered the distribution very clearly, the thing was realised that I had pictured."* (design manager)

Problems

The executive team perceived that the project had three problems. The most notable problem was maybe the fact that no representatives of distribution channels participated in the product development. Had there been these representatives involved, a direct sales channel could have been available for the new products.

> *"I would've had more co-operation with chosen, important buyers in order to get tips, that is mainly with the photos we should've visited certain buyers with them before the fine-tuning stage.* (chairperson of executive team)

The second problem was lack of knowledge on culture in foreign target countries which prevented development product lines for export.

> *"The problem with our project was lack of trips abroad. We should've travelled much more. Both more trade fairs and stores abroad. This way, we didn't get enough information on competitors, competing countries and local culture. Finland is not enough or the centre of the city of Lahti is not enough in order to get information, that is in today's global world you must be aware of what others are doing and what are the trends. And that information can't be gotten by any other method then by going out."* (chairman of executive team)

The third problem was that the companies participating in the project did not offer notable investments to advancement of the project. The most likely reason is the fact that the methods used in the project were new and thus unfamiliar to the entrepreneurs.

> *"If I go through once again the problems we had, well these entrepreneurs didn't really understand what we were doing. They didn't understand why we were doing them, some of the manufacturers didn't listen to us, they wanted to make models of their own. An entrepreneur is an entrepreneur, he looks at his own company and that's the difficulty with this business."* (design manager)

Project outcome

Three product families were created as the project outcome which in the first stage mainly included furniture for living rooms and dining rooms. Two studies were conducted with the product photographs made based on the pattern models and based on these studies, each product family has market potential.

4.3. Project V

Project V began from the need of a Finnish furniture store chain to have an original line for young people. Based on conversations conducted, a decision was made to create a line on a project basis. The project was planned in the winter of 2001 and realised from August 2001 to September 2002.

When planning the project, all the information gathered by the parties during the previous projects as well as useful scientific literature was utilised. Research was utilised in planning the project both prior to development of the briefing for the project and during concept testing. In addition, a variety of tools for giving instructions to designers had been created in the course of project F and these tools were now further developed. The process was basically similar to the one already utilised in project F. However, as for certain parts of the process, actions were now planned and realised in a more 'sensible' manner. Educational elements were built in the project. Therefore, the time used for the process was half of the time used in the previous project. Whereas project F was a training and development project, project V was a product development project with ambitious commercial objectives.

The objective was for the line to be sold in all of the stores of the furniture store chain as well as by chosen co-operative merchants in locations where the chain had no stores. In addition, export possibilities were kept open from the very beginning.

There was an example of sorts for the line to be created (a line created by the designer in question 10 years previously which did not get to the market due to bankruptcy of a unit of the manufacturer). This old line gave indications as to what kind of design quality the project maker expected to be created. An existing example also enabled better choice of design possibilities in early stages of the project.

Due to financing reasons, first stage of the project was choice of manufacturing factories. A major difference compared with project F was that the number of factories participating did not have to be so high and the objective was creation of one product family only. The factories were chosen based on the following criteria: 1) willingness to participate, 2) ability to co-operate, 3) price and quality level adequate to project objectives and 4) suitable location.

Research stage

The project was started by studying a variety of subjects. Significance of research was high, especially that connected with wishes of the target group. Significance of research was also increased by the fact that the team was trying to create a new brand of furniture. The research stage consisted of a quantitative research with questionnaires, qualitative research, interviews with store managers, analysis of the chain's current line, analysis of competitors and analysis of trends in a trade fair in Köln. The most notable advancement compared to project F was the fact that the studies, conducted partially in a visual form, increased readability and usefulness of research results, especially for the designer.

Table 4. Research conducted during project V and brief descriptions thereof.

Research	Research description
Quantitative research	Research objective was gathering of information needed by the designer about several issues connected with design and usability in the form of both visual and verbal research tools.
Qualitative research	Research objective was to deepen quantitative research and produce a view on the needs of customers. In the second part of the research, brands of competing chains were analysed using a projective method.
Sales manager interviews	The same questions were posed to the sales managers as to the customers; the objective being comparison of information received from different sources.
Analysis of trends in trade fair in Köln	Research objective was analysis of current state of trends as well as the future development outlooks in relation to certain themes. Basis for this analysis was created by the research and experience from project F.
Competitor analysis	Analysis of competition was conducted with the help of all participants of the project in stores located in central places in the Helsinki metropolitan area. Research was limited to certain themes.
Chain line analysis	Line analysis was conducted in eight stores in different parts of Finland with the help of store managers. Research material used was mainly visual.

The project did not include other excursions abroad, and no representatives of factories participated in the excursion to Köln, which in retrospect can be seen as a defect. This was a problem in the sense that the participants did not have any clear information about future trends and new models by foreign competitors. During the project, rumours of new trends were heard from a trade fair in Milan which at least partially contradicted with the issues chosen based on the Köln trade fair and those introduced by the research conducted in Finland. The challenge of the research stage was the fact that information from various sources was partially contradictory. Another issue causing uncertainty was lack of resources due to which future trends and new models to be created by foreign competitors could not be adequately anticipated with the research conducted.

> *"We didn't get any influences from abroad, we got the supply that overrode them. We should've anticipated more."* (entrepreneur in the executive team)[25]

The project manager himself did not participate in all practical implementation. Due to this, the project manager had difficulties in going 'inside' the results in the same way as with project F where the project manager himself conducted, for example, the qualitative research.

The designer actively participated in planning of the research and analysis of the results. In a manner, this created the basis for strengthening of the designer's role. Therefore, the designer was apparently able to achieve a better view of what was going on 'inside the customer's heads' and of the problems with the market. Close co-operation between the designer and the project manager also enabled overlapping of process stages, i.e., product specification was being prepared simultaneously with research and the designer made preliminary sketches as more information was received already prior to creation of the actual specification. However, no one but the designer himself saw the sketches created at this point.

> *"I think it gives a more accurate picture. If we'd had a ready-made briefing, then you would interpret it, but when you're involved in creating the briefing, you know exactly what it includes. Since you've pondered about its verbal appearance, then you know exactly what it is. If you've been involved in it, you get more information out of it. If we're talking about the questions alone but also compared to project F, that these trade fair trips and other visits, the designer being there, it created a more stable foundation as well. It created a deeper understanding of course it's much better, that is, I think project F was weaker in the sense that there weren't enough opportunity for the persons chosen to discuss, kind of expand their views."* (designer)

[25] This comment becomes understandable in the light that during the latter stages of the project, the view of the merchants was that the product created by the factory in question was too conventional compared to the rest of the products in the line and new products by foreign competitors.

Product specification

Development of the product specification continued with research from August 2001 up until the trade fair in Köln in January 2002. It was apparent during planning of the specification that the research themes had an essential impact on content of the specification. Thus, the results of the research stage and the specification deviated from project F. In its part, insufficient research budget left its imprint on the project. There was no possibility to answer all questions asked.

Based on analyses made in co-operation with the designer, two design issues that were fairly dominant in all product categories were found from the material analysed. These issues were used as the 'dominant' factors in the product specification based on which the striving for positive differentiation was created.

The template for the specification had been created by the marketing manager of the chain who had a certain view of the desired result that was somewhat different from how the product and product family concept was perceived in the specification. Otherwise, the specification was created largely based on the research, in the same way as in project F. Depth or consensus for the joint view is difficult to evaluate, since contribution of factory representatives in creation of the specification was minimal.

The specification was similar to the one used in project F, with two differences. Firstly, some concrete product properties were quite accurately defined in this specification, e.g., regarding usability. In project F, the most important issue was feeling of the briefing. Very little attention was paid to usability of the products in project F, despite the fact that research had offered plenty of tools for it. The reason was that the executive team wished to find new concepts for living. The wish was 'sensible' in the sense that very different models for living were achieved with the chosen specification model which differentiated the three product families created.

In project V, usability had a notably larger role in managing designing. This was partially due to wishes presented by the designer in the planning stage but also the fact that

concepts tempting in terms of usability could be created based on the research conducted. In addition, the project lacked the pressures inherent in project F, since the objective was to produce a single product family only and one of the major objectives of designing was to find a design concept compatible with usability benefits.

There was lack of knowledge in project V and all of the questions integral to the specification could not be answered. The project manager was also unable to create a single clear picture from the mass of information. In addition, the specification had to be created during a very short period of time. The designer, however, said that he had a clear picture of what to do. Foreperson of the executive team also felt the specification to be adequately clear and accurate. One may state that when the specification was finished, a fairly coherent overall picture of the project was created.

A difficulty connected with the specification was differentiation of it from the specification in project F. Despite the different target groups, the research indicated similar answers in some areas. In retrospect, some of the items used in the specification of project F should have been utilised more in the specification of project V. The final product specification consisted of the following parts:

- Definition of target group
- Target group photographs
- Positioning pictures
- Price level
- Project objective
- What we are doing
- Projective description of brand
- Definition of design quality
- Concrete usability and design definitions for single products

When preparing the specification, all of the success factors found during the research conducted could not be utilised, since the manufacturing companies did not have the technical resources needed. In project F, technical limitations were not considered at this

point, because the prevailing idea was: We will be able to manufacture anything within such a large group.

Despite the fact that the designer was actively involved in the research stage, problems were created when the project manager and the designer were unable to reach a common view as came to the concept of a bookcase. According to the project manager's view, a tour of stores conducted in connection with the trade fair excursion to Köln brought in a missing piece and thus an answer to an unanswered question about the bookcase concept (the designer was not with). The designer described his feelings around the hybrid bookcase as follows:

> *"Now I suppose we should analyse what the hybrid there actually means and one interpretation is that it consists of several different materials or then a certain structural principle with other kinds of parts connected to it. And you know the answer we'll get from the Finnish industry. If we talk about acidified glass, aluminium frames, high-quality sliding doors on rollers that are bigger than the normal ones or a new technique for hinges or lighting, for example, we're banging our heads against a wall. We've chosen the factories so that some are specialised in manufacturing a certain material, period, and our ability to take on some other materials was limited. "*
>
> *"I can't make a direct copy of it, but I did have the impression of the bookcase that it was briefed so that it's a versatile system consisting of elements that grows in all directions so there's a starting point for design, this module thinking, and you could say that when we were able to make it work, it was a jackpot and after all, when X saw the first sketch, if you remember the first sketch, he was delirious about it."*
>
> *"If there were some issues added, then I'd consciously simplified it so that we'd be able to stay in a some sort of price category. And these were actual the issues that influenced it. And another question, that's how long will a hybrid remain trendy? But now I guess we have an issue that is... if the price is right and quality is good, it may be quite long-lasting."*
>
> *"Well, this model of a hybrid that was exhibited in trade fairs, well it simply can't be realised as such in the Finnish market, unfortunately. If the purpose of a hybrid is to construct reasonably sized and airy and interesting combinations using certain values, values that are interesting as such and basic parts, well the Finnish market is not ready to accept that yet. And that was the situation at least in the designing stage that all of the merchants wanted it to be such that when they're simply stacked on top of*

each other or it grows in all directions, that way you'll get furniture to cover a wall. There were some versions with a hole and those were deemed bad. Also, in the latter stages we designed one additional element in order to cover the back part."

"In my opinion, the furniture based on the German model, I considered them to be more modern and youthful versions several pieces but they were completely turned down in the meeting as looking cheap, these are gadgets you can buy from Finnish lower price class furniture stores S or A, that we don't need these. That is, the bookcase doesn't comply with the briefing, in any sense. And this is where we come face to face with questions of interpretation again, that what is the real thing? What should it be like, the product complying with the briefing, but we didn't say in the briefing that it necessarily had to be, I don't remember it saying that it should be a hybrid. Our report said that this is what they were like."

"That may very well be the most successful piece of the line that it has received the best, most enthusiastic reception definitely. The reason is that there're plenty of familiar and safe elements, basic bookcase elements with maybe a hint of hybrid thinking, which is new. That might be just the right concept if we think it from another point of view that we'd go with more of a hybrid then we'd be coming closer to this club which in my opinion is quite close to the hybrid that whether that's the right way to go anymore."

"And on the other hand, if we were to go back to the German hybrid for a while, then I could say the fact that the cheap alternative, that is the image affected these choices, then in my opinion this, what your sketch over there is, then by creating that space lattice structure with chrome-board steel and by choosing walnut tree cupboards there with top-of-the-line lighting, then it's no longer cheap store chain A quality. That is, in my opinion the situation that prevailed was that by adding walnut tree cupboards with top-of-the-line lighting that's no longer A quality. That is in my opinion the situation was that, as we already noted, that when we have a sketch it'll very quickly... without pondering what the actual decision is, people won't be able to go deep into it like that's an A piece despite the fact that it's made of gold, it's A. When you haven't seen those fine, expensive German hybrid bookcases, you've already formed the image that Finnish ones are cheap and when you don't have the ready-made product, then you're unable to judge."

One of the reasons for creation of this problem was the lack of a common language: one person was unable to understand what the other person was aiming at due to lack of a joint concept system.

> *"One thing is the common language, that how we talk that if I say that this is how I see what it'll look like, but others don't see it, that's one thing about interpreting pictures."* (designer)

The bookcase chosen for further development did not comply with the briefing in the sense that the image created by it was somewhat more high-quality taking into account the target group. The objective of a system shelf which can be expanded to two directions possibly controlled the development of the bookcase concept more strongly than the design objectives defined in the briefing.

> *"It's become a product of extremely high quality, actually an exclusive product. You could say that, at least in my opinion, it's grown outside of the limits* (the briefing) *in that sense."* (designer)

> *"Usability was the most notable factor controlling design."* (designer)

During the research stage of project V, the project manager achieved a strong impression that collective creation of a specification was somewhat difficult and the companies participating in the project did not notably contribute in development of the concept. The reason may have been the participants being unable to get adequately 'inside' the research. It seems that the project manager as the author of the research and designer were able to best get an overall idea of what to do. It seemed that passing on first-hand knowledge on design to others was extremely difficult.

> *"The role of the entrepreneurs was quite minimal, that is views of the entrepreneurs did not show at all in other than the technical solutions, this was due to the nature of the project which was largely dictated by the buyer".* (entrepreneur in the executive team)

> *"I think it's zero. It's been an encumbrance for this project. I mean, I think that in creating the briefing, as I noted already in the beginning, well you only need two or three experts who are able to communicate with each other, who have roughly similar views on what we're doing. There's no point in ten people participating in it, it's completely unnecessary. I'd ask that what does the manufacturing unit, who is supposed to make products, manufacture them industrially, what does that have to do with design and creation of unities?"* (designer)

> *"The reason why they apparently participate is a old-fashioned model of thinking, that is when the factory owners are involved, they'll be able to*

influence that and appearance of the product and development and thus they'll be easy to manufacture. But I don't believe it, it's a cliché. Quite the opposite, it seems that the situation has only become more difficult, that everything that is desired was usually eliminated. That is, I don't understand what has been the advantage of them participating? It's offered no advantages." (designer)

Sketches

During the sketching stage, the close co-operation between the project manager and the designer continued. During this stage, the designer created 130 different computer-generated pictures of possible new concepts. Some of those were variations of the same theme, but most of them were clearly alternative concepts. The reason behind the large number of sketches was to offer the decision-makers several alternative routes for continuation of the project. However, some of the sketches may be classified as suggestions placed outside the specification. According to the designer's view, influence of the specification to creation of the sketches was approximately 30% and the designer's own personal touch 70%. When evaluating the created products afterwards, the percentage given by the designer for the number of products complying with the specification seems low. It is possible that the designer did not perceive all conversations conducted as instructions due to the extensive length of the stage during which instructions were given.

"10 to 15% of strict stuff and then approximately 30% of those that could've been developed or applied, that is of which stuff complying to the briefing could've been developed. 70% of something else entirely, experiments. The purpose of the sketches was, after all, mapping of the ideas of the orderer of the work."

The numbers given by the designer were influenced by the large number of sketches, i.e., there were several 'experiments' included. According to the designer's estimate, for concepts that were chosen for the prototype stage, the numbers were 80–20.

"Of those, those complying with briefing 80% and the rest did not completely comply with the briefing." (designer)

The large number of alternatives clearly made making of choices difficult. When the sketches were chosen, one could sense that people other than the designer were unable to clearly evaluate the pictures. When the comments of the participants mainly regarded technical issues or issues connected with usability, guiding power of design was inadequate.

> *"I think that my first sketches were suggestive. By that I mean they were about the feeling, the image of what they were like. But the participants were very willing to talk about various product properties and functionality, that was one issue. I got the idea that those people didn't quite understand what the product would look like, what kind of a feeling it would have. But everybody talked fluently about whether it'll have an additional shelf or drawer or some other gadget. Conversations about those issues were lively. And I suspect that some of this kind of issues took place during the elimination process. It was, after all, somewhat came to a dead end for some products, that for example as comes to the sofas, I had a huge number of sofas and I would say even today that the choice that was made wasn't satisfactory to me. That it didn't, like, comply with the briefing the way it should've been that it lacks something despite that. And if I were to comment the issue in a mean way, compliance with the briefing was not taken seriously enough during the evaluation session. They were too much in a hurry and that was one of the most important issues."* (designer)

The sketches were eliminated in the executive team by chain management. At the same time, some changes and improvement suggestions were made for some sketches. The objective of the first elimination was to find among the large number of sketches six concepts from each product group (bedroom concept, coffee tables, container products, sofa, recliner, dining room sets) for concept testing. Representatives of the store chain made the decisions on bookcase concepts to be chosen for further development and concept testing would only deal with assembly alternatives.

The direction was taken in fairly chaotic situation. The situation was not quite controlled by anybody and the choice made was slightly random. This was largely due to the large number of product groups and sketches which made the unity less easily manageable. It seems that the designer was the only person completely aware of what was being done. One reason behind this was the fact that the participants seemed to be unable to 'read' the sketches generated with a computer.

> *"A product is always different on paper than in practice, you're unable to make a sketch of it."* (store manager)

In addition, the project manager felt that the decisions were made based on other grounds than the product specification.

> *"Confusing, now there were hell of a lot of models with all possible wishes realised in them, and the choice was like that made in a candy store, not based on research results, other than those created by the store managers."* (entrepreneur in the executive team)

> *"We started to eliminate them, K had made some startling ones on purpose, but they were maybe too unconventional and from the other end we dropped out the too conventional ones, we were searching for a happy mean."* (chairperson of executive team)[26]

> *"It was a pretty difficult situation in my opinion, that people were thrilled that we had lots to choose from but then the situation of making the choices was traditional anyhow, at least the members not included in the executive team chose them based on a feeling of 'I think this is correct', that I was a bit afraid that or I felt that it wasn't a sure choice. It was based on the briefing but the degree to which the briefing was taken into account was somewhere in the range of 50 to 60 per cent."* (designer)

> *"Those who participated in the work, in my opinion they concentrated more on like technical or operational factors that are easy to judge. But when we start to talk about the spiritual or design side, which are more difficult issues, then the choice made was that they took the one that was more familiar and safe. That is, they didn't go deep into it and the reason may be that people are not used to doing it. "* (designer)

The sketch stage was confusing in the sense that there were several, partially conflicting objectives which lead to the situation not being under anyone's control.

> *"According to the first briefing, the M's (the head of the retail chain) personal one where we used the old Juvart line as an indicator, well, we've come down quite a way from there."* (designer)

The confusing situation was partially due to a conflict between the first oral briefing received by the designer and the briefing realised in the project as well as changing of

[26] Chairperson of executive team is descripted early with symbol M as a marketing executive of the chain.

project objectives. This was partially due to the fact that it seemed that the products could not be placed in the correct price category. On the other hand, the decision may have been influenced by a change in strategic objectives of the store chain, i.e., in this case a higher profile. The created bookcase, in its part, fitted well in the higher profile.

> *"M stressed that a model for youngsters, well it's necessarily no longer a youth model? As an assembly that large it isn't, but on the other hand, the audio centre may be just that."* (designer)

> *"At first, we were searching for a more affordable and youthful line but then we realised that we're unable to compete with price and then we aimed higher and it changed a bit along the way and then there was, of course, the research, when it was analysed."* (chairperson of executive team)

The created sketches for each product group can be evaluated as follows:

Sofa: Several alternative styles were suggested for the sofas during the sketch stage, three of which were chosen for testing. The sofa that created the most enthusiasm succeeded well in creation of the usability function included in the specification. Overall look of design probably did not completely correspond with the objectives set by the specification, and it was therefore changed by request of the chairperson to a certain direction. The second model presented was perceived as somewhat too futuristic and strict in terms of design. The designer himself was most interested in this particular model which is the reason for it being included in concept testing. According to the project manager's view, the usability dimension deemed important based on research was necessarily not realised in the way that had been desired despite the designer being of the opinion that the product could be developed to the desired direction. The third alternative was a new corner solution preferred by the chairperson of the executive team which is why the model was chosen for the next stage. The manufacturing factory did not express much enthusiasm for this model, since they perceived it as fairly expensive as comes to technical realisation. All in all, one could evaluate that none of the models necessarily was a direct answer to the question presented in the specification. It was here that it was probably most clear that the objectives of the briefing had not been fully understood or a suitable balance between usability and design objectives had not been found.

> *"A bit more exclusive model, a youthful model and an affordable, soft one. Youthful model referred to the semicircular corner model which included a space for lounging, the objective was to make it affordable. The final result was based on an old frame, like a brick in form, and I tried to bring it close to what we'd pictured it to be grinding my teeth."* (designer)

Recliner: There was actually one potential recliner model only and a decision was made to develop it further without concept testing. The specification had left the most room for development for the recliner. The output can be evaluated as capturing quite well the feeling of the specification.

Bookcase: Several bookcase concepts were presented. However, the store representatives liked a particular concept at the first sight and the decision to choose that concept was made right away. The chosen concept did represent best the feeling of the specification, although the project manager perceived it as not quite realising the central message of the specification, a sort of a change in paradigm for bookcases. However, all participants, including the factories, were enthusiastic about the product.

Bedroom furniture: The bedroom furniture presented were perceived as quite ready-made products. Variations of a 'design gimmick' found in the specification were made with the bedroom furniture and several variations were tested mainly in order to find the best ones. From the very beginning the objective was to take several heads for beds to production in order to offer consumers the possibility to purchase a head for a bed only and combine it with a mattress equipped with legs or a complete bed. At this stage, more testing was desired for the other bedroom furniture in order to leave room for development.

Dining room set: It was quite easy for the executive team to choose the dining room chairs to be tested. The manufacturing factory was also unanimous of the choice made. In the same manner as with the beds, most of the chairs were variations of a single theme very well presenting the 'design gimmick' defined in the specification. One of the chairs to be tested represented the designer's view about an affordable chair for a small kitchen. Despite it being a new version of a very successful chair designed by designer in the past, all participants deemed it as suitable for the project's objectives.

The choice of dining room tables was more complicated that that of the chairs. There were several different alternatives. The most easy to choose was a model where the designer had had an idea to manufacture the tabletop of tempered hardboard in the same manner as models by a Finnish factory A, in order for it to be suitable for 'rough' use by families with children. All of the participants deemed the model good in terms of both design and usability. The underlying idea may have been that of a striving to somewhat benefit from the image of A and sell more affordable and newer 'A' models. As for the other tables, the conversations conducted were more lively but six products to be tested were chosen quite unanimously. The models chosen included a completely new type of a solution for a table enabling its use in a completely new way.

Coffee tables: There were several alternatives for coffee tables as well. Issues connected with usability that had come up during the research conducted seemed to have quite strongly directed design. Finally, very different types of coffee tables were chosen for testing. There was no possibility to more deeply analyse design at this point. Some design details awoke most lively discussions.

Concept testing

Concept testing was conducted in March and April 2002 using qualitative and quantitative methods both in Helsinki and in Tampere. A notable number of the concepts were eliminated due to concept testing. The decision on concepts to be chosen for further development was partially made by the executive team based on research, some the decisions were discussed with the factories. At this point, there were not many disagreements and instead, a consensus was fairly easily reached. It remained unclear for the project manager as to how well consumers had understood the real nature of the sketches based on the issues presented in the chapter above. It seems that the factories as well as the consumers had, however, evaluated the sketches correctly as so-called basic concepts, it was probably difficult for them to get a final idea of what the sketches signified.

Prototype stage and concept fine-tuning

Based on the decisions made, the designer produced the manufacturing pictures needed by each factory (some of them in real dimensions) of which some were drawn to actual size. According to the preliminary plan, the prototype stage should have lasted from April to the end of May. The original idea was to conduct an exhibition of the unity created in the store chain's premises in Helsinki in order to offer customers, salespersons, store managers and factories a possibility to evaluate the prototypes created. This plan was, however, rejected by the executive team and evaluation of the prototypes was not completely finished. The prototypes were evaluated by certain salespersons and store managers alone. Evaluation of the prototypes was further hindered by the fact that some of the prototypes were so unfinished at the time of the presentation that it was difficult to form a final opinion of them. This fact also hindered fine-tuning of design, because the prototypes were not in the condition agreed upon in all the companies at the time when the project manager and the designer visited the companies.

> *"There were differences between the factories, some had been able to create surprisingly finished products, some were still unfinished and being developed still as we speak."* (chairperson of executive team)

The major problem with the prototype stage, however, was the fact that not all of the prototypes manufactured by some companies complied with the sketches. This was partially due to the methods of the factory in question to manufacture products, and the fine-tuning was created in compliance with the company's culture. Issues connected with production had an impact as well, i.e., the company wished to manufacture the products in the same manner as before and as affordably as possible. A reason may have also been lack of know-how in technical product development within the factories. Lack of visual education may also have reduced the quality of the final result, model makers did not necessarily understand the small design nuances of the sketches (concepts) thus creating a final product not quite corresponding to the objectives.

> *"If I'd have to give a general statement about the issue then, the same as before. You could say that those who were enthusiastic about the issue did the job well. That we had two factories that made the job as agreed. I'd*

> *drawn manufacturing pictures good enough for all the firms, that is I had the pictures taken myself of which some were scaled and some were drawn in natural size. Well, despite that they tried to cut corners and do it the easy way, that is manufacture the prototypes so that if a chair resembled a chair, that was good."* (designer)

> *"And the opposition we met was not from the management but from the model workers who did everything possible so that they wouldn't have to make anything new."* (designer)

> *"It's the normal situation that if you talk about the ability to develop your own production, that if you aren't shown a board of which it should be made, then you use what you've got in stock. If you're supposed to grind something in a certain way and you don't have the blade needed, you do it with some other method, that is in their opinion it doesn't play a large role if a form or a rounding or some issue in the product is done with another method than that agreed. That is, mostly lack of intelligence or else they don't see the difference there."* (designer)

It seems that visual education may be quite defective with people working in technical product development.

> *"The sketches were not refined into the more refined form that the sketches let to understand as being possible."* (designer)

> *"I'd say that these factories, they don't understand what fine-tuned designing or development is all about. If we think that we have a chair with four legs and a back and we put padding on it or not, then their opinion is that if we start to abrade it and add dimensions and mass to it and other things where they should be and put the upholstery just as it should be. These issues don't mean anything to them."* (designer)

> *"Had we worked with another factory, the products would've looked completely different. It is so that the production methods and production culture of each factory, that is the level of work, has an essential impact on the final product. As an example, the sofa, that they have a production line from which certain kind of sofas only come out. No matter what you say, you don't get anything else. And that's actually the company's trademark, it won't be changed."* (designer)

During the prototype stage, several conversations of fairly harsh tone of voice were conducted with the companies about the product concepts.

Legs of two of the dining room chairs could not be manufactured according to the designer's wishes. The reason was reluctance of the factory's product manager to manufacture the legs in a different way than that previously used by the factory.

> *"Development of the dining room sets was unfortunate in the sense that the first models were made so hastily from old materials that you couldn't get any idea of what they were like. The attitude there was not the best one possible. The same difficulty occurred with the dining room tables. I didn't encounter any know-how in technical product development there that would've offered the possibility to solve issues differently than maybe at present. The best way to describe it is possibly to say that if I'd created a clear veneer mould myself, compressed the first piece and cut it and sent it to the factory, the boys had gone to the trouble of cutting off strips from the back of an old chair and screwing them on, which was in no way even near to the product we were dreaming about."* (designer)

Only one of the sofas chosen was developed as far as a factory prototype. The manufactured prototype was fine-tuned by the factory, the designer and the project manager on a couple of occasions based on lively conversations conducted at the factory. In principle, nobody was actually pleased with the final result, instead several views on the 'correct fine-tuning level' existed. The sofa concept created was a negative surprise, at least to the project manager, since the prototype had been manufactured on top of a pre-existing frame for reasons connected with production and the project manager felt that this solution partially changed the concept into a negative direction.

The other two sofas chosen for the prototype stage were not manufactured, since based on conversations conducted with the store chain, it became apparent that the factory was not very keen on the other two models. A joint decision was made to leave them for the latter stages should the need arise.

> *"As for the sofa, the manufacturer didn't want to manufacture the more demanding products, that's why the sofa was left unfinished."* (chairperson of executive team)

> *"The sofas were way too far from what I see the group as being and from what we're trying to create."* (store manager for store in Helsinki metropolitan area)

> *"The first lounging sofa was manufactured on top an old frame, it didn't look like the picture at all, all of the pillows were different, of a different type, we took it to a store in the Helsinki metropolitan area to be presented where all of the salespersons liked it very much at the first sight despite the design weaknesses. I think that the enhanced front leg valance was a weird thing plus the design of the pillows, in light of our briefing. It didn't have any impact on the salespersons' enthusiasm. Later on, when the line was completed, the salespersons said that the sofa was, after all, in accordance with its name, that is it didn't fit in there. They changed their minds in two days."* (designer)

> *"We ended up with the solution of it having two sets of pillows in order to get the soft appearance. We never did achieve it because the firm isn't specialised in manufacturing soft things, their products are harsh, so-called high-quality products. The models was being developed with two visits to the company so that we were able to create certain models. But you could say that they weren't improved so that they would've corresponded to our briefing. And so the issue still remains unfinished."* (designer)

Plenty of fine-tuning was made for the bedroom furniture set. According to views of the designer and the project manager, the first prototypes lacked the design gimmick that was to make them tempting. As for the night table, several combinations for the legs and decorative lath were tested when visiting the factory. Finally, the decorative lath was deleted altogether.

> *"Development of the bedroom furniture in each factory, the moulded plywood panel that we decided to use in the back rest, we studied its variations and the company was also very interested in it. We had 5 or 6 different models there altogether. And the most surprising thing was that the owner worked in co-operation with me when choosing the more modern models. And you could see that we had a possibility there to make more clear, more in the lines where the whole line has gone, decisions to that direction. The first model pieces, well the owner too had deviated in them, so that if we had some vertical laths, then half of them were gone because he's an industrialist and he'll take half of them off because it's 50% cheaper that way. He was, however, used to working in co-operation with designers and he changed them to what they should be. Profiling for the first prototypes was not similar. You must keep in mind that he had actual size pictures, that he should've been able to make them. This is a tradition. Old tradition of doing things. They're busy. They have other business that's more important. If we come back to judging the models at the store, then it was the same as for the others, they chose the most*

conventional models, period. Didn't think about it any deeper. I think they deleted the more modern models." (designer)

"Well, the bedroom furniture were manufactured of solid wood and they were waxed, their surface finish is different from that of the other products, but they create additional value." (designer)

"Despite the fact that the general appearance of the bedroom is not quite what I'd dreamed about, especially as comes to the heads of beds, but as a whole and as for the level of finishing and waxing, they're quite high-quality, in that sense they meet the objectives of the current line. The judging stage ruined it yet again. They didn't think about it. As for the heads of beds, I presented at least three alternatives. I had a modern and clear one, maybe a bit cool and then I had one that was practical, traditional and then I had a conventional rustic one and you could say that it ended as bordering to conventional." (designer)

"The beds are all right, but as for the chests of drawers, well the drawers don't even match. I heard that they don't have the parts in order to make the drawers the right height, the cleat was needed because they don't have a suitable rail to put the drawer on, it can't be like this." (store manager)

The coffee tables were actually the only product group that was 'finished' the first time round.

"Development of the coffee tables basically proceeded right in schedule. I visited the factory three times and we proceeded in a systematic manner. After the first showing, the rough elimination was realised in a fraction of a second, after which we ended up closer to conventional models. In the entire coffee table project it maybe shows best how you can take away entire novelty value of a model, because in the latter stages the container function was deleted, that is nothing new was actually left." (designer)

As for the bookcase, several constructive discussions were conducted at the factory on technical solutions for the bookcase. The problems encountered could be solved, however, in a way satisfactory to all parties without essentially hindering productability or design, despite the fact that the bookcase was probably the most difficult product to realise.

Products were also eliminated during the prototype evaluation stage. The most unconventional coffee table was left in the prototype stage, because the distribution chain

deemed the price given by the factory for the table manufactured of solid wood too high. At this stage, the designer wondered why no other possibilities to realise the concept at a more affordable price range were explored. However, the elimination process was conducted basically in consensus with the factories and the store chain.

The elimination process stirred thoughts as to whether all persons participating in the elimination process were necessarily able to evaluate the true nature of the concepts.

> *"In the final stages, some of the people were of the opinion that the sofa was damn fine despite the fact it was a mongrel and had design conflicts in it, still some of the store keepers thought it was good. That is, you could draw a quite harsh conclusion that these people are not educated enough to judge or see the form and appearance of products in reality. It's apparent that a product is perceived as a unity only, a feeling when they see it for the first time for two seconds, then they judge it as good or bad. But all the details there, they don't mean anything."* (designer)

At this stage, the sofa received positive feedback from representatives of the chain despite the fact that later on it was deemed too conventional.

> *"They were all good models at that time."* (entrepreneur in the executive team)

Milieu concept

In the course of the year 2002, the major concern for the project manager was compatibility of the products and functionality of the unity. The products were first presented together in the beginning of August. The exhibition was mainly constructed by personnel of the store chain and it was a disappointment of sorts, at least to the project manager. The first issue causing disappointment was the fact that not all of the products were finished yet and it was thus difficult to evaluate them. Secondly, the world of colours was unfinished and the unity did not create a unity in that sense as of yet. Thirdly, the space reserved for the product family failed to present the best properties of the products in the best way possible. In addition, the exhibition introduced the fact that not all of the products were necessarily compatible with each other in the best way possible.

> *"I'm positive that if we'd used the same amount of money and time to photography in project V, we'd have a series of damn fine milieu photos if the content you had in mind for the briefing had been realised."* (designer)

> *"It wasn't probably, well, not what we were aiming at. It had stuff side by side. The disappointment was that they had see-through walls and all kinds of other junk visible, that if there'd been for example white walls and maybe been grouped a bit better, the space, then it probably would've been a bit more of a unity then it was now."* (designer)

However, the exhibition was an important culmination point in the sense that decisions on the final colours and corrections to be made to the products were made after the exhibition. The problem was that the line was presented at the same time to salespersons, store managers and co-operative merchants of the chain, and the image created was not necessarily the best one possible. In addition, launching of the product family was delayed due to the fact that the products were unfinished. An interesting feature as comes to the exhibition (as well as partially for evaluation process of the prototypes) was the fact that whereas constructive views about development of the concept were scarce in the early stages of concept development, at this point all persons participating had strong views on how the products should be further developed.

The milieu concept the project manager had tried to introduce during the entire project did not catch on until at this stage. Even then, the probable reason was a large and fine department of a foreign competitor that in everybody's opinion made products of medium price and mediocre quality seem notably finer and more expensive than 'in reality'. At the same time, the significance of the product family was made concrete.

> *"There're no product families in the market, only single products, and a product family will be a hit. It'll affect decision-making of consumers, even if they don't buy the whole series at the same time, but the knowledge that there's the kitchen sideboard or bedroom furniture available to complement this product. It'll give them a feeling that this is a safe choice. It'll lower their threshold for making a purchase."* (chairperson of executive team)

During final project meetings, several decision were also made regarding fine-tuning of product design. The decisions were largely made based on fast personal feelings. Some of

the decisions were based on opinions of single salespersons on what is good and necessary.

> *"It's really important that the salespersons believe in the products and are even involved in the development stage, that way they'll be more committed, because the role of a salesperson is after all very important, a customer can't choose a bookcase by himself, he really needs assistance from a salesperson."* (chairperson of executive team)

> *"The final meeting where we basically had to make a decision on unity of the line. The project manager felt that when the agreements were signed and the researcher had declared the project ended, then after that we were able to get to work and return to our old routines. We even felt that participation of the researcher was a useless ballast of sorts and after that actual work could begin, that is making decisions on a the basis what people feel."* (designer)

> *"Maybe the most glaring detail was the elimination process of the coffee tables, where actually all the factors that V (project manager) with his research and K (designer) with his pen had achieved were eliminated, no factors were left that research had shown people to want. The model unity we strived to create, it was quite heavily eliminated."* (designer)

> *"I'm not so smug that I could say that I was completely right with the design decisions, and I don't think V can either, but it's quite alarming that if we're unable to study how they perform it, on what basis the choices are made."* (designer)

> *"In the whole sector, the major problem is the fact that no matter how wonderful methods and research results, formulas for making conclusions, we offer industry and stores, in the end the decisions are made based on a what they feel is right."* (designer)

When the project officially ended, product development was not yet completely finished. The major reason for the delay was cancelling the exhibition in June, despite the project manager being aware of the fact that final fine-tuning cannot begin before the products have been concretely presented as a unity. Cancelling of the exhibition in June also lead to skipping of product testing with consumers. Instead, the products were tested by salespersons of the store chain.

"The project lacks consumer research, that is all the factors of which the consumers could maybe not care less were skipped, because the sales-persons make the decisions." (designer)

"The drawers were left out mainly because of their price, there has been little demand for them in the past and maybe the factory wasn't really willing to manufacture them." (store manager)

"The major mistake we made was the fact that we gave too much significance to store managers and their opinions. That is, actual desires of consumers weren't introduced, instead current knowledge of store managers of existing models and wishes were taken into account. The salespersons don't, in the end, know what they want, they live one day at a time and can't anticipate the future." (entrepreneur in the executive team)

"The thoughts were based on what we've seen people getting interested in here in the store." (store manager)

When this dissertation is being written, the designer is creating a new sofa, since the one chosen during the project is not perceived as interesting, and it is perceived as unsuitable for the product family due to the more higher standard of the bookcase. In retrospect, the sofa that was deleted in the spring because of the entrepreneur's unwillingness to manufacture it would have notably better fit in the created unity.

"We aren't finished yet, but the direction is right, the models are changing so quickly, a continuous process, we can't stop here." (chairperson of executive team)

"The sofa line included a model for youngsters and this softer model and the lounging model, but when we never got to look at them, then how can you make decisions there." (designer)

"When the project manager was especially pleased with the bookcase, then he now wants to construct the entire line on its terms, despite the fact that we talked in the very beginning of the project about the line consisting of pieces of furniture that are different from each other with level of design and feeling as the uniting factor, now we've gone back to the old and familiar, that is they all should look more or less the same, which can be controlled more easily." (designer)

Evaluation of final result

The final result can be evaluated as a fairly high-quality, personal Finnish line (with no foreign model copied) for which commercial success can be predicted, especially as comes to certain products. Novelty value of design is not especially high; instead, according to the set objectives, the concept includes old and familiar as well as something new. In retrospect, however, the novelty value could have been somewhat higher as well.

> *"No major new design ideas, we used existing information."* (entrepreneur in the executive team)

> *"Grade for the unity 8.5. We're satisfied with the unity. Maybe we should've gone with a bit more bold design and a bit more unconventional in order to have more novelty value during the launching stage. But on the other hand, when the research, according to it consumers and sales-persons maybe in a way want a warm feeling, softness and comfort, that they aren't ready for more bold design solutions. They come from Italy and Denmark at the moment, they are tough competitors in the field of design. But they don't necessarily compete with price."* (chairperson of executive team)

> *"Well, it went beyond the briefing in terms of both quality and price, but on the other hand this may be more suitable target group than the one we had previously, these are a bit older and more traditionally thinking customers and they do have the money and purchasing power needed and this is a more commercial line and quite modern furniture is coming from Denmark and it stands for the cause."* (chairperson of executive team)

> *"If I were to roughly describe it so that if we have products with new functions, some new forms, novelty value, then all of these issues were eliminated towards the end, and we ended up very close to a conventional and already existing product."* (designer)

> *"The outcome was too conventional. Trends change very quickly sometimes. A tremendous change has occurred in magazines as well. Foreign competitors have been an excellent surprise, it shows that they have studied issues."* (store manager)

> *"There was more with the price/quality ratio, it didn't like, it wasn't a bull's eye. Domestic factories are often too old-fashioned, manufacturing small lots with old machinery, then it's difficult to compete with foreign, well-equipped factories with excellent logistics, then we must invest in more in a personal outlook."* (store manager)

"7.5. Certain factories have made work that isn't satisfactory. They lack a kind of... They lack the something extra. They're too conventional, they lack a certain, let's say educated, academically educated person's, the thing you comment on: 'I see, there's a plaid just as fine as I was searching for' not too modern but, it lacks a certain something. Then there's the issue that so far these are still prototypes." (designer)

"The grade of 7.5 is 40% due to choices, 60% due to factories." (designer)

Problems

The single largest problem with the project was maybe the fact that due to the financing situation, the project did not have adequate resources to anticipate actions by foreign competitors.

"We need to achieve more flexibility and speed in the future, fashion is changing so rapidly." (chairperson of executive team)

"Too long compared to the end result, the information must be gathered much faster in order to perform product development in half the time." (entrepreneur in the executive team)

In retrospect, more thought should have been invested in the future direction of the chain profile. However, development of the profile has been tightly connected with development of international supply.

A realistic fear is cohesion of the product family in different stores all around Finland. The milieu concept may have even more significance here than normally, since the products have, at least partially, been designed as a unity in order to create the desired feeling.

"My fear about the whole thing is that it'll fall apart. We don't have the culture that we could manage a unity and so far we haven't defined in the project the persons responsible for designing the milieu and taking care of it, that's what is missing, and that's why I'm afraid that it'll fall apart." (designer)

The major problem with the project from the perspective of the persons realising it was the fact that operations in several issues went against the research, the specification and recommendations by participants.

> *"The briefing and research quite clearly showed what we must do and the research results were clear and I understood what we were aiming at and they should be applied and I tried to do it based on the possibilities available, but unfortunately other parties didn't understand or want to understand what we were doing and made completely different decisions in the end."* (designer)

> *"The final design result of the project could be crystallized like this: the starting points were excellent, that is we had the possibility to acquire information and V did so, but half way through the project when we started the elimination process, the participants eliminated everything that was new and when the line was so-called ready, everybody stated in unison that there's nothing new and interesting here and this issue was settled by saying that it's surprising how fast the lines are developed abroad, that you couldn't believe it could happen".* (designer)

Evaluation of projects F and V

When evaluating in retrospect, the qualitative research for project F that had a central role in creation of the product specification gave a very united picture as to the needs of customers. The underlying reason was the fact — that was apparently known already during the project – that the needs are partially different depending on geographic location of consumers. Based on a study on Finnish consumer groups published by Partanen and Tiensuu (2002), one may evaluate that the persons included in the Institute for Design Research consumer jury represented consumers from one segment only which would explain the similarity of their responses.

Also in retrospect, both of the projects were characterized by a strong process of elimination which was more or less rational. In several points, one may note that when eliminating unnecessary issues, necessary ones were eliminated as well which inevitably lead to reduction of the novelty value of the final result.

> *"In retrospect, you could ask whether manufacturers' and sellers' novelty value is so small a factor that if you change the material, that's enough. The most difficult thing appears to be filtration or understanding of the value of a new item or believing in it, it's easier to get the belief from somewhere else, a ready-made product, already existing markets tested elsewhere, this causes elimination of a new, innovative line. No matter how effective product development we have in the beginning, it may be completely watered down in the end."* (designer)

Based on the cases, often expressed problems with manufacturability or productability are shown in a slightly different light when the cases are more deeply studied and explanations connected with productability are not accepted as such.

> *"Manufacturers always have interests of their own, if there's a risk of new materials or investments, then they aren't very willing to take those on. As comes to problems with manufacturing, they have no willingness or know-how to make it in furniture for the home."* (designer)

Project F was a more future-oriented project as comes to the objectives, the objective was to create new kind of concepts for living. The objective with project V was creation of a timeless line which was maybe too much attached to the present and the fast space of renewing of foreign competitors was not taken into account. One should, however, take into account the fact that based on the research, consumers tend to favour relatively traditional furniture and therefore, the design objective of the project was an increase in novelty value with design nuances.

> *"Research signalled that we shouldn't bring on too much new too quickly, sometimes it feels like when I travel around and co-operate with the press, that I'm too early, that I should take it slow, the taste of the people changes at a slower pace."* (chairperson of executive team)

The basic problem with project V was that the original objective was to produce new products for young people (quite low price). However, the result was quite expensive products. Problems occurred because the products had been designed for the former field thus possibly making their aesthetic level too low.

Another notable difference between the projects was that project V was originally more commercially oriented and a more concrete result was reached.

> *"If I were to compare F and V, then V was notably deeper and the final result was ready-made products. This was not the case in F. In F, the creation of the concept and this image with these items, that is it remained in the model stage as comes to the products, but this was directed to ready-made products the whole time then you have to have more concrete product properties. I've already stated at some stage that it's a hell of a lot harder, because you have to manage more than the feeling thing, since realisation of the feeling, that's a hard thing as such."* (designer)

Incoherence with managing was typical to both projects. Project F was during attendance of the first chairperson (the chairperson suffered a heart attack and passed away at the Copenhagen trade fair in 2000) up until the sketch stage almost completely managed by the project manager. After the sketch stage, the project had several leaders; the chairperson of the executive team, the project manager and the design manager. Project V was mostly managed by the project manager up until the sketch stage, after which decisions were made by the chairperson of the executive team, the entrepreneurs, the designer, the project manager and salespersons in the distribution chain. Both projects included several stages that were important and that could not be controlled, at least by the project manager. Instead, choices and decisions were made randomly based on feelings of the participants.

> *"There're so many participants in these product development projects that there's no possibility to influence the final result."* (designer)

Significance of designer's freedom came up in a slightly surprising manner in the cases: too much control may cause a reduction in the aesthetic value of products.

> *"If a designer pays too much attention to wishes of other people, the concept of his or her own will get mixed up, the most important thing is to proceed according to the briefing, it'll give the image of what to do and then when you develop it according to your own views. If there are too many people explaining, it'll be a compromise where everything, the final result clearly dreamed of by the designer, will be deleted."* (designer)

4.4. Conclusion for empirical material

The empirical cases included in this study tell three different stories of creation of a product concept in the furniture industry. The first case describes product development process of a medium-sized furniture factory which is managed by the managing director; according to Tiensuu (1999), this is a fairly common course of action in the sector. However, one must note that even in this case the creation of the product concept was to some extent a collective exertion despite the strong role of the managing director. Only rarely are new products created by one person only.

The second case describes a networked product development project with several companies and participants included. The case can be perceived as an extreme example of a complex and rich concept design process. The project included 11 companies, 7 designers, the project manager, the design manager, the executive team and the administrative organisation.

The third case dealt with a product development project led by a retail trade organisation. Its multiplicity is placed somewhere in between the other two cases. Characteristics for this case included interaction between production, research, design and retail trade.

The empirical material used in this study was gathered over a period of three and a half years. The research material may be described as a rich description of the practices of concept design with many levels. Instead of 'clinical' cases looking back over time, the cases used in this study are stories of situations under pressure where mistakes are made as well. The cases describe practical actions in a highly uncertain situation. Uncertainty was caused by several factors, e.g., uncertainty about trends, needs of customers, actions of competitors, etc. . In addition, the action research cases showed that possibilities of the researcher to influence actions are limited which reduced the possibility to anticipate and solve problems encountered during the processes.

It is probable that the research will 'reveal' several problem areas in concept design that must be managed in an appropriate manner. The empirical data shows how demanding a

task it is to achieve good results. The cases show, e.g., how difficult it is to work as a team especially as comes to definition, development and fine-tuning of design. However, this does not necessarily show inferiority of teamwork but only that it is challenging from the viewpoint of management. The cases also show how a concept can be changed when a process advances, often in an uncontrolled manner. The cases show that especially networked product development projects are very complicated processes to manage. They include a variety of conflicts which reduce the possibilities to reach a consensus.

The cases introduce different methods of gathering information, combining it into the process and create a conceptually 'good' product. The core is creative design, relevance of information and a process striving for additional value and its synchronisation (management).

The following summary can be given for the empirical cases used in this study:

Project O

- Based on preliminary interviews with the managing director, the development ideas just came 'from somewhere out there'. However, when the issue was more closely examined, it became apparent that the product ideas were based on information gathered from various sources. The sources of information included, e.g., trade fairs, furniture industry magazines, products of competitors, expectations of distribution chain, productional limitations and company's strategic objectives for the future. This may be dubbed the research stage which occurred in a more or less conscious manner.
- The managing director created a personal view of what the product under development should be like based on the research stage. This can be dubbed creation of a product specification. The most notable challenge in this stage was probably development of a concept that would be new in some way and interesting from the viewpoint of customers.

- Transfer of the solutions created in the mind of the managing director into concrete pattern models was not easy. The model maker had to make several attempts before the final result corresponded to the objectives set by the managing director.
- There was a continuous conflict between productional issues and issues connected with design of the product. Many design solutions were difficult or impossible to realise. This caused plenty of work for the company's production department.
- Even the small changes made in outlook of the product notably changed its nature, i.e., the concept was very notably changed when minor changes were made in it.
- After definition of the so-called basic concept, the product was 'fine-tuned' by, e.g., variation of background boards, doors, format of television sets and height of side boards.
- Development of the product seemed to be simultaneously a collective effort and an effort by single persons. Despite the fact that the managing director had a notable role in the process, several persons participated in development of the product who in their part influenced the final result created. The managing director, however, made a notable part of the decisions which was his conscious decision. This way, an internally coherent solution was to be created, instead of an average of the opinions of various persons.

Project F

- The concept was created above all based on research conducted in the beginning of the process. This research created a foundation for design of the product family.
- The challenge with creation of the product specification was creation of a concept with something new in it but not so much new, however, that consumers would shun it.

- Mediation of information from one person to another seemed to be extremely difficult at times. Persons were unable to understand what others tried to communicate.
- Transfer of the instructions created when the specification was made into sketches made by the designers proved to be difficult. Based on the cases, one may evaluate that none of the seven sketches was a completely 'right' answer.
- During the project it was noted that managing work of the designers was very difficult. It seemed that some parts of the process could not be managed.
- At some stage, instructions given to the designers seemed to reduce quality of the work made by the designers. Too many instructions had created a situation where nobody was aware what was being created.
- The participants had various views as comes to the direction to which design should be developed and a functional compromise between these views was necessarily not found.
- The surprise with the prototype stage was that the prototypes did not necessarily correspond to the plans.
- When the products were placed on display as a unity for the first time, it was noted that some of the products were not 'functional' on their own. They were a good addition to the product family as a part of the product family but they were not very interesting as single products.
- One of the most notable challenges was organisation of teamwork. Creating as teamwork proved to be notably more difficult than had been anticipated based on scientific literature. There were many instances where concept development in a group in a 'rational' manner was impossible.

Project V

- Research created results that somewhat varied from those of the research made in project F. One reason may have been the fact that time had passed or that the research was conducted at a different location. However, this suggested that what and how is studied has an impact on what kind of a specification is created.

- Creation of a product specification was challenging despite the fact that research suggested many outcomes for the specification. Despite the research, thinking processes and thoughts of the participants had a notable role in creation of the specification. In addition, when the process was under way, there was not full certainty as to what a so-called correct specification should be like.
- Transfer of the specification into sketches was difficult. To some extent, not all of the sketches corresponded to the objectives set in the specification. Despite long conversations conducted, the designer and the project manager were not necessarily able to reach a common view as comes to some of the product groups.
- Managing of a designer is highly sensitive. Instructions are needed but too much management may weaken creation of a concept.
- The participants had difficulties in communicating with each other, especially in the early stages of the process when there was nothing concrete to talk about. Reaching a common view was difficult. One could state that in some cases, collective development of concepts reduced quality of the final result.
- There were several 'leaders' for the project at the same time which made planning of a coherent unity more difficult.
- Actual fine-tuning did not actually occur at any stage during the project, because the decisions made on the basic concept were still chaotic as comes to many of the product groups.
- The product concepts changed further still in the prototype stage, often in a surprising way. Outlook of the products was always more or less dependent on the factories that manufactured them which did not necessarily always correspond to the project objectives. The concepts did not necessarily 'come to life' when they were transferred into products.
- When the products were for the first time set on display in the same room, it was noted that they were not necessarily functional as a group.
- The process could not, at least to some extent, be controlled by the project manager.

Most important dimensions of the cases

Based on the cases, challenges and problems in concept design are similar even in fairly different operational environments. This observation is also in conformity with several designer interviews conducted in a study by Tiensuu (1999). One may assume that when operating with similar issues, the challenges are roughly the same but the tensions will be different in each situation. This is described in Table 5. One may also assume that the 'reality' of concept design is even more complex than that. The dimensions presented represent variables within the empirical research material. The purpose of further research is to create a more versatile view of the challenges in concept design.

Table 5. Spirit of empirical research cases.

Variable	Project O	Project F	Project V
Amount of information	Small	Large	Medium
Level of creativity	Low	High	Medium
Degree of collectiveness	Low	High	Medium
Systematic nature of operations	Random	Systematic	Systematic but more random than in project F
Nature of information	Significance of tacit information high	Significance of both tacit and explicit information high	Significance of both tacit and explicit information high; however, significance of the former more pronounced
Interaction between physical and mental reality	Weak	Strong	Medium

The strategic cases analysed during this research project can be described with the field in Figure 12. The field includes three dimensions taken from the empirical material: creativity (here, this term refers to the unity created by analysis and synthesis), control (here, this term refers to management of complexity and simplification) and design information. The figure shows that the cases studied are placed in different parts of the field thus describing the most important differences between the cases. In project O,

creativity and amount of information were relatively low and control was relatively weak. In project F, creativity was high, amount of information was high and control was fairly low. In project V, there was plenty of information, large amount of control and mediocre creativity.

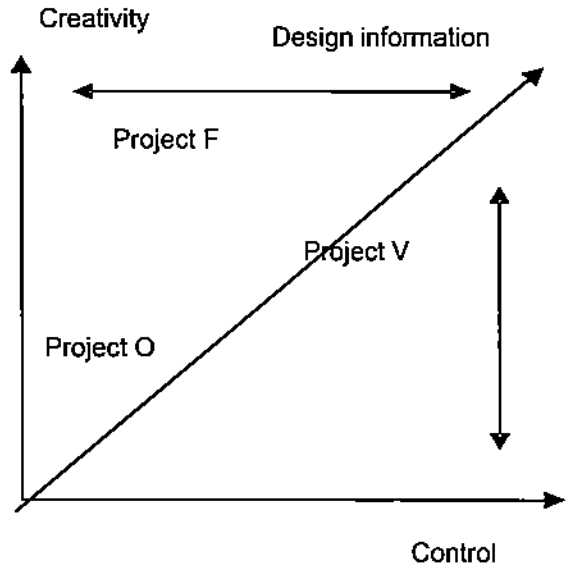

Figure 12. Research cases placed on axles of creativity, control and design information.

Theoretically, one may think that a successful product requires balanced management of the processes in question. One may, however, assume that these dimensions are emphasised in a different way depending on the situation and depending on starting points of concept design. The creative process may receive a notable role if the objective is to create products with high novelty value. Information process, in its turn, may be emphasised if the objective is to create a new product concept for a clearly defined customer segment. The significance of control, however, is apparently high in all cases, because without control, coherent concepts cannot be created.

One may assume that in a so-called 'ideal' process, the objectives are strong creativity (novelty value), high amount of information (satisfaction of customers' needs and positive differentiation) and strong control (internally coherent unity). However, a so-called ideal process does not guarantee creation of a successful product. Instead of

strength (quantity) of processes, success depends above all on competence of participants and quality of mental processes. E.g. one may assume that instead of producing large amount of information, it is more important that the facts are studied in the correct manner and correct conclusions are made in a way that is effective both in terms of time and resources.

The most important when creating new product concepts is the ability of participants to formulate information in a manner that differentiates the product under development in the mind of a customer in a positive way, and thus creates the product concepts desired. This may also be done in circumstances where the amount of information and the degree of creativity are low.

One may assume that the above-mentioned dimensions create curves in the form of reversed letter u, where their improvement improves quality of the process up to a certain point, and after that point, results will no longer be improved. Therefore, overall investment targeted to concept design has no linear relation with the result. Problems occur, e.g., due to management of the unity and interdependency. The dimensions formed like a reverse letter u presented above may, however, be regarded mainly as a theoretical construction. In practice, their enhancement may increase the quality of a output. Projects where adequate resources and time are available for the culmination point of the above-mentioned dimensions to be reached are extremely rare.

5. FROM FUZZY END TO CONCEPT MANAGEMENT

The analysis unit used in this study has been the concept design process and interaction therein. Therefore, the study is an analysis of actions in micro level. In order to make the process of concept design understandable, it must be described from various perspectives. Existing theory offered references that when studying concept design, one should take into account, e.g., perspectives of creativity and information as well as the level of collectiveness of actions. One may assume that with these factors, we will be able to at least partially understand how the process leading to creation of a concept proceeds in practice. In accordance with the framing of questions for the study, answers to, e.g., the following questions have been searched in Chapter 5:

- Where do concepts come from?
- How is information transferred into concepts?
- What kind of problems are encountered during the process and how can they be solved?
- How can tacit and explicit information be combined and managed?
- How should individualistic and collective work be combined as appropriate concept design management?

One may also assume, that our understanding about concept design can be made deeper with the help of a frame of reference by Senge (1990: 203). According to him a phenomenon must always be studied from two perspectives. The first perspective is created by process thinking and the other by mental models connected with process management.

The basic objective of this study was to create a framework model of concept design. The questions above and the empirical research material suggest that concept design is a versatile and multi-levelled phenomenon. One can see that description and analysis of concept design require an explanations model consisting of several levels. The objective is to integrate various phenomena into an internally coherent unity. Thus, we will be able to proceed from chaotic 'fuzzy front end' towards concept management.

Chapter 5 is organised in such a way that in Chapter 5.1, the concept design process is described from the point of view of information. Analysis is based on the assumption that the basis for concept creation is refining information created during a more or less systematic research stage in various stages. Thus, the challenge lies in successful going through of each stage and transferring meanings from one stage to the next and from one participant to another.

In Chapter 5.2, concept design is described from the point of view of critical conflicts. Based on the cases, it is apparent that due to contrary objectives, a conflict inherent to each stage is created and it must be solved.

In Chapter 5.3, readiness of individuals to work together in order to create a new concept is analysed. Usually, concept design is, at least to some extent, a collective process. Instances where one person creates a concept, sketches and prototypes alike are rare. However, the cases indicate that joint creation is not as easy as scientific literature usually suggests.

In Chapter 5.4, concept design has been organised from three points of view: factual and mental processes as well as organisation of activities. Whereas factual processes in a way create the structure for the process, mental models define how to act within this structure. Chapter 5.4.1 includes descriptions of factual processes and Chapter 5.4.2 descriptions of the mental processes. Chapter 5.4.3, in its turn, describes organisation of activities from the viewpoint of collectiveness which in a way defines the readiness of participants to skilfully act alone and together.

Chapter 6 includes the conclusions of this study. This chapter is divided into three parts. Chapter 6.1 presents a multi-levelled and dynamic model of concept design. Chapter 6.2 includes pondering as to what second generation process research could signify based on this research project. Finally, Chapter 6.3 includes pondering on the possibility to generalise the results and poses challenges for future studies.

5.1. Management of design information – management of meanings

In most of the models of product development (e.g. Kotler 2000) the process begins with producing ideas and their evaluation. It can be seen that the models have been created via analysis of large technology-based companies; what is typical for this kind of companies is that they have many ideas. *Models do not describe how ideas and concepts are created but instead the process of evaluation and elimination for already existing ideas*[27]. Implicitly, the models assume that ideas are created with creative thinking somewhere out there[28]. One may ask that if concepts are created from ideas, then where do the ideas come from[29]? These stage models have in their part helped creation of 'mystery' of creativity connected with product development. Existing models may be criticised for assuming creation of a concept being a non-systematic operation which cannot be managed.

An action model, where the NPD process proceeds spontaneously and randomly from one idea to another could be called an idea driven working modell. In systematic product development, one strives to create an internally coherent concept in accordance with pre-defined technical, commercial and design objectives. This requires chronological integration of various sectors of expertise in order to simultaneously develop various dimensions of a product. Randomness does not refer to creative ideas able to develop a concept into the desired direction but the fact that the process and therefore its final results cannot be managed.

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[27] It is problematic to define what an idea is because something cannot come into being from nothing. Therefore, an idea should be regarded as an insight which is created when an individual – often after a long process of subconscious thinking — realises a new possibility to use, e.g., a material or technology in a new way. It is often a question of combining already existing factors in a new way, which is the definition for creativity coined by Leiviskä (2001).

[28] This work may also be unconscious, and thus its perception and description with means of research is difficult, which in part explains defects in the current models.

[29] According to Kotler, a product idea is a possible new product and a product idea may be transferred into several concepts According to him, a product concept is a version developed further which is expressed to a customer using terms meaningful to the customer. (Kotler 2000: 327)

A concept cannot be created from nothing: the participants must have something to develop. These elements could be called concept building blocks and they are created based on information from various sources. Based on scientific literature, there are three of these building blocks: needs of customers, company objectives and technology. Despite the fact that these elements seem to be the most central issues for development of a product, there are other variables affecting definition of product properties as well.

From this point of view, we should speak of extent of concept design instead of customer or technology-based concept design. The extent of concept design can be perceived as defining how widely information is gathered and utilised when developing a concept (c.f., e.g., Cooper, 1990; Bacon et al., 1994; Khurana & Rosenthal, 1998). The question is identification of factors affecting definition of product properties. Based on this study, these variables include, e.g., trends, needs of customers, actions of competitors, brand and expectations of distribution chain, needs of production, possibilities and limitations set by purchasing, definition and choice of target group as well as strategic company objectives (Figure 13, for more information,see Appendix 1). These factors have mostly been handled as separate variables in scientific literature. Based on the view presented in this study, these factors have interdependencies.

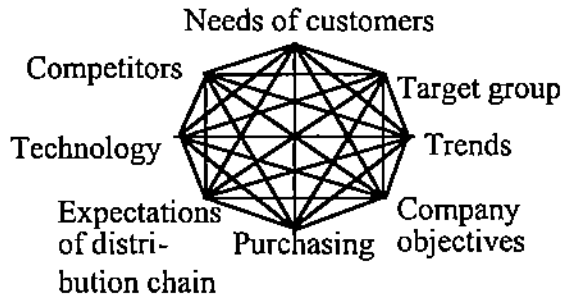

Figure 13. Concept building blocks.

Traditional models often include a simplification: product development is perceived as having begun from a certain issue, such as needs of customers. However, that is only one of the inputs influencing concept development. Customer-based thinking is supported by research that has proven beyond a doubt that only products satisfying needs of customers

have the possibility to succeed. However, scientific literature suggests that product development stemming from needs of customers as such is not an adequate basis for development of new product concepts. Brown (1992) ironically states that despite the fact that literature on marketing has traditionally emphasised customer-centred nature of product development, many notable innovations have, paradoxically, been based on technological ideas[30].

Usually, not technology alone can be used as a starting point, since it is only a means used in solving customers' problems. A technological idea is a solution to a problem and product concept must define the solution. In addition, level and feeling of design, factors connected with usability, price and quality level, materials and colours must be defined.

With a few exceptions, product development cannot be company-centred either, despite the fact that taking into account company brand and limitations of production are important.

Against the general model of thinking, no special starting point can be defined for analysis-based concept design. All the factors mentioned above must be taken into account when defining a problem and concept development should, however, be analysed simultaneously, i.e., evaluate factors affecting the product and analyse them as a whole[31].

[30] According to the traditional pattern of thought, companies should be either technology-centred or market-centred in their product development (Crawford 1991; Van de Ven 1986; Galbraith 1982). According to Crawford, however, research proves that successful companies strive to simultaneously utilise both approaches. A new product development project is directed from the very beginning both to a problem of the customers and a certain technological solution which is used to solve the problem (for more information,see, e.g., Cooper 1984; Urban et al. 1987; Hendry 1989; Johne & Snelson 1988).

[31] The fundamental objective of concept design is creation of a purchase decision with customers which deviates from the generally used concept of fulfilment of customers' needs. The difference is that the latter refers to the needs of customers today whereas the former refers to the experiences of customers tomorrow when their expectations are influenced by what is possible (technology), what is desirable (trends) and what kind of unities of possibilities (concepts) competitors offer. A consumer is not necessarily aware of what will be desirable in the future. In addition, suggestions by competitors may exceed the expectations of customers.

Concept design and creation of a concept presented here may be partly explained from a viewpoint of information. The challenge for participants operating in concept design is transferring the results of a more or less systematic stage of gathering of information via several stages into a ready-made product[32].

A product concept is refined to its final form during several stages and with a process of transformation. Transfer of the project from one stage to another can be described as a process of transfer of sorts (Figure 14)[33]. The question is how the result of a stage can be transferred to the next stage in such a manner that its content and feeling stay in form or are refined into a better form. From this point of view, the challenge lies in ability of the participants to transfer meanings (cf. Lautamäki 2000)[34].

When the process proceeds from one stage to another, design information will change its form and the concept will be refined into something new, something that necessarily cannot be predicted in the early stages of the process. Refinement refers to the fact that the early forms of a concept only suggest of what the final result should be. Form of the concept will be defined when the process proceeds and view of the desired result will be gradually specified.

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[32] Description of a process of this type requires a dynamic model, where the project variables are functions of the past (Koput 1992). The output of a stage is always, to some extent, a function of the preceding stages.

[33] One can find some similarities with the process of concept creation by Burchill (1993) (see in more detail in appendix 2).

[34] The problem with management of a design problem can be understood with the help of a frame of reference for design information created by Hassi (1998) (for more information, please see Appendix 4). The model starts from the idea that any target of observation is data. From this point of view, text in a book, a study, a product specification and a sketch are all data to be observed and analysed by humans. With these observations and analyses, a human will have a view of the object being analyzed within his or her own mental reality. Thus, one may say that the person has information regarding the object. This information must still be interpreted, i.e., meanings given to it. With the interpretation, a person will have knowledge (knowledge is often defined as a well justified actual belief), due to which humans will act as they see best. Despite the fact that data and information have been separated as concepts here, 'design information' in this study refers to the same concept.

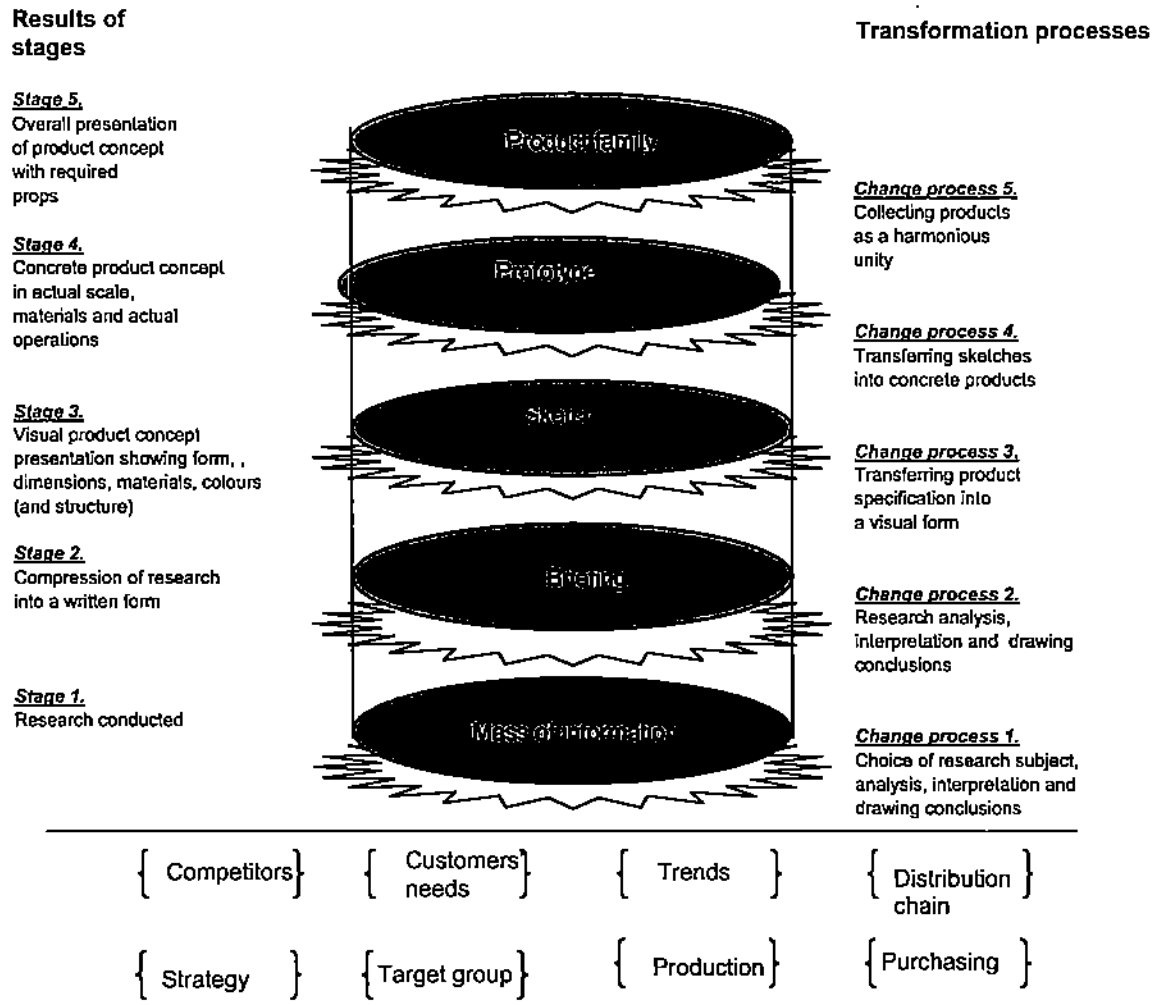

Figure 14. Transformation project for design information.

The form of a concept will also change along the stages[35]. In each stage of the process, a concept will be defined in a manner typical to the stage in question. In the early stages of the process, concept will appear at an abstract level and its 'readability' will also remain low and it may be understood in several ways. Due to low intelligibility and abstract nature of the concept, it will be handled in a way that is not very detailed and the decisions made cannot be very detailed. When the process proceeds and the concept

[35] During the research stage, a concept is an indefinite amoeba of information which will be specified into a written form during the specification stage. In the sketch stage, a concept has a visual form and in the prototype stage it is a concrete object. During the last stage of the process, products created will be combined under a joint milieu concept.

becomes more concrete, its level of intelligibility will increase and number of possible interpretations will be reduced. At the same time, view of the desired quality of design will be defined (cf. Kinnunen 2001). This also means an increase in fine-tuning of decisions regarding design, i.e., increased significance of design nuances.

In addition to the transfer processes, the challenge with each stage is development and fine-tuning of the concept in a manner typical to the stage in question. *In order to go deeper in this analysis, one can assume that it is developed into its final form by going through of three part processes in each stage: (1) definition of concept, (2) development of concept and (3) fine-tuning of concept (Figure 15)*[36]. During the first process, a definition of what is to be created will be made. Concept definition refers to making a decision on the basic concept of a product or a product family. Despite the fact that a concept has already been mostly defined during early stages of the process, concept definition takes place during latter stages of the process as well, and the reason is that participants are replaced in each stage. A sprout of a concept created during concept development will be further refined into a more advanced form (e.g., usability, design or manufacturability). The further the process proceeds, the more significance design nuances receive. 'Final clicking in place' of these nuances has been described with the term fine-tuning.

Therefore, concept management includes successful performing of the stages as well as the transformation processes in between the stages. The process is at the same time both cumulative and simultaneous. Cumulativeness refers to the concept being developed during several stages, with the personal touch of several participants. Simultaneousness, in its turn, refers to the fact that crystallisation of a new concept into a 'diamond' requires focusing of thinking.

[36] Cross (1984) has described the designing process with terms pre-design, actual design and design of details.

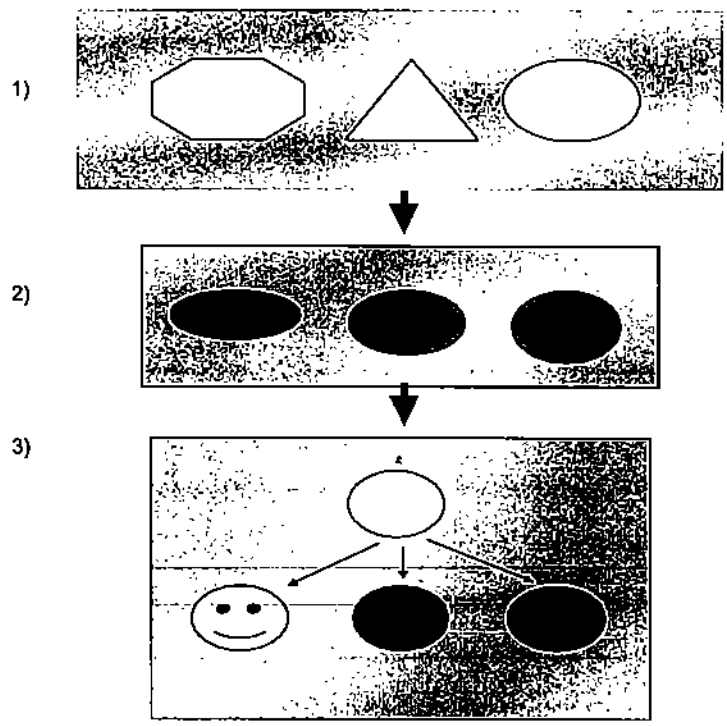

Figure 15. Definition, development and fine-tuning of concept.

5.1.1. Management of design information in product specification stage

A product specification can be understood as the function of the results of the research stage and different types of specifications may be created using different methods which leads to different kinds of results. In this stage, the problem is to deal with the gathered information which always includes uncertainty about, for example, whether messages from customers have been correctly interpreted and whether they have been transferred into the 'correct' form.

As comes to creation of a product specification, the essential issue is what is studied and how it is studied. The contents and nature of a concept will be developed according to the results, since the gathered mass of information creates a preliminary specification of sorts

(see Figure 16)[37]. This was apparent in, e.g., projects F and V in that dissimilarity of the research offered different preconditions for creation of a specification.

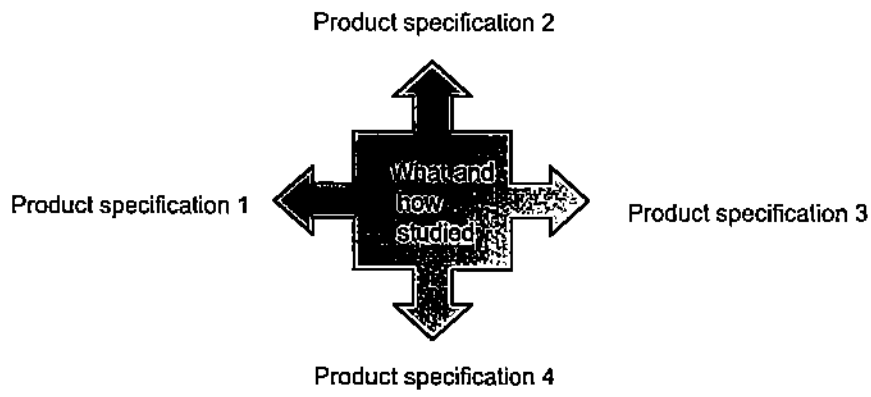

Figure 16. Impact of research subject and research questions in creation of product specification.

When creating a product specification, product properties will be defined based on information produced by research. The stage begins with an analysis of the gathered information and continues with formation of a synthesis. Analysis refers to interpretation of gathered information. The objective of synthesis is to create a product specification (product on a conceptual level, including the interpreted meanings: images, words, visions) desirable from the viewpoint of a customer. The objective of the stage is organizing information from various sources into a unity without inconsistencies. The purpose of a specification is to create instructions and define limits for the following stage. A specification is a tool used in communication with a designer. At the same time, a specification creates a point of comparison for evaluation of sketches and prototypes.

[37] Lack of necessary information may be described as a jigsaw puzzle of an idyllic Finnish country-side scene with a small red house, a barn, a black cat and a meadow full of flowers. If any of these elements is not present, understanding of the picture will be harder or its interpretation will be altered. If the picture does not include the barn, the picture may be interpreted as any small house either in the city or in the countryside. If the picture lacks the house in addition to the barn, the picture shows a meadow in any part of Finland. If the meadow is also removed from the picture, the cat will be the only thing left.

Product specification can be described as the heart of design management. If it pulses with the wrong pace, seeing issues eye to eye will be difficult in latter stages of the process as well. A specification defines what is to be done and what is the desired direction. A specification either directs or does not direct development of a concept to a desired direction. Uncertainty is caused by the fact that inputs from various sources can be combined in numerous different ways, and there is no certainty that you will find the correct combination as comes to success of the product concept. Therefore, the participants must to the best of their abilities decide how they will react to various limitations and the information of the market available.

The most notable problem with the transformation process is the nature of signals from the market. Some of the signals are strong and clear, others unclear and weak. This could be clearly seen in projects F and V. In the former project, the project manager himself produced the information required and in the latter it was produced mainly by others. The result was that in the latter case, view of the project manager about needs of customers remained more superficial than in the former. Zhang and Doll (2001) ascertain that first-hand knowledge of the needs of customers more effectively stimulates the imagination than abstract data on marketing.

Despite product specification seeming to be an important tool in design management, its guiding power is limited. Both Project F and project V showed that a direction only can be defined with a product specification. Direction refers to the area of design that can be perceived as being inside the boundaries set by the product specification. Based on the cases it seems that a product specification can be interpreted in various different ways due to which some of the sketches created in project F did not fit within the product specification.

5.1.2. Management of design information in sketch stage

Creation of sketches refers to transferring the product properties defined in the preceding stage into a visual form, creation of a unity consisting of form, dimensions, structure and

material[38]. This stage consists of three sub processes: analysis, synthesis and evaluation. Analysis refers to interpretation of the product specification created in the preceding stage. The clearer the definitions are, the easier it is to understand them. The most difficult issue is definition of desired design, since design information is largely so-called tacit information. Synthesis, in its turn, refers to transferring this understanding into concrete product properties. The purpose of the evaluation process is studying of the created sketch in relation to the objectives set by the specification.

The basic problem with the sketch stage is the fact that the specification is open to various interpretations. The difficulty with concretization of a product specification is the fact that the product definition created in the preceding stage may be realised using several means. The sketch created may be varied by changing both the basic concept and parts of the concept (Figure 17).

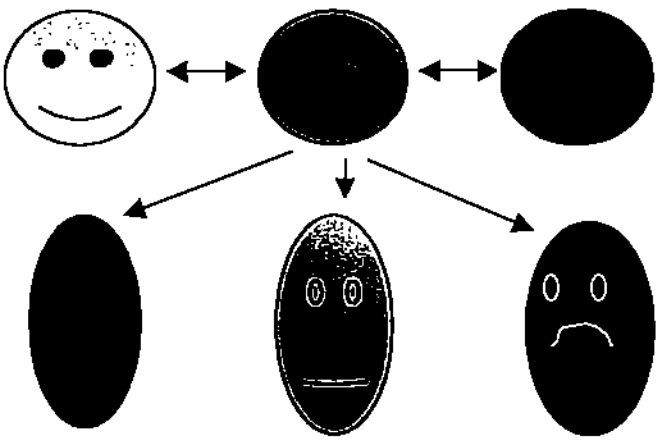

Figure 17. Concept variation possibilities.

Therefore, the form created in the sketch stage does not necessarily correspond to the objectives set in the preceding stage and the concept may be changed into a previously

[38] The division into stages presented here deviates from the view presented in chapter 3.2 in that Jones (1984) and Bach (1973) who studied product design mainly from the perspective of a designer see processing of information (combining of gathered information) to take place during the synthesis stage, which has mainly referred to creation of a new form. Based on this study, information gathered is processed over several stages. Therefore, the process is more complicated than previously suggested.

unplanned direction. In the case of project O, several concrete realisations of the bookcase were required before it corresponded to the mental view of the managing director. In project F, seven designers produced seven different suggestions of a product family, some of which were completely unsuitable to the objectives set by the product specification. In project V, the designer produced more than 130 sketches. The sketches varied on a very wide spectrum and they were first eliminated by the executive team to 36 sketches.

Attempts were made to eliminate openness to interpretation both in project F and project V by concept testing[39]. However, it seems that the designer only is able to internalize the logics of advancement (interpretation of sketches). Thus, the process cannot necessarily be managed. This signifies that something concrete (e.g., a sketch) should be created as early on as possible in the process in order to allow for collective development of the concept. The more concrete the form of a product concept, the easier it is in principle to collectively develop. This argument supports the idea of the need to begin controlled management already in the early stages of a project.

Students participating in a study by Leiviskä (2001: 154) stressed the fact that it is not self-evident in projects with emphasis on design that all participants understand to what material presented in a visual form basically refers. According to Swan (2002), a visual form is one form of information despite the fact that it is more difficult to explain to 'readers' who are not used to seeing and understanding visual concepts. Swan points out that visual literature is similar to verbal literature in requiring practice and intellectual familiarization to the matter.

In all cases, the concepts were created mainly on terms of design, i.e., a design concept was created first and an overall concept after that. One cannot, however, state without a doubt that an overall concept is a derivative of a design concept. For some of the products

[39] Concept testing enables gathering of customer feedback during product development regarding, e.g., usefulness, acceptability and design (for more information, please see, e.g., Moore 1988; Anschuetz 1006; Dolan 1003). However, concept testing has been discovered as not always being reliable in anticipating success of a concept in the market (for more information, please see, e.g., Duke 1994).

in the cases, usability guided design, for some design was the leading factor. Most of the times, a concept was created as a result of interaction between various items.

The emphasis of scientific literature on product development is on technology[25]. Despite plenty of scientific literature, only the frame of reference developed by the Minnesota Innovation Research Program (MIRP) takes into account significance of people (participants) in product development (Van de Ven & Poole 1990). Nevertheless, several persons operate in each product development process and products are always creations of humans. A notable part of design management takes place outside the actual design process in the form of choices made by a designer. Based on the cases studied, it seems that personality or personal touch of a designer has at least as strong impact on the final result than the instructions given and guidance, i.e., a product will always look like its creator. A form created is always a subjective view of its creator. Therefore, creation of a connecting thought in each product development project depends on the person (or persons) who interpret the market and needs of customers as well as those who design the product.

5.1.3. Management of design information in prototype stage

In the prototype stages of the cases studied, several colours, materials, dimensions and structural solutions were tested when striving for a 'perfect' outlook of the concept. The output created was evaluated compared to the objectives set. The process was returned back to the previous stages from the sketch stage if the product properties did not correspond to the objectives.

[25] Significance of humans usually comes up in scientific literature in a different way. Several researchers (e.g., Van de Ven 1986; Quin 1988; Roberts & Fusfeld 1988) emphasise the significance of so-called 'champions'. According to Quin, innovations are similar to a human child. In order to be successful, an innovation requires a mother (a champion) to emotionally love it and stay with it when others are willing to give up. Van de Ven (1986) notes that ideas without 'champions' do not lead anywhere.

In the prototype stage, the pattern maker or makers (in a networked project) transfer the sketches created in the preceding stage into concrete products. Despite manufacturing of prototypes basically being a routine operation, based on this research, technical product development has a notable impact on the final result. The manner of a factory to manufacture products may in the worst case even water down a product under development. In the prototype stage, the soul of the product is either 'awoken' or it is not awoken. Based on the cases, management of fine-tuning of design is important, because the prototypes created do not necessarily correspond to the objectives defined during the preceding stages. Problems may occur with, e.g., defining dimensions and mass which will lead to the product missing its final 'edge'.

One reason for difficulty with transformation process is that images and practice rarely correspond to each other. In the cases studied, view of the participants about the desired product properties was not specified until they were able to visually evaluate the product. This problem was maybe more notable in the case of project O, because a visual sketch of the product concept was not created in any stage of the process which would have facilitated, e.g., evaluation of the product's dimensions in advance. Thus, evaluation of the visual appearance of the product required construction of a concrete bookcase.

In addition, the process of transfer is hindered by the fact that at this point, personal patterns of thought of the participants step into the picture. The fact that *the transformation processes take place in the participants' mental reality means that the result of each stage is always an artefact of the mental models of the participants.* This is an explanation as to why *the process seems to in a sense refuse being managed.* The assignment of a task created during the preceding stage (a sketch or a product specification) is open to interpretation and the problem is achieving equivalence between images of the product by participants and those by model makers. Since the same words, patterns of thought or drawings may refer to very different concrete realisations, these risks in product design can never be completely eradicated. Thus, in the cases studied, one reason for the fact that the desired final results were not achieved until after several 'experimentations' may have been differences between patterns of thought of the participants; transfer of images into a verbal and visual form and finally into concrete products.

5.1.4. Management of design information in milieu concept stage

Both project F and project V revealed that a concept is not in a sense ready until the products have been placed together according to the milieu concept designed for sale. Especially with project F it seemed that the participants were unable to achieve an accurate image of the final result prior to creation of the milieu concepts. Despite the fact that the prototype stage already reveals maturity of design, this maturity will be yet again measured more accurately in the milieu concept stage. Placing of products next to each other as home-like unities revealed several development needs that had not been discovered in the earlier stages both in project F and project V. However, systematic and analytic design management was difficult especially in project V due to many voices of the participants in the situation.

However, creation of a milieu concept revealed the underlying dangers in a networked product development project both in project F and project V. The problem with project F was that the product specification and the resulting guiding actions mainly regarded the product family concept. As a result, one could see that certain single product concepts were not finished or were unsuccessful in the sense that they did not work as single products. The problem with project V, in its part, was the fact that the product specification and the resulting actions stressed single products over the product family concept. Due to this, the product family concept possibly remained somewhat unfinished which may also be also due to defects in the milieu concept. Based on the cases, simultaneous management of both product and product family concepts in such a manner that each product is an interesting unity in itself and the product family creates a somehow internally coherent interior decoration solution seems to be of paramount importance.

5.2. Management of critical conflicts

There seems to be a basic tension typical for each stage that is prevalent in each stage of the process, and this tension may cause conflicts. Conflicts are created when there is a striving to partially optimise a single point of view. From the perspective of overall

concept quality, the target of optimisation should, however, be the overall process and its objectives (success of product). E.g., despite the fact that the process of simplification reduces a creative process by setting, e.g., time limits and requirements for the final result (instead of endless development), this is even desirable from the viewpoint of the overall process, since if launching of a product to the market is delayed, it may be a deathblow to the project.

Conflicts are a 'natural' part of the process and they cannot necessarily be eradicated. Instead, they must be identified in order to be able to manage them in an appropriate manner. The cases suggest that the tensions can be turned into strengths. Skilful management of the tensions can, in its part, promote fine-tuning of a concept. *Therefore, it is all about finding a balance stressing the ability to solve conflicts with the advantage of the overall process in mind.*

5.2.1. Critical conflicts in product specification stage

Concept creation in 'a historical perspective' seems to be a problem, because traditionally it has been perceived that a concept should simultaneously have both references to the old and familiar as well as novelty value[40]. Success with design in the furniture industry rarely refers to a completely unusual or unconventional design. Despite the fact that new, previously unseen design concepts awake plenty of attention, rarely are they commercial success stories (cf., e.g., Tiensuu 1999). Accordingly, it is difficult to even bring an already existing or completely familiar concept to the stores. Therefore, it is a question of how well different dimensions of design are combined and what kind of importance is given to different variables.

The challenge lies in combining various items of a product in such a manner that the final specification combines both a creative process producing novelty value and an

[40] According to Noel (2000), several explanations may be found for the phenomenon. Utilisation of existing design may be familiar to a customer and thus safe. In addition, one must take into account the fact that the forms that sell the most have apparently been discovered to be the best.

information process setting the boundaries. Finding of this balance was probably most difficult in the case of project O with a fairly simple and commonly used basic concept. Combining was the easiest in project F where the boundaries set for familiarity were not very strict. In a way, project V was a compromise between the other two cases, and in retrospect, the boundaries set by the familiar and the safe in project V had too much importance during the process of choosing concepts.

5.2.2. Critical conflicts in sketch stage

Based on the cases, the basic tension of the sketch stage is created by a conflict between creativity of a designer and the limits or boundaries (information) guiding design. Aesthetic values are notably important in design of furniture, and limitations set by the project seem to somewhat impede their realisation[41]. This came up with designer A in project F as well as with the bookcase and the sofa in project V.

According to Mumford and Gustafson (1988), creation of a new idea is an internal cognitive process of an individual which may sometimes be promoted by interactive processes within a team. Bach (1973), in his part, states that creativity is connected with subconscious processes and creativity is virtually impossible in connection with conscious processes. According to Liedtka (2000), a designer thinks with his or her pen. Liedtka points out that according to some theoreticians, verbalisation of issues may even prevent intuitive creation (please see also Root-Bernstein 2000). From this perspective, so-called master pieces seem to be created more or less in the designer's unconscious and the limitations set by the conscious mind prevent refinement of this unconscious view.

However, the tension created seems to be necessary, because it strives to ensure that the product under development is suitable for customers and corresponds to their expectations. Therefore, actual design expertise seems to refer to a designer being able to control the tension and utilise it. In such a case, the specification directs design but the

[41] According to Diaz-Kommonen (2002: 136), design also refers to desires, wishes and fantasies.

designer is able to offer his or her 'creative self' adequately many possibilities to express itself. Thus, the limits guiding design should be so thoroughly internalized that they become self-evident for the designer (cf. top of the line sports or musical performance requiring abandonment of conscious thinking and allowing subconscious expertise to lead; for more information, please see, e.g., Green & Gallwey 1986; Gallwey 1997; Harre 1977).

5.2.3. Critical conflicts in prototype stage

Productability of a product has been pointed out as an important factor for success of a product in several connections (e.g., Van Dierdonck 1990; Carlsson 1991). The objective is as good productability of a product as possible (information guiding concept development) in order to be able to retain production costs 'reasonable'. In the case of project O, there was continuous balancing between productability and appearance (creativity) of the product. Most of the times designing views predominated. The primary objective was to create a product concept superior in its design. Due to this objective, however, there were continuous problems with technical solutions in the production department. These problems were, however, solved over time. In project F, productional limitations had notably less significance than in the case of project O. In project V, manufacturing of products was notably guided by wishes of the production department which in some cases led even to watering down of the original idea behind the concept.

The striving for optimal productability is often in contradiction with objectives of the creative process. In light of the cases, productability of a product and low production costs should not become a purpose in itself, since optimisation of costs may lead to weak sales if all possible factors creating additional value which are difficult to manufacture are eliminated from a product. Therefore, the most central issue is optimisation of these different objectives.

5.2.4. Critical conflicts in milieu concept stage

The challenge with the milieu concept stage arises from the need to create harmony. Here, harmony refers to compatibility of various products. It refers to management of a unity which at its best will produce additional value to consumers, diminish the threshold in making a decision to buy and create positive images of how a product might look like in the consumer's home. Creation of harmony is easy in the sense that products are concrete and thus easier to interpret and evaluate than in the preceding stages.

The critical conflict in this stage is created between abundance of information and a process striving for harmony with simplification. Abundance of information refers to the spectrum of development views of the participants which was especially pronounced in project V. Due to the large differences in views, concept fine-tuning was difficult. In most cases, decision-making consisted of compromises which were necessarily not in the best interest of the product family.

5.3. Challenges of joint creation

Teamwork has been studied from various perspectives (please see, e.g., McGrath 1984; Johnson & Johnson 1994; Cleland 1996; Brown 1995; Gahagan 1977; Lichtenstein et al. 1997; McCalman 1996; Leonard-Barton et al. 1994; Dunphy & Bryant 1996; Cohen et. al 1996; Souder & Moenaert 1992; Katzenbach & Smith 1995). In this study, the perspective has been that of assumed productivity of teamwork and work of individuals in concept design.

Based on scientific literature, functional integration and teamwork seem to be effective methods for increasing the efficiency of product development, especially in product development with emphasis on technology. A product development project is offered to a team that meets already in the early stages of the concept design process in order to produce collective ideas. In a project with emphasis on design, the responsibility for concept design usually lies within one designer and a possible team will not step into the

picture until later on, when a sketch suggestion has already been created. (Goldschmidt, 1995)

There is plenty of research on the assumed differences between groups and individuals in effectiveness in the field of social psychology and the results are extremely conflicting[42]. According to Brown (1995: 124–133), the results are largely dependent on the methods chosen. However, McGranth notes that most studies are unanimous on the fact that groups often fail to act with the efficiency that could be expected based on know-how of individuals therein. One reason for this may be inability of groups to utilise their full potential (Steiner 1972: 14–66). According to Brown, it is difficult for members of a group to synchronise their actions and pull together. He does, however, note that there are some studies (e.g., Marquart 1955; Faust 1959) where the loss of effectiveness has proven minimal. On the other hand, Brown reminds us that from time to time the results achieved by groups may be notably higher than the sum of the know-how of its members.

[42] In the case of so-called intellectual tasks (where there is a correct answer to be found), groups achieve more correct answers than individuals; however, in the expense of time used for the process (Davis 1969: 37–41). When the time used by an individual was used as the indicator, groups showed to be much less effective than individuals (McGrath 1984: 69). Effectiveness of 'statistical groups' consisting of individuals may be higher than that of actual groups (Gahagan 1978: 101–102) and therefore, Steiner (1972: 14–66) points out that based on research conducted by Shaw (1932) and Marquart (1955), the result achieved by a group is a direct consequence of the problem-solving abilities of the most skilful individual within the group. In their part, Johnson and Johnson (1994: 225) have reached a conclusion to support the view in favour of effectiveness of groups. According to them, several studies (e.g., Baron et al. 1992; Davis 1969; Johnson & Johnson 1989; Laughlin 1980) have confirmed that groups tend to be quicker in learning, make less mistakes and reach better decisions as well as create results of a better quality than individuals. Johnson and Johnson state the underlying reasons based on research by, e.g., Watson (1931), Barnlund (1959) as well as Falk and Johnson (1977) being: 1) interaction between members of a group produces results, perspectives and strategies that none of the members have not though of before, 2) based on a study by Ziller (1957), groups are more prone to identify and reject incorrect solutions than individuals, 3) according to a study by Bekhterev (1924) and Villasenor (1977), a group has a more accurate memory of events than an individual. Creation of a concept for a new product, however, is a problem for which there is no single correct answer available. Traditionally, one of the central tasks of research and product development is unstructured problem-solving (Walton 1985). According to McGranth (1984: 79—80), a notable part of problems of this type are solved with the help of groups and it has been studied with, e.g., observation of the work of a trial jury. McGranth lists arguments for and against the use of a group and division of labour but offers no clear answer to the question posed. On a general level, one may state that groups are more prone to making decisions that include more risks than individuals (McGranth 1984: 80—81; Brown 1995: 142—143). In product design, this means that decisions made by groups are more likely to lead to either greater successes or greater catastrophes due to discrepancy of a product.

Nemeth and Owen (1996) state that in the light of several studies, groups are less than the sum of their parts and as comes to creativity, the consensus is that creative work should be left to individuals. According to Nemeth and Owen (1996), the underlying reason is that a notable part of the studies have reached the conclusion that individuals tend to produce more creative ideas than groups. Therefore, based on existing research, one can state that a group is necessarily not superior to an individual in development of creative ideas[43].

Since concept design is a complex process with several inputs included, it is difficult to ascertain by ways of research in a reliable way whether the size of a group is the main factor causing the differences in results of processes. According to Nakata and Sivakumar (1996), research results on impacts of individualism and collectiveness in product development seem above all contradictory. According to them, this paradox can be solved if a product development process is divided into stages which can be understood as concept design and development stages; individualism may be important during the concept design stages and collectiveness, in its turn, in the latter stages. West and Anderson (1996) have also reached the same conclusion [44]. According to them, one may assume that a process of innovation begins with an individual. Creation of a new idea is a cognitive process in the mind of an individual despite the fact that interaction processes

[43] In a study by Leiviskä (2001: 142–143) on an IDBM program, people perceived teamwork as both a difficult and a beneficial approach with emphasis on the latter. According to Leiviskä, due to teamwork, humans had a more extensive field of experience, perspectives and know-how to solve problems. According to Leiviskä, an individual can never be able to control issues in the same way as a group. Mapping of unities was easier as a group and the unity was more than the sum of its parts, according to Leiviskä. In addition, an important characteristic of a team was the fact that it is able to produce plenty of ideas. The results of Leiviskä supporting effectiveness of teamwork must, however, be analysed critically. The study dealt with teamwork of students, and therefore its results cannot be directly generalized to apply to teamwork of so-called professionals. In addition, the results may be evaluated as handling cases where a team brought together a variety of perspectives in the same way as Jackson (1996). Thus, teamwork seems more effective than the work of an individual. The research does not, however, show how teamwork functions when it is targeted to definition, development and fine-tuning of design.

[44] This view is also supported by a study by Moenart et al. (1994) according to which 'formalisation' of projects (the extent to which communications connected with a project, decision-making and power has been centralised to the hands of relatively few persons included in upper management of project groups or organisations) and 'decentralisation' (good relations between functions and consensus about roles of R&D and marketing) increase interaction between the functions in question. However, only project 'formalisation' and the 'atmosphere' in co-operation between functions notably correlate with project success.

within a team may sometimes promote it (Mumford & Gustafson, 1988). Also, in teams, the number of innovative individuals participating anticipates the nature and radicalism of innovativeness of a team (Burningham & West, 1995; West & Anderson, 1996))[45].

5.3.1. 'Healthy' and 'sick' compromises

The problem with collective processing of information is that members of a team interpret a phenomenon in different ways which may lead to various conflicts (Zhang & Doll, 2001). If the differences in views make reaching a consensus difficult, a team may solve problems with the help of compromises, thus reaching a solution acceptable to all members instead of a creative solution (Jackson 1996: 63)[46].

The ability to make compromises is usually connected with interpersonal relations but it is a skill of spiritual orientation also in concept design. It refers to the readiness to search and approve concept design as a series of compromises. The designing process consists of reconciliation of a variety of factors and finding the optimal result for the objectives set. In such a case, we are talking about a healthy compromise. Project O is an example of a product where, as the production manager put it, 'technical solutions and appearance hit each other on the side of the head'. The managing director who operated as the process co-ordinator had to find out the point where price and appearance of the product reached the correct balance.

Personal preferences and traits of personality of people transfer with them also to product design. Whereas the work of a single designer is labelled by personal characteristics of

[45] Fairly notable part of scientific literature on teamwork is 'marketing' coloured by an ideology not based on empirical research. Several articles in favour of teamwork are based on tests conducted in closed testing conditions, and therefore, their results cannot be transferred as such to complex and dynamic practice (for more information, please see, e.g., Davis 1969; Gahagan 1978; McGranth 1984).

[46] According to Zhang and Doll, the most important issue in avoiding conflicts is a team having a clear vision of what a product does, what a product is and for whom a product is targeted. According to them, a team will be able to operate rationally only with a joint vision. The problem with the suggestion by Zhang and Doll, however, is that they do not describe how a team will be able to create a clear vision.

the designer, in a collective process the final result may be created as the average of various preferences of decision-makers. The more compromises are made, the greater is the danger of the original product objectives not being met and the final result consisting of a mixed group of various views. In such a case, we are talking about a sick compromise. This is why the managing director wanted to tightly hold the reins of project O in his hands. The danger of sick compromises was especially high in project F where a large group of people gave their advice on concept fine-tuning.

Here, sick compromises do not refer to compromises that are inherent to a concept design, such as reconciliation of structure, form, material and dimensions, but instead to personal, often confronting differences in views of individuals which may water down the original idea of a product. Thus, we are speaking of a meristic product development process proceeding from parts to a whole and not from the whole to parts, as holistic product development. The latter may, at least in part, be deemed as a precondition for creation of harmonious design-centred products.

According to Mumford and Gustafson (1988), a central theme in scientific literature is management of original thinking and competing viewpoints. Despite the fact that Tjosvod has deemed in several studies constructive conflicts as improving the quality of decision-making and thus the quality of outputs as well (e.g., Tjosvold 1982; Tjosvold & Field 1983; Tjosvold, Wedley & Field 1986; Tjosvold 1991), it is hardly surprising that according to Oakley (1990), almost every function at some point wants to influence project management and design decisions. That will in its part make creation of a unity without conflicts more difficult. In a study by Donello (1993), the most typical task of team members was representation of their functions which lead to forceful defence of the territory of each person's own department and confrontations within the team. Therefore, different views, terms and action models are likely to make creation of a sensible unity harder (please see, e.g., Gorb, 1990; Oakley, 1990). If worst comes to worst, a situation may occur where the parts of a product of a product family are incompatible. When a product is developed with collective decision-making – as co-operation between production, marketing and product design – there is the danger that various sectors of product

development will lead lives of their own and instead of integrated development, the focus lies on competitive views or arguments due to unsynchronised product development.

5.3.2. Tacit information and collective concept creation

Nature of information has an essential impact on fruitfulness of collective actions. A notable part of research on teamwork has been realised in technology-centred sectors. Thus, their results cannot be transferred as such to, e.g., the furniture industry where the most important factor increasing competitiveness is design instead of technology.

The methods in development projects for technology-centred and design-centred products deviate from each other in terms of, e.g., analysis and synthesis. In technology-centred projects, a notable part of the information required can usually be presented in the form of numbers or technical specifications making it relatively easy to transfer it from one person to another (explicit knowledge, Nonaka & Takeuchi, 1995: 3–95). It is relatively easy to divide a problem into sub problems which may then be solved. Relations between the sub problems are technical in nature which facilitate their reconciliation[47]. The fact that scientific literature is technology-centred can be seen in, e.g., how the significance of communications has been evaluated in scientific literature. E.g., Tushman (1988) notes that research has continuously proven that a correlation exists between amount of verbal communication and success of projects. This should be interpreted from the perspective of a notable part of the information being in the form of numbers or in otherwise explicit forms.

The situation is completely different for design-centred products. On the basis of all of the three cases, it seems that a notable part of the information required is so-called tacit or unconscious information which is difficult or impossible to transfer to others. Therefore, Zaltman (1997) states that most mental operations occur in the area of tacit information

[47] Articles which introduce collective practices deal with cases where technology is combined with design (please see, e.g., Jackson 1996). Therefore, they are not necessarily stories of how design is collectively managed.

and thoughts are created by images[48], i.e., non-verbal communication dominates the thinking process (Marks 1978). This almost inevitably leads to defective communication between individuals.

When studied more accurately, a 'rational' idea of information and distribution of information seems impossible. A notable part of information and expertise possessed by humans is in a form that cannot be transferred, at least not directly[49].

Understanding must also be taken into account in communications. Communication without understanding is of little value. Information may, of course, be transferred, but it will necessarily not be transferred to knowledge because it is not understood (for more information, please see, e.g., Venkula, 1994: 130). When communication regards complete constructions of thoughts, such as a design concept, mental context of a communicator must also be taken into account (cf. definition of bookcase concept in

[48] Zaltman (1997) justifies the issue as follows: Despite the fact that verbal language has the most notable part in, e.g., communication and storage of thoughts (Bickerton 1990), verbal language does not correspond to a thought (Kosslyn & Koenig 1992). One must also take into account the fact that conceptual abilities of humans have been developed long before speech (Edelman, 1992: 108). A thought is created when neurons are sufficiently activated for an individual to experience them as conscious thoughts (Damasio 1994).

[49] When preparing for a book 'Sparks of Genius', Root-Bernstein discovered that no scientist thinks with words, and according to Root-Bernstein, neither do many other humans doing creative work. For many persons, writing did not come in a verbal form but instead, as Isabel Allende would put it, 'from somewhere in my gut'. Gary Snyder would say that writing begins with visualisation and re-visualisation and Stephen Spender speaks of manipulation of the logics behind images. Nobel prize awarded researcher Barbara McClintock frequently speaks of developing a feeling for an organism. By this she means that she felt like having become a part of a plant she was studying: 'I noticed that the more I worked with them, the larger they became and when I really worked with them, I was not outside of them but instead a part of the system.' Joshua Lederberg, another researcher awarded with a Nobel prize, stresses the importance of becoming a part of a biological system; a participant who knows how he or she would behaved were s/he a chromosome. Albert Einstein wrote of mental experiences with visual images and muscle feeling. Mathematician Stanislaw M. Ulam stated having used mental images and muscle feeling when performing calculations. Einstein wrote that when he had solved problems visually and kinetically, normal words and other examples had to be arduously found... in a later stage. Creative thinking – thinking of any kind that creates and conceptualises new points of view – is based on tacit information presented by Polanyi, images, muscle tensions, play, empathy, emotions and intuitions. All of the above-mentioned are forms of information with little room in our world where thinking has almost always been presented in a logical form with words and mathematics as its language. However, new ideas are in an illogical and non-verbal form from where they will later on be transferred into symbolic language. All non-symbolic thoughts require being conscious of sensitive and emotional feelings. (Root-Bernstein 2000)

project V). This refers to the fact that a message is placed into a context within the mind of each communicator and since each communicator has his or her own mental context, the object of interaction receives different meanings in the mind of each person, e.g., design that is rich for a Finn, may seem simplified to a German who is used to richness. Thus, communication regarding design is inevitably defective. Therefore, Venkula (1994: 130) states that when you are communicating fragments without a context, the most essential feature of understanding; perception, creation and use of relations, will not occur. According to Damasio (2000), a brain researcher, we are unable to connect with the experiences of another mind. According to Damasio, we are, however, capable of experiencing a somewhat similar 'landscape', but we will each create the experience based on our individual starting points. This means that explaining the basic mechanisms of experience and receiving an experience are two completely different issues. According to him, the mind and consciousness are first and foremost private phenomena.

Transferability of information can be seen as an even more complex process prone to disturbances if one is to approve Venkula's (1994: 11–15) claim that whole of the mental system with all of its sub systems participates in transfer of information and information is not constructed based the conscious sub system only but instead interaction between the emotional, the aesthetic, the ethical and the empirical systems is also needed in order to create information[50].

[50] Venkula's five E's (all concepts starting with an e in Finnish):

- Epistemic sub system is a rational or conscious sub system which is usually assumed to control other subsystems or being able to control them in the future.
- Emotional sub system is the system connected with human emotions and instincts that manifests these emotions and instincts.
- Ethical sub system is the system connected with human value systems, responsibility and sense of duty that manifests these issues. With the concept of ethics, Venkula refers to an individual's way of doing things, not actions guided by someone from the outside.
- Aesthetical sub system is a system of form, harmony and relations that organises and puts issues into their correct places in one's mind. According to Venkula, the aesthetical system seems to have a function of organising messages and observations, harmonisation, search for a beautiful form (cf. a solved conscious problem is a state of matters which is even expressed as 'clicking into place' in some languages). The contributing factors in a problem find their proper places due to which disharmony is vanquished and harmony is created.
- Empirical sub system is the system based on actions and personal experience of an individual.

In addition, collective working is made more difficult by the nature of product concepts. Several concrete factors of which it is relatively easy to discuss within a group can be found from a product concept, such as technical properties, durability, ecological aspect and usability (functional quality). From the perspective of design management, the objective is a concept that awakes the 'right' images, i.e., symbolic meanings, in minds of customers. This refers to images created by product design and emotional reactions due to product usability caused by sense of touch (e.g., softness of seat) and sense of smell (e.g., new leather) (mental quality). Based on the cases studied, collective working with images appears to be difficult. One may, therefore, assume that some of the mental models of the participants are not realised and transferred into a concrete form.

The problems connected especially with transfer of tacit information and utilisation leads to two kinds of problems:

a) Development of a concept in the conscious minds of individuals collectively seems to slow down advancement of the process. The process does not proceed because participants are unable to communicate information and their mental models to others in an adequately fine-tuned level.
b) Due to problems with communication, co-operation is often described by views competing with each other instead of integrated development.

Information available for collective use seems to represent the top of the iceberg of overall know-how and knowledge of individuals only. Individuals are able to utilise only a tiny part of all of their information and know-how they possess. Collective concept development is random, because participants are unable to communicate to each other their thoughts which often remain in the level of images and unconscious knowledge.

This is because its collective utilisation requires the information being managed by an individual on a conscious level. Significance of this fact shows very well when studying an argument by Bouwen and Fry (1996: 546–547) that life in groups is presented as conversations. Therefore, a collectively produced concept may be understood mainly as an artefact of conscious information that can be expressed.

Apparently, development of a design concept occurs, at least to some extent, as an unconscious process in the mind of an individual on the level of images, and it is extremely difficult to transfer it to other participants. Development of a concept in the mind of an individual as an image enables working at the fine level needed and as an adequately deep-probing process. In reverse, concept fine-tuning and achievement of depth is very difficult collectively, especially in early stages of a process when there is nothing concrete to rely on. Clear indications of collective working being able to weaken or even destroy a concept under development can be found in the cases studied. *From the perspective of aesthetic refinement and management of complexity, it is thus difficult to collectively develop the consept* (cf. Bach 1973; Liedtka 2000).

The dilemma with collectiveness and the individual-centred approach can be understood by studying Figure 18. Collective operations enrich a concept under development, at least in principle, but at the same time creation of depth suffers (advancement of an process in design). From this perspective, the collective approach is suitable for certain situations whereas the individual approach is a better solution in others. The ideal solution is the star in the figure below being in the middle of the fourfold table which would signify product development through collective actions being rich and due to individual-centred actions also deep-probing.

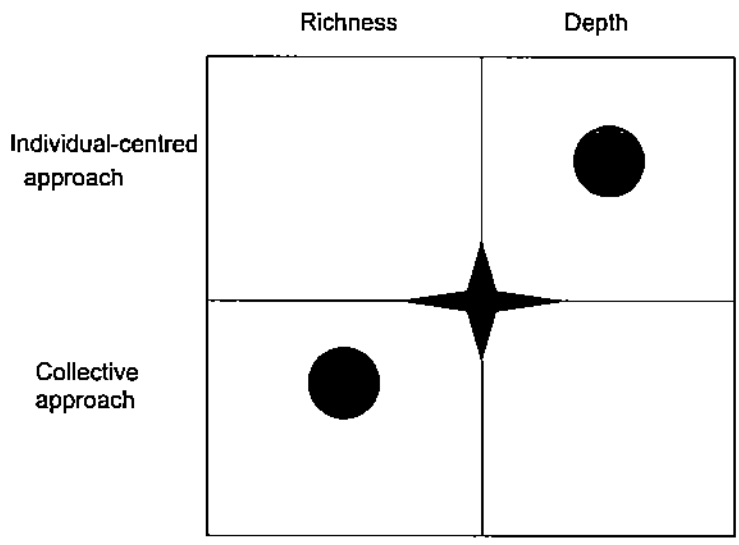

Figure 18. Richness vs. depth of a concept.

Nonaka and Takeuchi (1995) suggest a model where the creation of new information is based on the assumptions that tacit information can be transferred into an explicit form and that this transfer is sensible. One may, however, assume that the ability of participants to handle, e.g., design information in various stages of concept design in an explicit form (conscious information) is limited. The process may be effective only if it is possible to transfer a complete process of thought to other participants in a project[51]. *The consequence is that in design-centred sectors, it is not always sensible to strive to transfer tacit information into an explicit form and thus into collective working.* Instead, the limitations and possibilities of tacit information should be identified and the process constructed accordingly.

The problems with transfer of information in concept design may be reduced by acting alone and yet together. This refers to participants first working alone in developing a concept, but later on communicating results of their work to others. This also includes information on how they have reached the result. After the transformation process, each participant will interpret and compare the concepts created and possibly create a new, more extensive suggestion which may then be discussed again in a group.

Not all information can be transferred, nor is it necessarily sensible to transfer it into a collective discussion on a conscious level. Transferring subconscious processes into words may too soon 'finalise' a model under development or produce a suggestion that is too 'raw' (not fine-tuned enough). The advantage of this model is the fact that it combines the advantages of working alone and teamwork: the possibility to utilise tacit information and probing deep into a phenomenon when working alone and combination of various viewpoints in teamwork. In addition, it will create better preconditions than teamwork for introduction of intuitive knowledge of individuals (for more information, please see, e.g., brain researcher Damasio's study on intuition, Damasio 2001: 161–192).

[51] Therefore, West and Anderson (1996) state that effective teamwork requires collective understanding of the project objectives from the members of a team.

5.3.3. The interaction between physical and mental reality

When studied more closely, information and knowledge can be perceived as more complex phenomena than they are usually perceived in practical work. *In addition to interaction between explicit and tacit information, an integral issue in design information management is the interaction between physical and mental reality. Information and knowledge can, therefore, exist in an explicit and an implicit (tacit information) form either in the physical or the mental reality* (Figure 19). Explicit information in the physical reality may refer to a colour or some other easily interpretable information. Tacit information in the physical reality may refer to information in a product that is difficult to interpret, e.g., images awoken by design of a product (symbolic meanings represented by a product). Based on the cases studied, one may assume that product development competence described in Chapter 5.4.2 largely refers to the ability to act with various forms of information in a manner that further refines a concept. Therefore, this approach emphasises the participants' ability to communicate information and the ability to generate new, interesting product concepts using the information communicated.

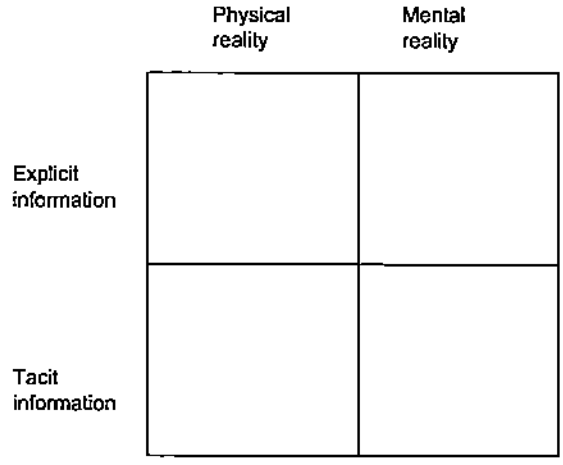

Figure 19. Various forms of information.

Concept refinement can be perceived as both concrete facts and processes occurring within mental reality of participants. Concrete outputs of concept design (product briefing, sketch, etc.) are artefacts of mental models and vice versa. Mental models of

participants are concretised into a form that can be handled by others above all in a concept in a physical form, e.g., a sketch or a prototype. Due to the concrete form of the concept, collective working is increased and the concept will be returned in a new form, which is usually more ready-made than before, into mental models of individuals[52]. Thus, mental and factual processes create an iterative unity (Figure 20) and the major problem with product development remains the interaction between the material and the mental reality (cf. Hassi 1998: 19). The information received about needs of customers is transferred during product design into information carried by a product (Clark & Fujimoto 1994: 281).

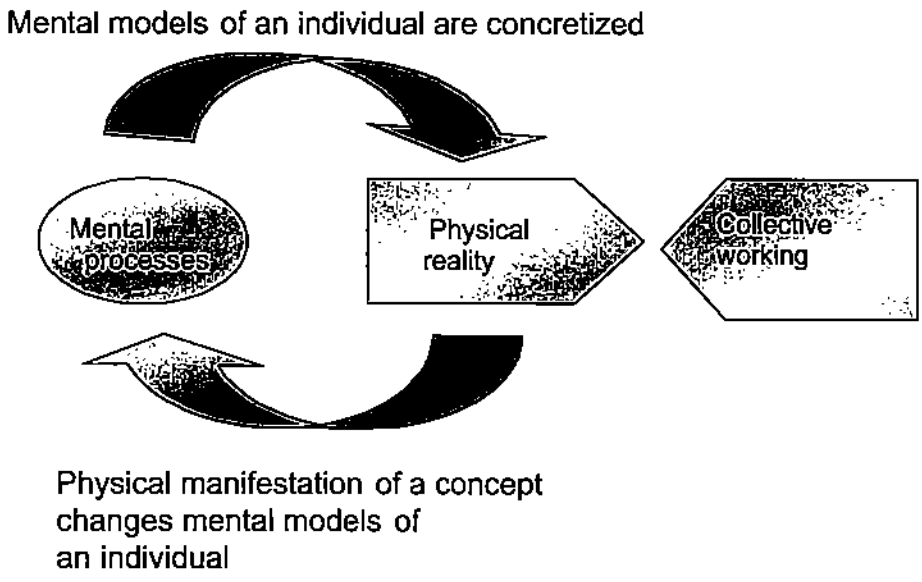

Figure 20. Transformation process in concept design.

The roles of a compiler of a product specification, a designer and a pattern maker can be perceived as transformators of sorts who transfer mental models into a concrete form and communicate with other participants using this concrete object as a medium[53]. The cases studied suggest that the problems connected with collective conceptualisation can be

[52] One may assume that the more abstract the information, the more difficult it is to manage (at least collectively). On the other hand, the more concrete the form of a concept, the less it seems to develop.

[53] Liedtka (2000) regards design as a process of argumentation instead of a mere process of analysis and synthesis. Thus, design would refer to negotiation instead of optimisation.

solved, at least to some extent, if participants are able to concretise their mental models already in the early stages of the process. Thus, the ability to concretise is a tool enabling a larger number of participants to participate in concept design and change their own mental models regarding a concept.

The transformation processes in between the stages are possibly one of the most difficult points in concept design management. Success of a transformation process depends on the ability of the 'sender' to transfer his or her mental and physical models and the ability of the recipient to receive signals and issue meanings to them. The cases studied suggest that concept fine-tuning is especially problematic because it refers to working with fine nuances (which may nevertheless have a very notable impact to the final result) which require very fine-tuned mental models from the participants.

Manageability of the transformation processes can be increased by continuous interaction between the physical and the mental reality as described in Figure 21. This can be achieved by participants going through an iterative process comparing their interpretation to the model to be transferred (which may refer to a model in either the mental or the physical reality) whereas a new, more elaborate model may be created through re-interpretation which better corresponds to the original model. Thus, the process is described by advancement step by step. Advancement includes continuous securing that the interpretation made is 'correct'.

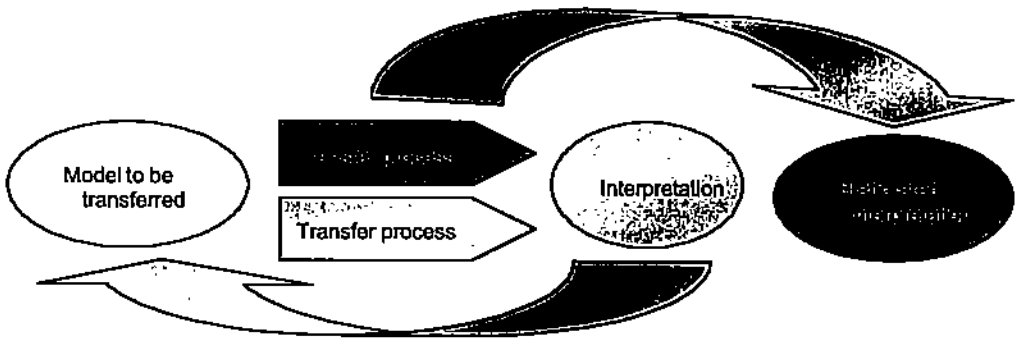

Figure 21. Transformation process step by step.

5.3.4. Controlled collectiveness

According to Van de Ven (1986), product design is a collective process advancing over time. McGranth et al. (1996) define competence as a collective characteristic which appears and develops within various project teams. Wilson (1990) ascertains that a successful innovation requires bringing together persons with various skills. What does participation mean in product design? Does it refer to collective decision-making as well? Two basic strategies can be identified for development of required know-how:

1. Concept design may be collective in the sense that participants from several areas of expertise are involved in concept design and a product is developed together. In this model, each sector brings with it its specific knowledge and a new product is created by making joint decisions.
2. In a strategy to the contrary, concept design is controlled by a single person who possesses the necessary basic knowledge of various sectors of concept design and experts from various areas of expertise are used mainly to complement the knowledge and expertise of the central person. The task of other persons is thus

producing the information necessary for the process integrator. Concept design remains collective but is controlled and borders on a team of one.

One may assume that up to a certain point, teamwork is more effective than an individual-centred way of working. A group at least potentially possesses more views, knowledge and expertise than an individual alone. Based on theory, combination of several different views creates new kind of additional value[54]. *The challenge problem, therefore, is how to integrate this knowledge and expertise in order to develop a joint and internally coherent concept.*

However, according to Seth et al. (2001), when a project development team includes many members, it may make decision-making weaker because it will easily lead to an algometric process of decision-making. The problem can be illustrated when keeping in mind that a communications structure becomes exponentially more complex as the number of persons involved increases; when a group includes two persons, there is one internal relation within the group, with three persons five, with five persons 89 and with seven persons 965 (Lönnqvist 1994: 61). Based on this study the combination of several viewpoints was difficult and in several cases, striving for collective concept development even reduced quality of the final result created.

The problem can be approached by stating that collectiveness and control are not opposites to each other but instead methods complementing each other. In the cases studied for this research project, concept design was at the same time both controlled and collective. However, collectiveness does not necessarily refer to collective decision-making. Participation is an important factor, but it does not necessarily refer to participation in decision-making. Collective actions should refer more to co-operation between various areas of expertise, search for the information required (support groups) and communication of that information to the core group in charge of decision-making. *Instead of collective decision-making, one could call this controlled collectiveness*

[54] This could also be the case because, e.g., Lautamäki (2001) discovered in his dissertation on the furniture industry that some of the meanings were shared by designers, retail trade and manufacturers (shared), some were connected to roles (not shared).

(consulting participation, Hatvany & Pucik 1988)[55]. Collectiveness is connected with teamwork, control with hierarchy. Despite the collective nature of a project, someone needs to make the decisions and this always includes control which in organisations is traditionally divided according to hierarchic levels. Thus, the focus lies in the manner of management and organisation of the process. The major question is how control and responsibility are divided in various situations

Despite collective working being more effective in principle, in practice an individual-centred model seems to work better. Therefore, creation of concepts in the cases studied was the responsibility of the core group. The question is necessarily not that of prevailing theory being wrong. Instead, collective practices, especially when connected with design problems, often include problems which necessarily cannot be solved with our current knowledge. It seems that the significance of collective product development practices is lower with design-centred sectors than with technology-centred innovations. *Thus, one may conclude that the more notable the role of design in concept management, the larger is the significance of an individual-centred model. In this way the complexity and the development of design can, at least in theory, be better controlled.*

5.4. Concept design from three perspectives – factual and mental processes and model of joint creation

According to Senge (1990: 203), a phenomenon must always be studied from two perspectives. The first perspective is created by process thinking and the other by mental models connected with process management. Based on this study, concept design should be analysed from three perspectives (Figure 22). The first perspective describes the

[55] Despite teamwork having a central role in, e.g., Japanese concept design, also in Japan a product concept is usually created through co-operation of a few central persons (cf. Nonaka & Takeuchi, 1995: 211). According to Hatvany and Pucik (1988), only a few other Japanese practices are as misunderstood in Western scientific literature as the process of decision-making. According to them, endless conversations in order to find a consensus are not everyday practices in Japan. When a decision on an issue has to be reached quickly, decisions are made by a persons responsible for the issue in question and in other situations as well, decision-making could be described as consulting. In teamwork, the emphasis lies in listening to all parties, not reaching a consensus.

factual processes during which a concept is developed into its final form. The factual side of a process refers to concrete structure of a process, stages, sub processes and concept building blocks. Factual factors create a map of sorts which the participants strive to interpret based on their mental models.

The second perspective is created by mental models controlling the process. Whereas factual processes in a manner create the structure of a process, mental models define how to act within these structures[56]. Mental side of a process thus refers to thinking occurring at the level of an individual and a group and the mental models therein whose consequence actions are. The third perspective refers to operations models connected with co-operation. One may study this from the viewpoint of degree of collectiveness of actions. This refers to the fact that successes are not created by actions only (actions in factual processes, e.g., creation of a briefing) but most of all by how actions are conducted (actions within mental processes). This is, in turn, influenced by how actions are organised (readiness to action).

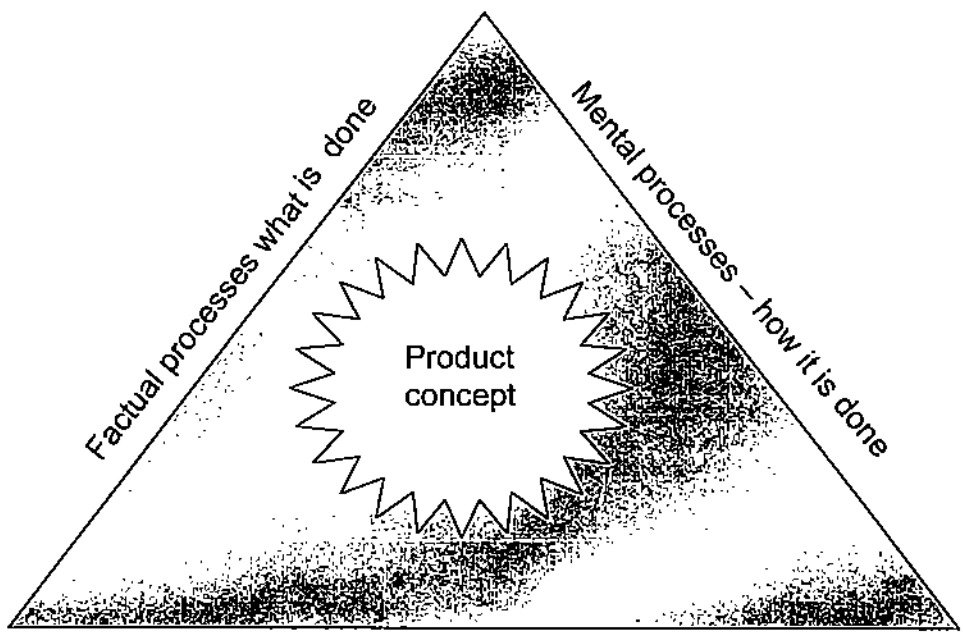

Figure 22. Perspectives to concept design process.

[56] In this sense, Chapters 5.1–5.2. deal simultaneously with factual and mental processes.

Thus, in accordance with the second research question, logics of a process refers to the interaction that is created between various elements of a process. These elements include both concept building blocks and various participants. Logics of a process may be perceived as referring to the dynamics between various stages of a process as well. *Logics of a process has thus been used in this study as the superordinate concept for all the forms of interaction that can be discovered within a concept design process.*

5.4.1. Factual processes

Based on the studied cases, concept design can be studied as four factual processes as presented in Figure 23[57]. The bottom side of the figure describes concept design as a unity (a) created by the stages. Based on the cases analysed, a product concept is refined into its final form through five stages: research, product specification, sketch, prototype and milieu concept stage.

The way in which information changes when the process proceeds from one stage to the next is described here with the term design information process. This can be seen in the description of the process b presented in the figure as a symbol describing the transformation process that has been placed in between each of the stages. Therefore, the problems in concept design are not created by mere completion of the stages, but also by the ability of the participants to transfer information in between the stages.

A concept will be developed to its final form within each stage by going through the three part processes (c): concept definition, concept development and concept fine-tuning. During the first process, a definition of what is to be created is made. The sprout of a concept created during concept design will be refined into a more advanced form. In the third part process, the concept will be fine-tuned in order to reach the desired tuning.

[57] The process descriptions presented here should be perceived as a map of concept design where all 'roads, pathways, hills, swamps and rivers' of the landscape are drawn. It is important to draw a map because without it, it is difficult to head to the correct direction. When reading these descriptions, one can note that we live in a relativistic world. The farther we proceed from the cases used as the basis for these descriptions, the weaker they describe reality.

Each stage of the process includes various tensions. The tensions are created by objectives that are at least partially contradictory, such as conflicts between design and productability. These conflicts are described with the symbol d.

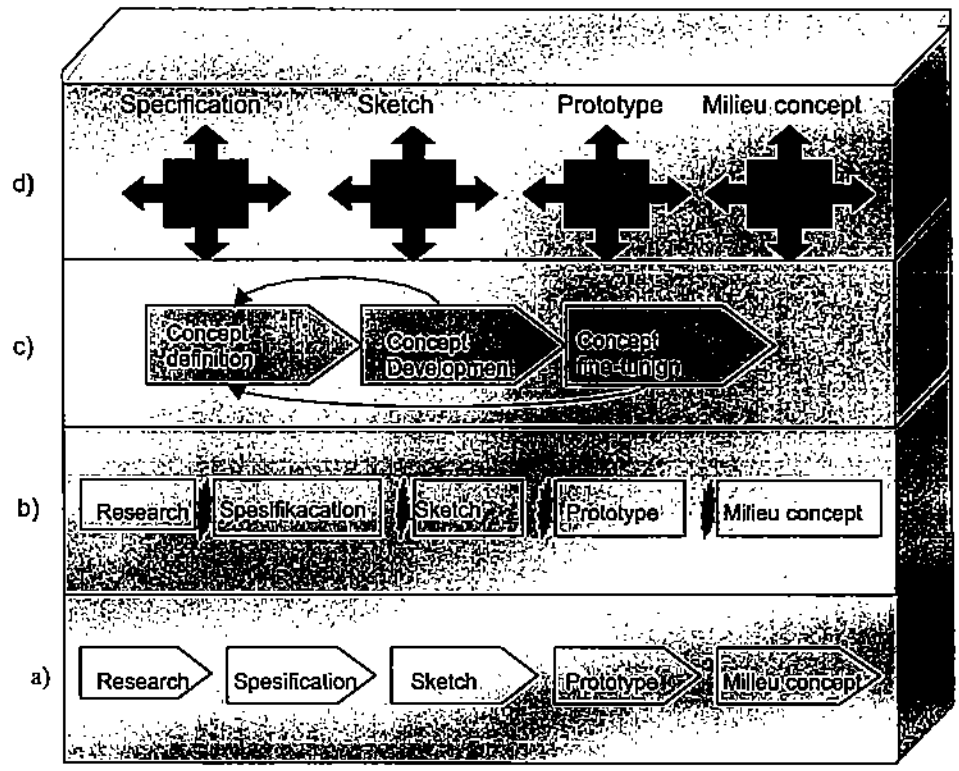

Figure 23. Factual concept design processes.

5.4.2. Mental processes and product development competence

A mental model refers to the manner in which an individual observes and understands his or her surroundings. Mental models create a frame of reference based on which an individual makes decisions regarding his or her actions. (Senge 1990: 174–204)[58]

[58] The empirical material used in this study shows that each individual has a strong frame of reference through which they observe the world. Therefore, creation of a joint frame of reference is a difficult and slow process where the prerequisites for creation of a collective concept are weakened[58]. This refers to the participants being unable to question the patterns of thought used, i.e., to learn. According to Argyrise and Schön (1996), learning can be divided into two parts: "single-loop" and "double-loop" learning. In the former, an individual strives to find solutions better than before for existing problems. In the latter, an individual reflects the situation more

Individuals tend to easily repress information that does not fit in the prevailing views. This phenomenon may be explained in situations of high commitment with the theory of cognitive dissonance by Festinger (1962), according to which an individual strives to inner coherence with various elements of the thought process in order to avoid unpleasant feelings caused by dissonance[59].

Studying mental models and processes is of paramount importance since according to Griffin (1997), there is no single correct way to organise a product development process, but instead success largely depends on how a process is managed (for more information, please see, e.g., Poolton & Ismail 2000; Coughlan & Brady 1995). This may be called competence of action (for more information, please see, e.g., Venkula 1988, 1994, 1995) or product development competence (for more information, please see, e.g., Van de Ven 1986; McGranth et al. 1996, Ylinen 2004). Here, product development competence refers to the mental models and mental processes which participants use when creating a new product concept. From this perspective, completion of factual processes alone does not necessarily lead to success but success depends first and foremost on how participants act in these processes (cf. e.g., design information transformation processes and critical conflicts).

Mental processes refer to ways of thinking and acting which are created in the mental reality of both an individual and a team. They define success of the transformation processes or processes of change between the stages; how a concept is defined, developed and fine-tuned in the various process stages. The quality of mental processes also defines how well information can be refined.

Five mental processes were discovered in this study that seem to have a notable role as comes to management of concept design. Four of these processes – *reflection, generation, management of complexity and process of simplification* – are connected with

deeply than before and may come to the conclusion that the problem to be solved and the method used are wrong. The result may be a new approach to examination or a better definition of the problem leading to more innovative solutions.

[59] For more information on commitment, please see, e.g., Laaksonen (1994).

refining of design information and the last one – compressive thinking – is connected with preconditions for joint creation.

Concept development is based on refining information gathered during the research stage in several stages into a ready-made product. In this process, the most central issue is creativity and, to be more precise, interaction between creativity and information.

The concept of creativity admits several interpretations. Creativity refers often to sudden realisations and their coming into being cannot necessarily be explained. However, Walton (1993) states that creative thinking as the creator of success is nothing but a myth. Robinson and Hackett (1997) remind us that creating wild ideas is not creativity and creating wild ideas without a target is an illusion, mere information without any real substance.

One may assume that the best explanation for a creative process is created by the model of analysis and synthesis (please see, e.g., Jones 1984; Bach 1973; Archer 1984). The strength of models lies in the fact that they are based on information analysis but this does not eliminate the need for creativity[60]. In this model, creative thinking is based on analysis of a defined problem and processing of information received thereof. However, one may assume that reality is more complex than the model leads to understand.

According to the definition of creativity presented in this study, in the course of a creative process an individual or a group analyses and combines design information and derives new kinds of models of thinking thereof in order to produce additional value. Therefore, creativity does not refer to creation of new ideas only, but (more or less) systematic work with a certain objective. This work has been described here with the help of four mental

[60] According to Livols (1993), creation of a concept requires utilisation of both the right and the left cerebral hemisphere. The first stage, the analytical stage, takes place in the left hemisphere and the 'day-dreaming stage' in its turn in the right hemisphere. Enhancement of one hemisphere over the other, i.e., replacing systematic actions with creativity, for example, is a dangerous myth according to Owen (1992). According to Khunara and Rosenthal (1998), the key to know-how required in concept design lies in one's ability to find a balance between creativity and an analytic approach.

processes: reflection, generation, process of simplification and management of complexity.

These mental processes refer to ways of handling design information which also creates limitations to development work according to properties of the building blocks[61]. As terms, reflection and generation refer to analysis and synthesis. However, scope of the former terms is broader. Simplification is necessary in order to define chaos and management of complexity is necessary in order to create a harmonious unity. In this way one can *keep the process manageable (process of simplification) and produce harmonious concepts (management of complexity).*

Instead of creative thinking, a creative process is thus seen as a complex process where various mental processes develop and refine design information. From this point of view, creation of a concept is a more deep-probing, complex and challenging process than the dialectic model of analysis and synthesis leads us to believe.

Reflection

Reflection is usually defined as thinking which 'looks at itself'. According to Dewey, in reflection an individual reconstructs his or her previous experiences and perceptions. Old perceptions are studied in the light of new experiences. (Aaltola & Syrjälä 1999: 14) Senge (1990: 191–192) defines the concept of reflection in a broader sense as a skill of an individual to become aware of how we create mental models and how they affect our actions. With this, Senge refers to Schon's (1983) concept of reflection within actions. Schon describes the concept by using the metaphor of thinking with one's feet and learning by doing. Schon signifies that we cannot only think about actions but we can think about actions while acting.

[61] The nature (clarity of information) and properties (nature of information) of the building blocks define what can be created from them.

Reflection largely refers to an ability to learn. Research conducted in the beginning of a concept design process creates a certain kind of basis for learning which must be reflected. Reflection creates understanding of situations which is important, because each situation always creates a unique phenomenon and previous experience cannot be directly applied in solving it.

Thus, the concept of reflection is more broader than that of analysis. The latter concept refers to rational interpretation of available information, whereas the former also takes into account the irrational side of an individual (tacit information). It refers also to the ability of an individual or a group to evaluate suitability of the mental models used in the analysis in the situation at hand[62]. Several questions are connected with this:

- Is the problem at hand the right one?
- How should the problem be approached?
- How do the mental models used affect the conclusions drawn?
- Should the frame of reference used when interpreting information be changed?

Generation

Whereas the term synthesis refers to combination and reorganisation of gathered information [cf. Leiviskä's definition of creativity (Leiviskä 2001: 51)], generation refers in addition to these factors a striving to refine the concept into a more elaborated form. It also refers to the ability to change and replace when necessary the mental models with more 'refined' ones which may promote refinement of a concept. In addition to creative thinking, it refers to purposefulness (needs of customers, objectives of company, etc.). Generation also refers to the ability to operate with various forms of information [63].

[62] Based on the cases studied, ability of participants to refine their mental models into a more 'refined' form is quite limited.

[63] Here, the various forms of information refer to explicit and tacit information (for more information, please see Chapter 5.3.2) and information available in the physical and the mental reality (for more information, please see Chapter 5.3.3).

Management of complexity

The term complexity may be regarded as follows: the more connections an issue has, the more complex it is. The more connections there are, the more alternatives there are. (Beckham 2001)

Management of complexity is one of the notable problems within product design (Van de Ven 1986; Walker 1990; Tiensuu 1995; Khunara & Rosenthal 1998). Management of complexity is important in order for the final result, whether it be a single product or a product family, to become a harmonious and coherent unity (cf., e.g., objectives in the concept development stage of project F) which in its part increases additional value perceived by customers. Management of complexity refers to both harmonisation of design and combining various items of a concept (e.g., design, usability, productability, etc.). The challenge with management of complexity lies in the large number of factors to be taken into account and differences between the variables to be integrated.

Most problems with management of complexity deal with design which is possibly the most important single product characteristic of furniture or at least the factor that is most difficult to manage[64]. This is due to the special properties of design language compared to, e.g., verbal language. Design language refers to a simultaneously syntactic model. Design language includes all the same elements as verbal language but they differ in that

[64] Two basic approaches may be used in management of complexity: management from unity or construction from parts (for more information, see Appendix 5). The problem with a process proceeding from parts to a unity (meristic approach) is that sensible parts may create a unity with little sense (Van de Ven 1986; Tiensuu 1995). The opposite of the meristic model is holism (Kaila 1963: 29). In answer to the question as to how to avoid a situation where a unity is a trivial sum of its parts, Van de Ven (1986), in his part, utilises the concept of a hologram created by Morgan (1986). In content, it refers to the same issue as the concept of a holistic approach used here. It refers to development occurring from a unity towards parts where different factors are studied as parts of a whole. The holistic approach is of significance in the furniture industry, because according to Hirschman (1983), industrial arts products cannot be defined and analysed as a structure of their attributes. I.e., products cannot be analysed as a sum of their parts. *The more significant the role of design is in development of a new product, the more important is an approach proceeding from parts to a whole.* However, the cases offer references as to appropriateness of the approach used in fine-tuning varying on a case-by-case basis. An approach directed from parts to a unity may be useful if one wants to vary the basic concept in the fine-tuning stage in order to reach the best

design language is simultaneous. In the same manner as a Rubik's cube, solution of a design problem requires simultaneous examination of various items. Various sectors of a concept cannot be developed as items separate from each other but they must interact.

Therefore, it is of paramount importance for concept management that we understand that a concept is created via several compromises. The problem with integration is that a change made in a variable may require changes in other variables as well, e.g., change of a design detail may reduce usability or cause a significant increase in price[65].

Process of simplification

Simplification is required in order to organise chaos. Despite chaos being a desirable state in certain stages of a process, it does not necessarily lead a process towards the objectives set for it. In order for participants to be able to find a some sort of a joint view of a product concept, they must have the ability to simplify the information available into a form enabling actions ('actionable information'). In both Project F and Project V, several situations occurred where the information available was simplified, thinking and actions were focused and thinking was made parallel. All of these actions were made in order to create order from chaos ('process of making sense'). One may assume that to a certain extent creation of additional value (if additional value created by a product family is not taken into account) in projects similar to projects F and V is more difficult than in so-called normal situations, because the need to transfer from chaos to a more controlled unity is greater, at least in principle.

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result possible. Thus, by making minor changes in parts of the concept, extremely notable changes may be made to the feeling of the overall concept.

[65] Problems due to optimisation of parts are shown very well in a case studied by Norman (1989: 215): "If aesthetics ruled design of common objects, life could look prettier but it would be much more uncomfortable. If usability ruled, life could be more comfortable but more ugly. If design was defined based on production costs and productability, products might not be pleasant-looking, functional or durable. Each of these issues has its significance, but if one rules over the others, that will lead to problems."

5.4.3. Models of joint creation – Alone and together?

Due to problems with difficult transferability of information and collective creation, teamwork is necessarily not a precondition for success of product development; it is necessarily not even a desirable model for organisation of the process. Instead, one may assume that the most important issue in creating together is the relation between work by an individual and teamwork.

Teamwork may either create additional value or reduce the quality of the output. Teamwork has a positive impact if the mental models of participants complement and support each other whereas this may lead to enrichment and/or clarification of the concept. Teamwork may, however, lead to an opposite result if the collectively realised transaction remains superficial (significance of tacit information) or reduces the creation of the concept (e.g., due to conflicting views). One can assume that concept design includes both individual and teamwork. From this point of view the main challenge is to combine them.

Madhavan and Grover (1998) stress that creation of creative ideas depends on the ability of participants to engage in meaningful conversations creating synergy with other team members. If a common view cannot be found, at least to some extent, in the course a process, the process may be described as an endless series of conversations which does not lead to the correct result as comes to project objectives.

Combination of thoughts and information proved to be surprisingly difficult both in project F and project V. One may assume that problems connected with co-operation between humans are due to the inability of participants to think compressively[66]. *When oversimplified, compressive thinking refers to flexibility of thinking and an ability to*

[66] Isaacs (2001: 23–32) notes in a similar manner that we are not used to thinking together. Isaacs offers dialogue as the answer for the problem of thinking together. According to him, dialogue is a common pattern of thought and way to think together. Dialogue is a living experience of acquiring information which occurs inside humans and between them. Dialogue reinforces connections between humans, views truly shared by humans and mutual understanding thereof. The objective of dialogue is to harness combined collective intellect of humans into the use of a group. (Isaacs 2001: 23–32.)

utilise new information received from other participants (information and views of participants) in order to develop a new concept.

Compressive thinking refers to the ability to communicate facts and thought patterns as well as flexibility of thinking in order to combine various views. Thoughts of others which previously seemed strange and frightening now support each other. Instead of repression, participants will find elements complementing their view in the thoughts of others which improve the joint concept and bring new kinds of views into it.

In the course of the cases studied, several situations occurred where multiplicity of views caused problems in co-operation. In some of the situations, personal views of participants differed from each other in the extent that it was extremely difficult, if not downright impossible, for the participants to reach an integrated, joint view of the product concept. The following is a examination of the factors that prevent success of compressive thinking.

Limited capacity

The basic problem with collective conceptualisation is the limited capacity of humans to deal with uncertainty in complex situations. According to Van de Ven (1986), humans tend to create stereotypes in complex situations in order to be able to deal with the complexity. According to him, several empirical studies have proven that the ability of most individuals to reach decisions in complex situations is defective. In both project V and project F, as uncertainty grew too strong, co-operation was blocked. The number of possible combinations became so high that groups were no longer able to reach decisions.

Mass illusion

An approach that can be used in analysing this phenomenon is the concept of mass illusion introduced by Eskola (1979: 65—69) which is familiar from the fairy tale of the emperor's new clothes by H.C. Andersen. The concept of mass illusion deals with whether humans

primarily react to each others' external or internal thoughts and feelings. Eskola calls this the inherent protection method of a social institution. According to him, the tragic issue with mass illusion (and the problem for concept management) lies in humans searching for a mutual connection in false external reality instead of realising that they have the possibility to find each other (a joint view in concept design) in genuine inner feelings and thoughts as well.

During this research project, this phenomenon was first discovered in project F where the quality of conversation in the workshops aiming at development of a product briefing was low. However, each entrepreneur had 'smart' opinions in conversations with the researcher. In the same manner, the joint workshops for project V consisted of participation and were therefore not fruitful (if the commitment created in these workshops is not taken into account). External actions, such as adopting attitudes toward development of the product concept, did not necessarily correspond to the inner feelings and thoughts of each individual. Due to this, the workshops can be described as controlled from the outside. Therefore, it seems that there are models of behaviour, thinking and feeling emphasising individualistic consciousness present within the participating companies which are not especially creative or productive [67]. At the same time, the threshold for breaking these norms created through long practice seems to be fairly high.

Aversion of conflicts

The fifth problem was the need to avoid conflicts which clearly coloured co-operation. According to Mörä (2000), it is a common pattern of thought that a community operates at its best when there is consensus as to the objectives and means to be used and when all participants follow the same rules, i.e., the organisation has reached a state of consensus. However, Mörä states that harmony may nevertheless be ostensible, e.g., the atmosphere in meetings is often friendly but indifferent. Therefore, Senge (1990: 249) states that in

[67] The underlying reasons may be, e.g., social pressure to present oneself as modest or reluctance to offer one's own expertise to the use of others. One must, however, also take into account social pressure which may be high.

contradiction to the general belief, there are plenty of conflicts within successful teams. It seemed that the need to avoid conflicts controlled the joint activities also in the cases studied in this research project. Interaction was delicate and presenting of dissenting opinions was avoided. In addition, when dissenting opinions were presented, healthy disputes were avoided.

According to Isaacs (2001: 247–279), the striving to avoid conflicts may be connected to a broader context, fields of discussion. The concept of fields of discussion refers to four different fields in which conversations are conducted. Isaacs describes conversation within the first field as deadly polite where nothing can be questioned. In the second field, according to Isaacs, views tend to 'collide with each other' which in practice means that humans begin to argue about whose view is the correct one. At the same time, anxiety within humans and that connected with human relations comes to the fore. Isaacs states that despite the fact that there are other fields of conversation, many groups never proceed further than this one. The third field is described by studying and pondering. Participants no longer stick with their own viewpoints only but also tell how they have reached this viewpoint. Team members begin to see different issues and are ready to study their assumptions. Questions are pondered from various perspectives. According to Isaacs, in the fourth field humans experience a flow which often leads to one person verbally expressing thoughts of another. Traditional opinions are loosened in order to allow room for new opinions.

When studying the cases used in this study based on the fields of conversation by Isaacs, one must ascertain that the various groups did not go much farther than the second field. Conversations belonging in the third and fourth field were mainly conducted during projects F and V between the project manager and the design manager (in project V, the designer). Otherwise, conversations conducted may be categorised as belonging in the first field when using the concepts by Isaacs.

Preconditions for compressive thinking

Humans attempt to analyse their environment in order to make it understandable. However, changes in cognitive structures that induce changes in perceptions about reality require time. (Grønhaug & Olson 1999) Therefore, Senge (1990: 258–259) notes that teams need practice in order to learn how to work together. In all of the cases in this study, the teams were new and partially temporary. This signifies that the results cannot directly be applied to long-term teams. However, on the other hand one may assume that similar problems are encountered in operations of long-term teams as well, as the studies by Senge (1990) and Isaacs (2001) prove. One may, therefore, assume that the freshness of the teams used in this study revealed the problems better than usual.

Due to the problems discussed above, one may find certain preconditions that are needed in order to allow room for compressive thinking. The first factor is ability of participants to be genuinely present as themselves in situations where there are many participants. Secondly, groups must avoid too eager aversion of conflicts. Thirdly, participants should develop patterns of thought which enable increased mental flexibility. Thus, adopting of new points of view would become easier. Fourthly, participants should find, at least to some extent, a common way of working. Fifthly, participants should develop their ability to endure dissonance until various information components have been placed into a new order. Sixthly, participants should also develop their collective consciousness in order to improve collective integration of thinking.

6. CONCLUSIONS

6.1. A Holistic model of concept design management

According to Drucker (1993: 7), knowledge is the only resource with any significance in our new economic system. The world is managed with strategic knowledge and expertise. Knowledge refers to a view of the direction to which the world is headed and what should be offered to customers tomorrow. The significance of this knowledge comes up, e.g., in the automobile industry where business is based on predicted knowledge derived from needs of customers and the market situation. For the same reason, the fashion industry in Italy (e.g., furniture industry) is still going strong, despite cheap imported products. Expertise refers to an ability to transfer this knowledge into product, marketing and action concepts. Concept design signifies both acquiring of critical knowledge and its refinement into the form a product concept with novelty and additional value. Market research may only offer references as to the 'right' solution. During a concept design process, information is created which is then refined into the form of a concept with the help of expertise.

The process described above is called 'economy of duplication of information'. A product intensive in information is expensive to develop but (relatively) inexpensive to produce. (Lahti 2002: 9) In Finland, the significance of concept design and predictive design research has probably not yet been understood in the same manner as the competing countries. The government of Japan has financed predictive design research already since the year 1928 which, according to Hassi (1998: 43) has been a critical element of the country's industrial policy since the second world war[68].

In Finland, a competitive edge has traditionally been sought via development of, e.g., technology, production or logistics. *However, a customer does not purchase technology or logistic solutions which are secondary issues. A customer purchases product concepts*

[68] According to an editorial published in Finnish financial magazine Kauppalehti Optio on 3 October 2002, the large clothes industry company Hennes & Mauritz has hired 70 designers for anticipate trends.

which create the primary competitive edge of a company. Despite the significance of the quality of new product concepts, the significance of concept design has been poorly understood in Finnish companies. The underlying reason may be the fact that concept design is a complex and confusing process of which it is difficult to get a hold.

The objective of this research project was creation of a description of the problems connected with concept design and making them understandable from the perspective of concept management. Therefore, the model presented here describes concept design as a process that can be (more or less) systematically managed. The objective of systematic management is to reduce randomness within concept design[69]. This strives to increased accuracy of product development. The objective is to create a new product with additional and novelty value.

This objective is to be met by managing factual and mental processes in an appropriate manner. Realisation of this objective, in its turn, is highly dependent on how actions are organised, i.e., how work of individuals and teamwork can be combined in a productive manner. This is described in Figure 24 which presents a model of concept design aiming at a holistic representation.

The model includes several levels. In the core of the model lies design information that can be in an explicit form or as so-called tacit information. What is important in addition to explicit and tacit information is interaction between physical and mental reality.

The most important issue in management of concept design is the actors ability to gather information from various sources and to refine (cf. mental processes) it into a form that 'rings the bells' of a consumer. *Therefore, the question is above all about systematic*

[69] According to Butler, the tendency of managers and researchers to divide a decision-making process into stage models is an attempt to present this complex, iterative process as logical and understandable segments. Managers tend to act rather than plan. Psychologically speaking, it is more comfortable to focus on the final result than the problem. The desire to act overcomes the need to think, define and plan. (Butler 1994)

management of design of information (cf. Hassi 1998) [70]. Concept design differs from the process of creation of information described by Nonaka and Takeuchi in the sense that communication, combining of information, is often not enough in order to create a new concept. *Instead of mere transfer of information, the challenge with collective concept design is the ability of the group to create something that does not yet exist*[71]. From this can be derived the idea that concept design does not refer to analysis and combination of existing information only but also refinement of information into a more elaborated form.

The structure of concept design is created by factual processes that define what is to be done during concept design. Based on this study, concept design is created by the following factual processes: stages (e.g., research, product specification, etc.), transfer processes in between the stages, sub processes and critical conflicts.

Going through of factual processes does not, however, necessarily lead to success. Instead, success depends first and foremost on actions taken during these processes, i.e., how skilfully participants can refine information in various stages of the process, transfer meanings from one stage to another and create together. This side of concept design has been described with the term of mental processes. Four of the five processes identified in this study – reflection, generation, management of complexity and simplification – are connected with refinement of design information

Research indicates that a part of an innovative process should be the responsibility of individuals, a part responsibility of a group. The question, therefore, is how to organise the interaction for joint creation in order to refine a concept. The fifth mental process, compressive thinking, is connected with this issue. One may assume that if participants are unable to think compressively, co-operation will not be very profitable.

[70] This is connected with the idea of design being information (for more information, please see, e.g., Niiniluoto 1989; Hassi 1998).

[71] According to Liedtka (2000), the major difference between, e.g., scientific work and design lies in the fact that the purpose of science is to explain how things are whereas a designer deals with issues that do not yet exist.

The second circle from the outside of the model describes concrete product competition factors (design, usability, etc.) that are used in order to produce various benefits to customers. These benefits are described in a summarised manner in the outer circle of the model with the terms of additional and novelty value.

For a new product concept to be successful in the market, it must have a relative competitive edge, i.e., it must be somehow better from the viewpoint of a customer than the products offered by competitors. This can be achieved by adding additional value observed by customers within the product concept, i.e., creating a product that produces notable benefits in relation to its price. Without novelty value, a new product concept is not an innovation but a copy of an already existing product. The significance of concept novelty value is presented by a study by Gemser and Leenders (2001) on the impact of design to financial performance of a Danish furniture company. According to their research, traditional investments in design have little impact on the financial results. The underlying reason, according to them, is the fact that this so-called new design is similar to that already on the market. Their research material shows that more innovative design leads to better financial results, e.g., improved turnover and increased export.

The outermost level of the model describes the environment for which a new product is targeted. Thus, it is not possible to design products of whatever type during concept design: instead, they must have realistic potential on the market in the chosen environment.

The model presented here creates a certain way of thinking regarding reality that has been created in the same manner as the model on development of a strategy presented by Pettigrew and Whipp (1991: 25–29). It has been created based on the starting point for the research and the empirical research results. The model strives to holistic description of the phenomenon studied. The most central characteristic of the model is the fact that it assumes that concept design is a multi-levelled, complex and dynamic phenomenon. Going through the process requires integration and simultaneous management of various factors. One may assume that it is this factor that makes management of concept design so challenging.

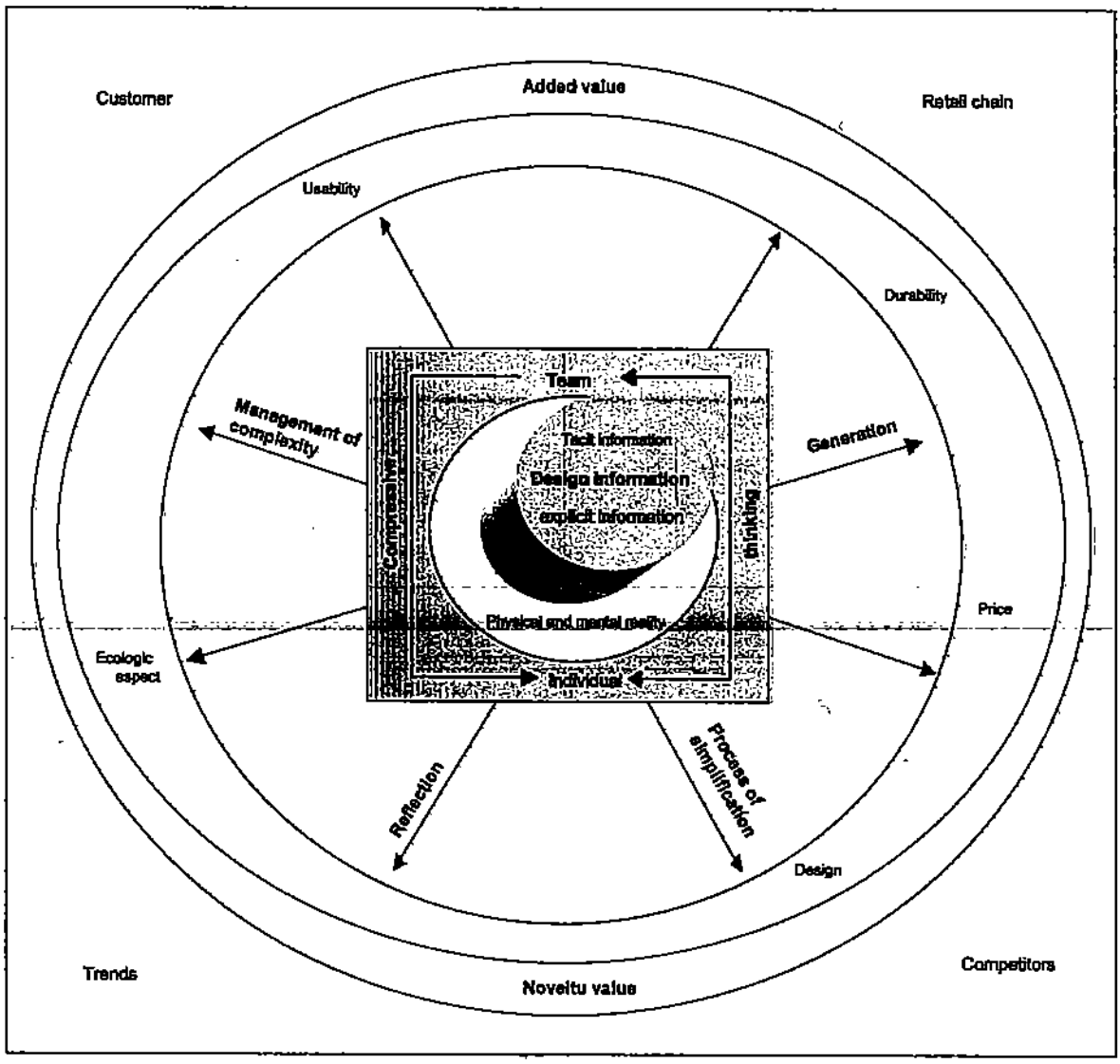

Figure 24. Model of concept design.

6.2. Towards second generation process research

It is of paramount importance to note how the ontological, epistemological and methodological background assumptions behind a research tendency have an impact on both formulation of questions and the answers received. A notable part of prevailing models perceive the world as being organised by variables being placed in a linear order at a certain point in time. The models are then often non-dynamic and strongly simplified descriptions

of reality. With the cases studied, the world was perceived as different than the review of scientific literature had lead to believe. Based on the empirical material used and analysis thereof, one may state that in many ways, the prevailing paradigms do not lead to 'sensible' research settings for the research problem studied.

This study is based on dynamic and complex thinking of processes/systems. As pioneers of the pattern of thought, one may mention, e.g., Lawrence and Lorch (1967), Van de Ven (1986, 1987, 1989, 1990, 1992), Pettigrew (1987, 1990, 1991, 1997), Senge (1990) and Venkula (1983, 1988, 1994).

Despite the fact that the objective of system thinking is 'taming' of processes, the approach still recognises the (at least) partially uncontrollable nature of processes. The objective is to conceptualise processes and identify logics therein. Thus, a better understanding of processes can be achieved. When the 'rules of the game' are identified, the ability to act appropriately increases.

In this study, concept design is presented as a model of a dynamic process. The process of innovation is perceived as a complex series of actions which may proceed over time in various manners (cf. Van de Ven and Poole 1989: 1990). It perceives reality as a simultaneously multi-levelled process with chaotic traits. The key to the approach used in this research are the relations between various factors in the process. Instead of simple and stable relations, various items of the process create a dynamic and multivariate network of relations. Thus, x and y describe various elements in the process which create the final result xy based on their mutual interaction[72]. This interaction of elements creates preconditions for a new 'variable' (Venkula 1988), such as a product concept.

The results of the procedual study strive to describe this reality holistically as long-term periods (cf. still photos, Senge 1990). Due to this, from the perspective of second generation process research, the process is studied from the front, as if one is going through the process him/herself.

[72] Compare Mohr's (1982: 54) model for a process which refers to a relation typical to variance theory: if x , then y, with the process description method developed by Venkula (1988).

According to the frame of reference created by MIRP (Van de Ven & Poole 1990), second generation process research also takes participants into account. Senge (1990: 78) also states that a human is a part of the process instead of being a subject standing outside of the process. A process of innovation is not a mechanical machine operating on its own. Instead, humans and their actions have an important role in success of the process. This has been described by dividing the process into two parts: the factual and the mental side.

Based on this research concept design can be perceived as an evolution process of sorts. Concept development is based on a concept being refined during a process during several stages, with several points of view, participants and new information present[73]. Complexity of the process easily leads to concept development being to some extent uncontrolled and living a life of its own.

6.3. Final words

Based on the empirical material for the research, one may assume that the world of concept design is relativistic. Based on the cases, one cannot offer any normative instructions which could be followed in order to succeed in concept design. Instead, the research offers references as to which issues should be taken into account.

Due to complexity and dynamic nature of the phenomenon, research may only locate critical dimensions, relations (interdependencies) thereof, 'limits' for these inter-dependencies (e.g., through description of conflicts). Therefore, the results achieved cannot be perceived as laws and powerful generalisations, but a holistic understanding of the studied phenomenon only. The descriptions includes explanatory power, because instead of being accurate operations instructions, they represent possible ways of working

[73] This point of view takes into account the problems connected with various stages of concept creation (cf. critical conflicts) and those connected with the transfer processes in between the stages (cf. management of design information). Multi-levelled nature, in its turn, refers to a concept being reviewed in each stage from various points of view (sub processes).

(Pentland 1995). Citing Simon (1992), a description becomes an explanation when it refers to structural properties of a system.

Concept refinement has been in its part explained from the point of view of information and critical conflicts. One may, however, assume that other points of view can be found for analysing concept design which will, in their part, explain the challenges of concept design in a certain environment. The task of further studies is to find out what other approaches can be used in 'taking charge of' concept design.

Research indicates that a part of an innovative process should be the responsibility of individuals, a part responsibility of a group. Integration of work by an individual and teamwork is a new research area. It is apparent that research investment in this area could produce notable advancements in development of products that are conceptually superior to those developed before.

Second generation process research is still a new research approach. The research at hand has, however, proven its potential in creation of new kind of understanding on advancement of processes. Especially promising is the possibility to analyse a phenomenon studied as a complex process enabling modelling of dynamic and complex phenomena as well. That is why further development of second generation process research is of paramount importance.

One may state that most of economic research studies look at the phenomena at hand from the perspective of upper management. This upper level perspective has inevitably led to a reader not necessarily understanding practices of product development. Therefore, Wagner and Hayashi (1994) state that despite the fact that research has been able to identify factors leading to success of products, their practical realisation has been difficult; the knowledge of what to do does not necessarily help in planning of how to do. The objective of this study was to find out how concepts are created, what challenges are included in the process and how the pitfalls of the process can be avoided. However, expectations can be set for future research of this type.

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APPENDICES

Appendix 1. Building blocks for concept design

Needs of customer

The significance of a customer-centred approach in successful product development has been presented in various studies (e.g., Roberts 1985; MacClean 1990; Roy 1990; Johne 1992; Zirger & Maidique 1990; Bentley 1990; Anderson et al. 1994; Gima-Atuahene 1995; Ottum 1997; Deshpande et al. 1993; von Hippel 1988). Based on these studies, one could state that unless a product fulfils the expectations of consumers, its success on the market is unlikely. Quality and a competitive edge require a customer-centred operations model (Lengnick-Hall 1996). Satisfaction of customers is the most important goal for a company, because companies with high levels of satisfaction among their customers also acquire the most profits (Anderson et al. 1994). When referring to design of furniture, the pattern of thought used is often a designer-centred one, stressing creativity of designers. According to Swan (2002), this is, however, a part of the positivistic ideology where designers owned the designing process. Swan claims that during this era, the implicit assumption with designers was that their creations benefited the surrounding society whereas in post-modern philosophy, the approach towards design is more tolerant and multi-levelled starting from what good benefit consumers.

Generally, product development in the Finnish furniture industry is, however, production-centred (cf., e.g., Tiensuu 1999). The major reason behind this approach may be the fact that companies lack the tools to realise customer-centred product development. The high number of unsuccessful product development projects indicates that the means of larger companies to study expectations of customers are limited as well. Despite the fact that according to Johnson (1996: 433), search for information has become an important factor in defining success of a company, there are problems connected with analysis of needs of customers that are hardly ever approached in scientific literature.

According to Lengnick-Hall (1996), despite the fact that the importance of a customer-centred approach has been realised, only a few researchers have specified the tools that could be used in transferring customer-centeredness from words into actions. As comes to furniture, analysis of the needs of customers is harder than 'normally', because industrial art products cannot be defined and analysed based on their attributes (cf. Hirschman 1983). Leonard and Rayport (1997) state that the problem with customer-centred product development is the limited ability of customers to imagine and describe possible innovations.

Technology

Technology is divided into to sectors: productability of a product and know-how needed in creating a new product. Traditionally, the objective of co-ordination of production and product development has been improvement of manufacturability (Van Dierdonck 1990; Carlsson 1991). According to Daetz (1987), integration of product development and production offers benefits to both the product and the production system used in manufacturing it. It is important to integrate product development and production, since several studies (e.g., Cortes-Comerer, 1987; Daetz, 1987) have shown that depending on the product, more than 50% of quality and up to 95% of the production costs are defined during the product development process.

Needs of company

According to Burgelman and Sayles (1986: 42–46), in addition to balancing technology and needs of customers, needs of manufacturing company should also have a notable role. In its part, a product development strategy should reflect the company's overall strategy (Tuomi-Nurmi 1984) or operations idea (Hertenstein & Platt 1997). According to a definition by Omsen (1985), product development is a part of the overall strategy of a company and its purpose is to uphold or improve the company's competitive position in

the market sector chosen. From the viewpoint of product development, *implementation of a strategy refers to development of right kind of products in order to concretise the strategy chosen.* According to Herstein and Platt (1997), product development transforms strategic concepts into artefacts which are concrete manifestations of the strategy. Clark and Fujimoto (1994) note that an organisation defines itself through the products it offers. Strategy and product development can be perceived as elements developing each other in a co-operation process (Hertenstein & Platt 1997).

Expectations of distribution channel

Furniture trade is more advanced in Finland than industry of the sector: five leading chains, Isku, Asko Furniture, Stemma, Europa Möbel and Sotka Finland, control approximately 75% of sales of furniture for homes (Ministry of Trade and Commerce, 1998: 9). Due to the centralised nature of sales in the sector, factories compete for the same distribution channels, since no alternative systems are available. The persons in charge of acquisition in practice decide what is to be offered to consumers. Thus, small and medium-sized factories of the sector have two customers: retailers and their customers (Tiensuu 1999: 22–24). Gummesson (1998: 115–120) calls this kind of chain 'relationship to customer's customer'. Therefore, the task of product design is to develop products which in addition to being well-suited for the needs of customers are preferred by distributors (Tiensuu 1999: 22–24).

Purchasing

Development of whole new products (such as computer desks and chairs developed when computers became more common) is more of a exception than a rule in the furniture industry life cycle (a mature sector). Since furniture has been manufactured globally for hundreds of years, discovery of whole new forms is unlikely (cf. Tiensuu 1999). 'Novelties' are mostly created when new components or materials are used or combined. In a mature sector, suppliers are mostly the sources of innovations (Utterback 1994). From this

perspective, activeness of purchasing largely correlates with innovative ability of a company.

In scientific literature, the role of purchasing as a part of the product development process has been mainly noted in the automobile industry (e.g., Clark 1989; Midler 1995)[74]. Ragatz et al. (1997) state in their publication that integration of suppliers of components from outside the company produces many benefits, such as lower costs, improved quality and decrease in the overall time used for the process[75]. Benefits may be expected to be similar also when talking about integration of purchasing within a company as a part of product development (for more information on the role of suppliers in product development, please see, e.g., Burt & Soukup 1995; Clark 1989; Bonaccorsi & Lipparini 1994; Cusumano & Tekeishi 1991).

Trends

The significance of trends has increased in the furniture industry and furniture has become, to some extent, trendy. According to a study by Partanen and Tiensuu (2001), almost 60% of Finnish furniture buyers evaluate trendy nature of a piece of furniture as an important criterion when buying. In order to be able to compete, companies must have some abilities to anticipate trends. Economic science has dealt with trends and their anticipation at least since the 1950s. In the first articles (e.g., Wasson, 1968; Reynolds, 1968), anticipation of trends was perceived as relatively simple. In the 21st century, the problem with anticipating trends is the fragmented nature of the world and relativity of time.

[74] Midler (1995) has reported about integration of purchasing into product development for the company Renault. Previously, the task of Renault's purchasing department was to find components that comply with the given specifications and are as affordable as possible. Nowadays, the department operates in close co-operation with the product development department solving problems connected with projects. This change in operations method has induced notable changes in costs. E.g., in the project Twingo, component costs were decreased by approximately 18% and for some components as much as 30% without any decrease in quality.

[75] According to sector reports by the Finnish Ministry of Trade and Commerce (1996: 36; 1998: 32), materials costs were the largest single cost item in the furniture industry (approximately 50% of overall costs).

Competitive situation

As the competitive situation becomes tighter, it is not enough to understand customers, but in order to succeed, a company must also study its competitors (Kotler, 2003: 241). When the needs of customers have been mapped, a company is face to face with a new problem when the other companies in the sector satisfy the same motives in the same way (Laakso, 1999: 96—97).

Target group

According to Allenby and Ginter (1995), an organisation is successful when it understands the needs of its customers and reacts to them more effectively than its competitors. This requires that the company knows what kind of consumer groups, segments, there are in the market, what do the consumers of these segments want. Segmenting may help to target product development and marketing to certain segments in the market (Dickson & Ginter 1987). This should not be a surprise, because the benefits of segmenting seem to be notable: better understanding of the market, prediction of consumers' behaviour and identification of market possibilities (Kotler 1997). According to Brooksbank (1994), research has proven that the most successful companies are those that are specialised and concentrate in a well-defined market segment.

Appendix 2. Models for concept design

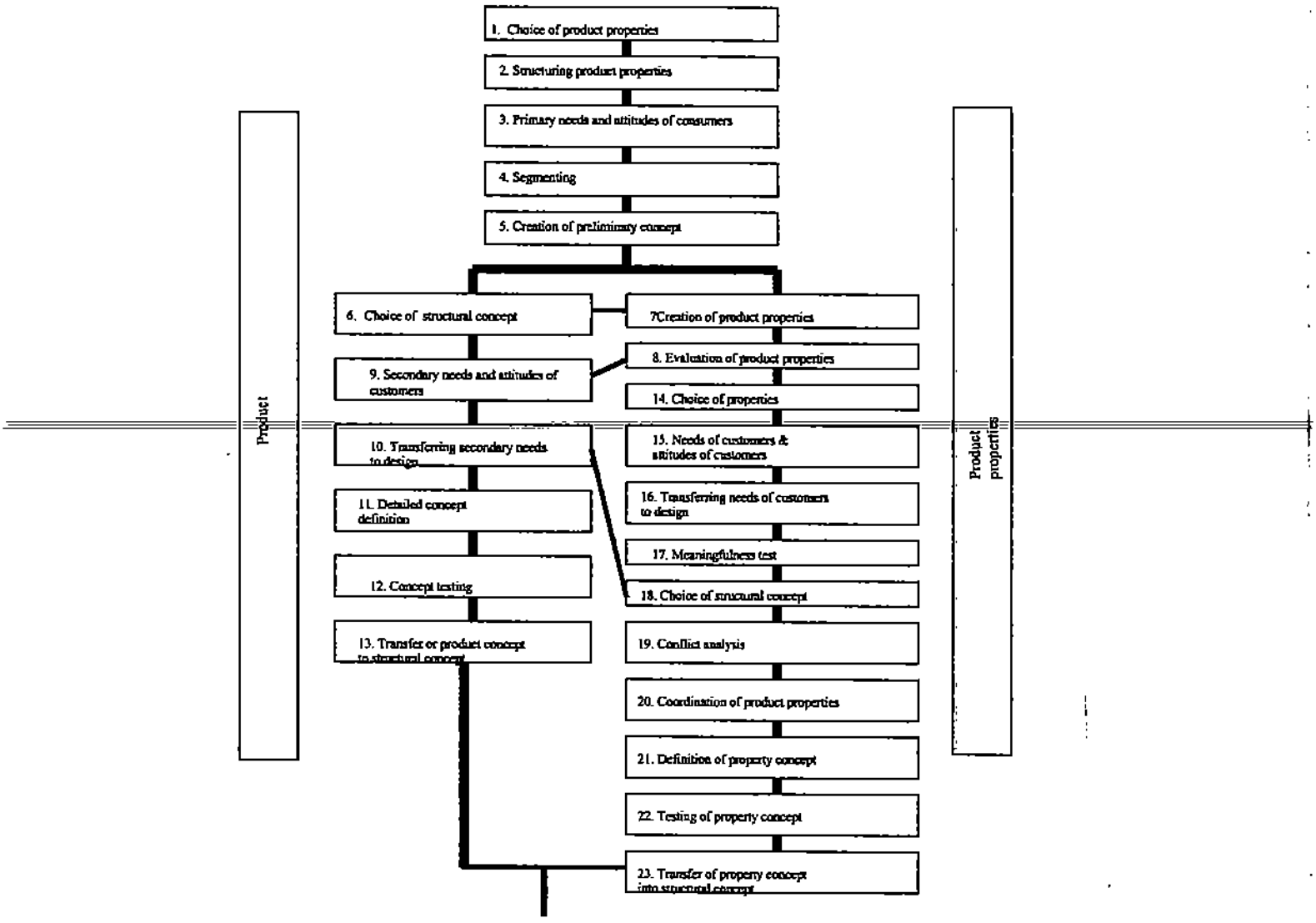

Figure 2.1. Concept design model by Schmidt (1997).

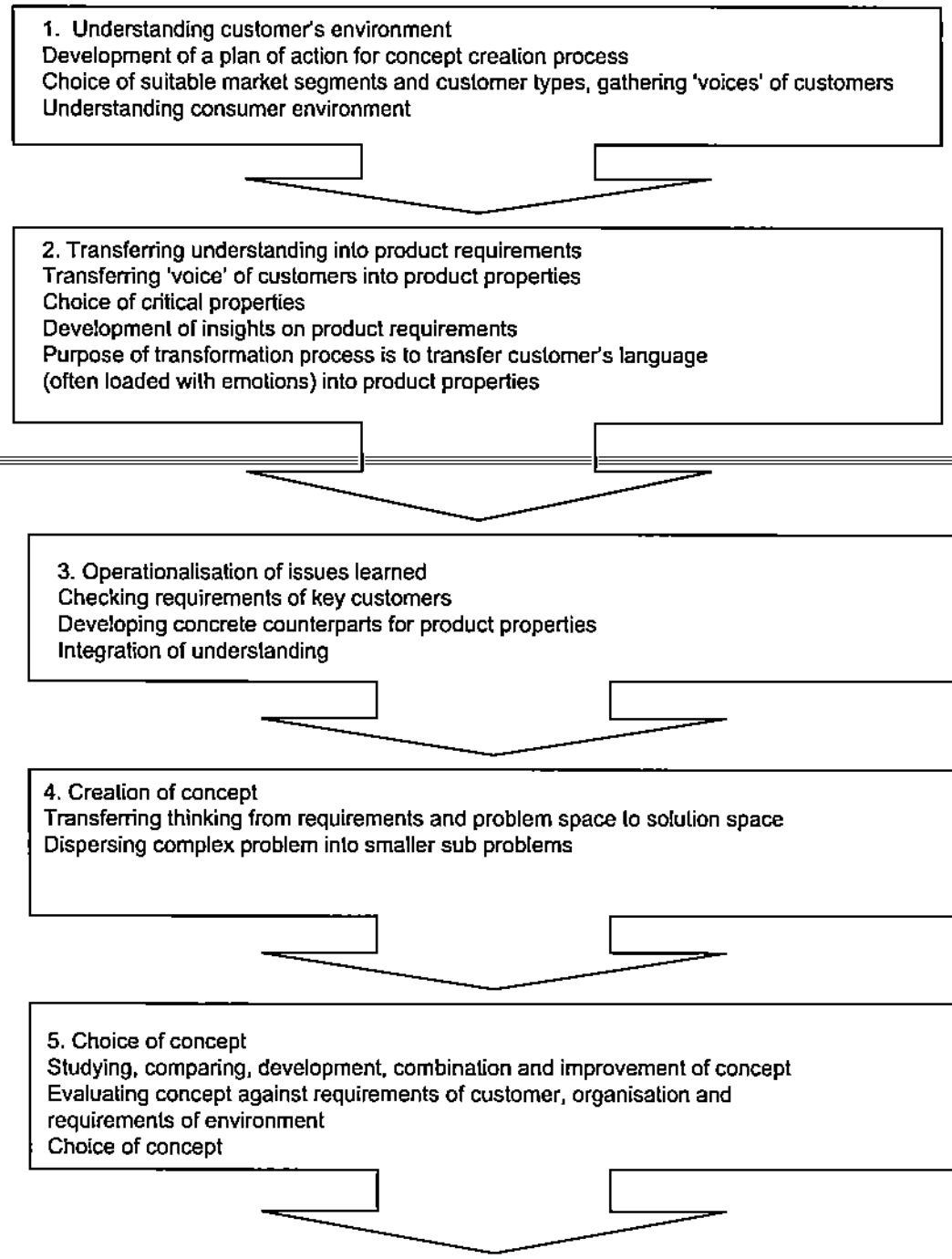

Figure 2.2. Process of concept creation according to Burchill (1993).

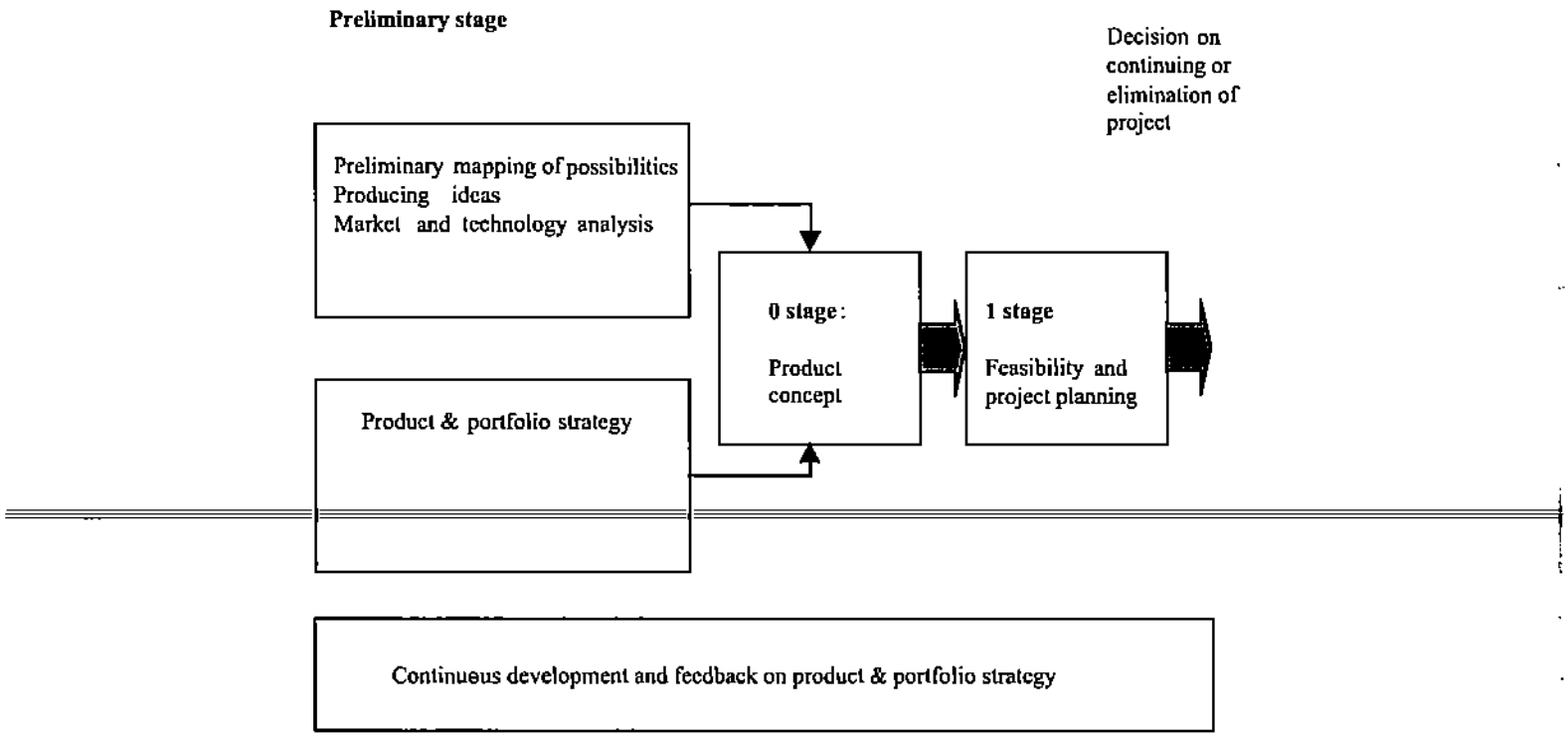

Figure 2.3. Khunara and Rosenthal's (1998) model on concept design.

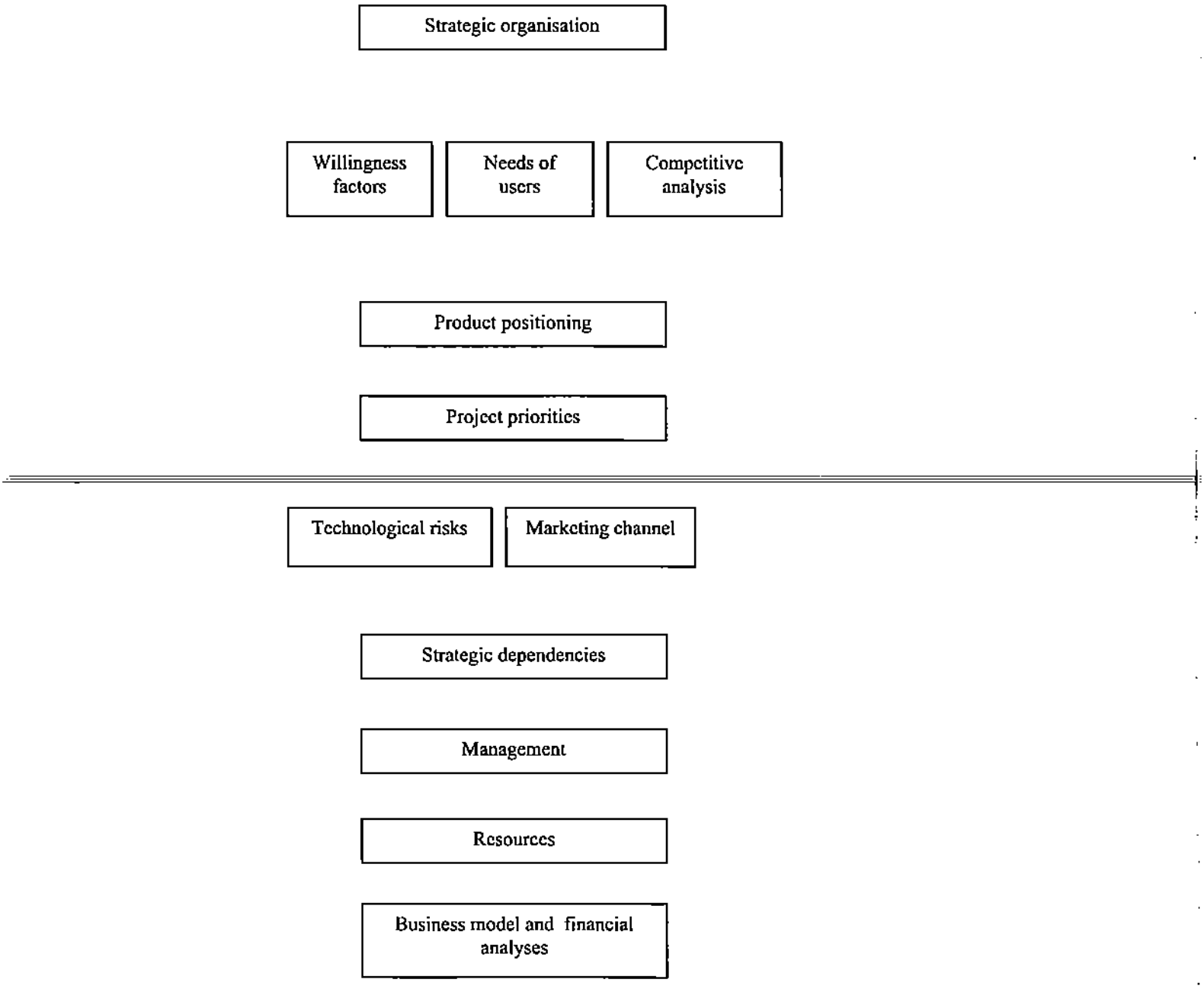

Figure 2.4. Wilson's (1993) model on concept design.

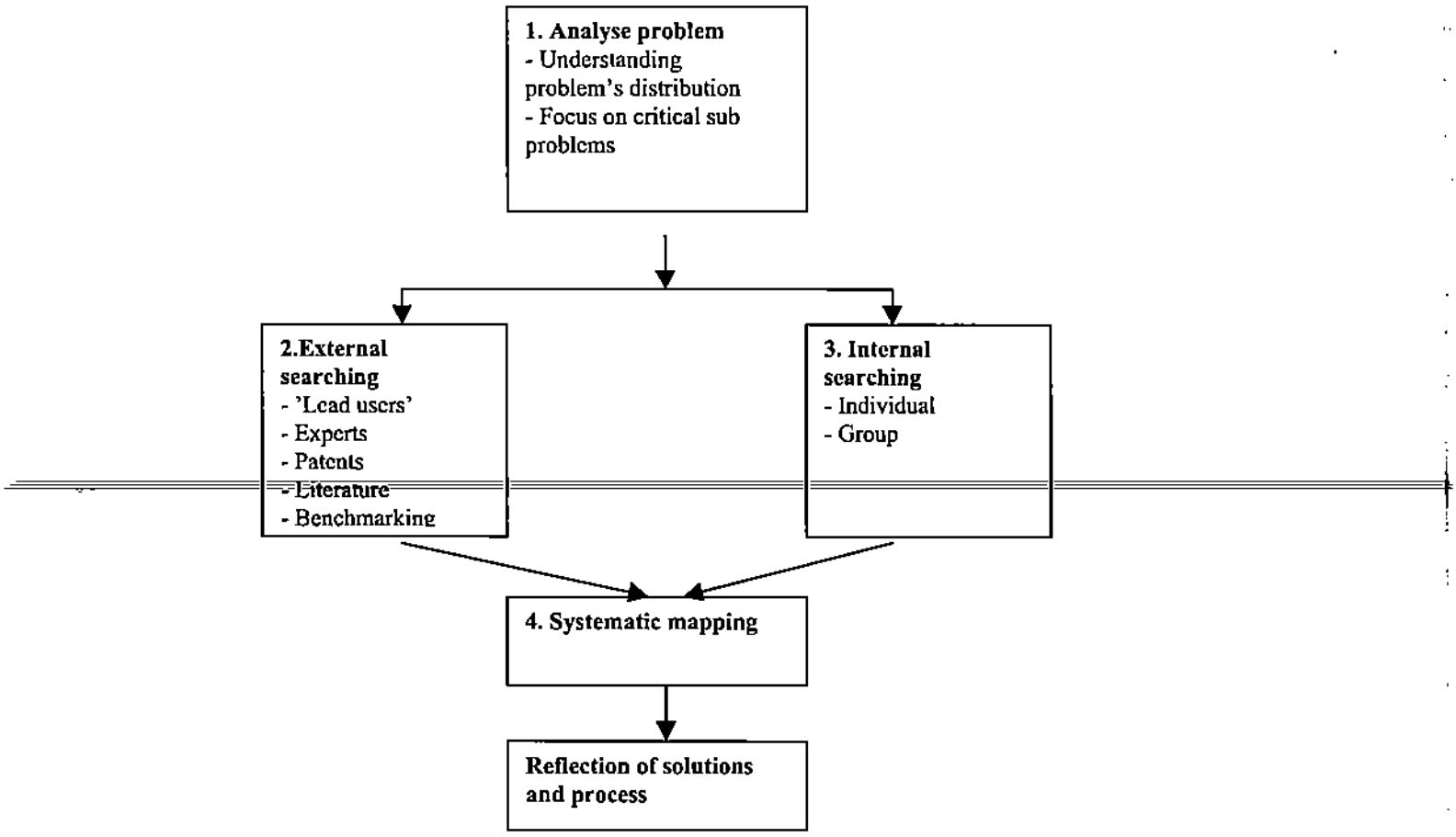

Figure 2.5. Ulrich and Eppinger's (1995) model on concept design.

Appendix 3. Visual descriptions of empirical cases

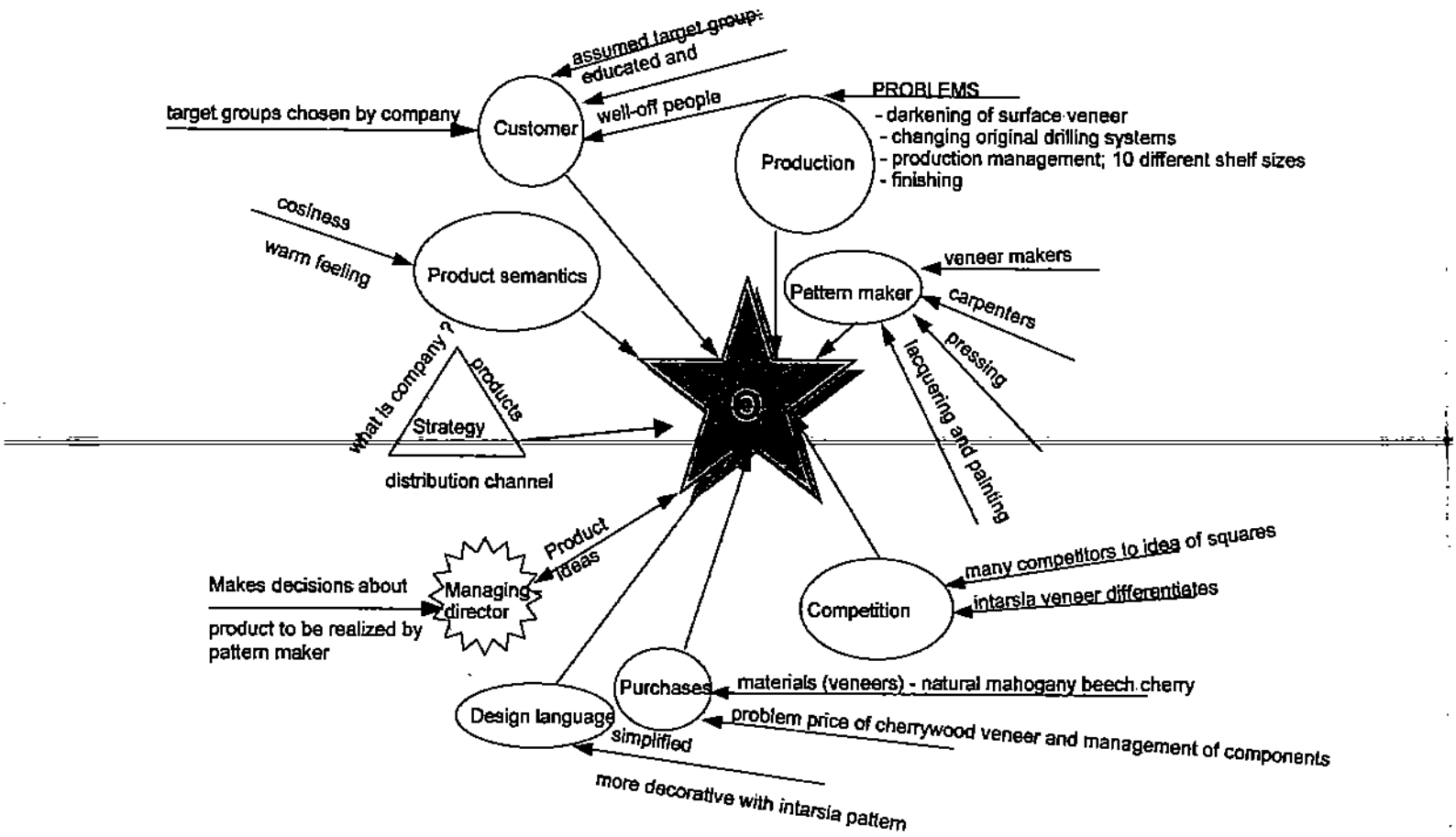

Figure 3.1. Cross-sectional figure of development of project O.

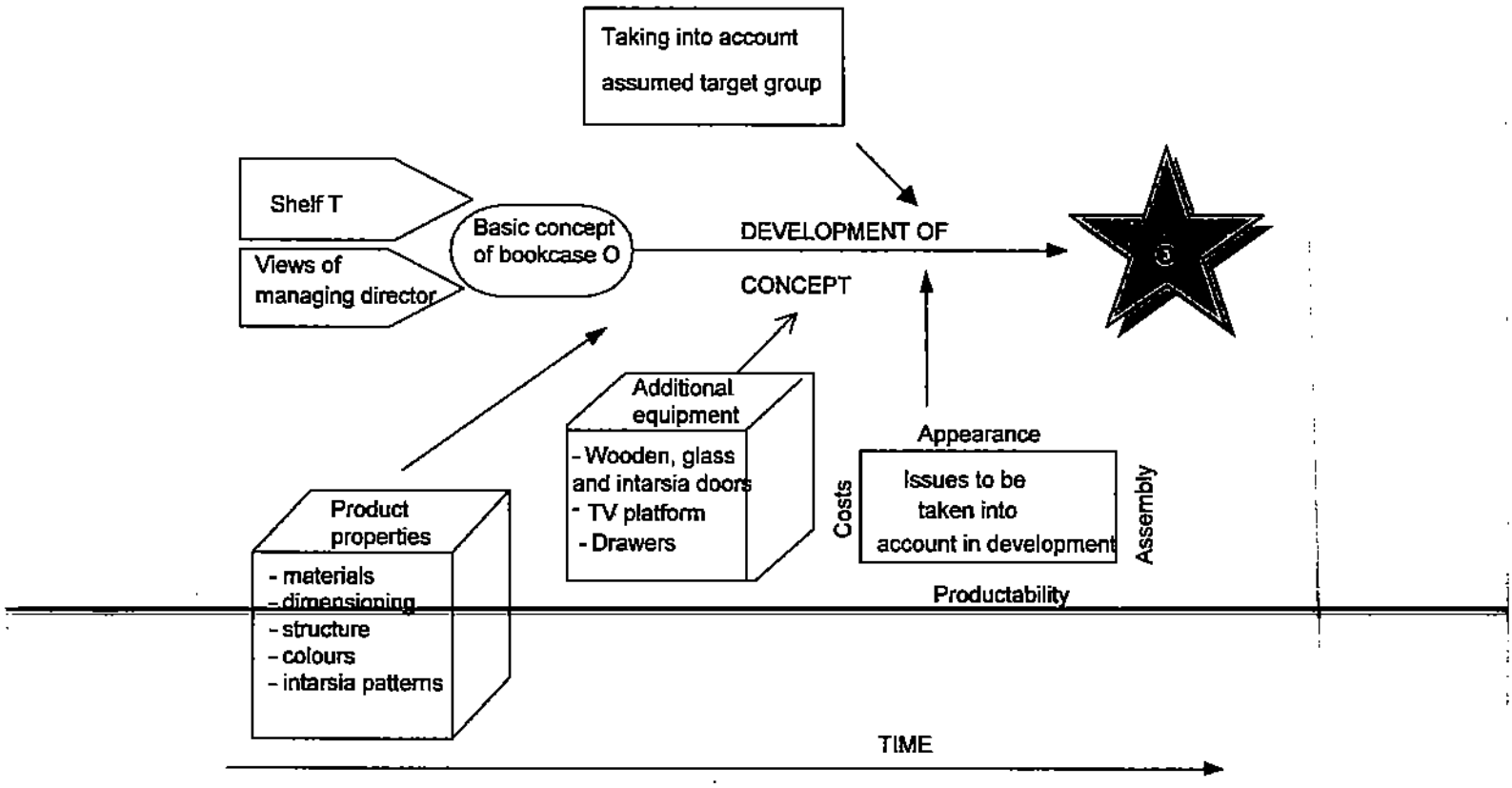

Figure 3.2. Development of project O over time.

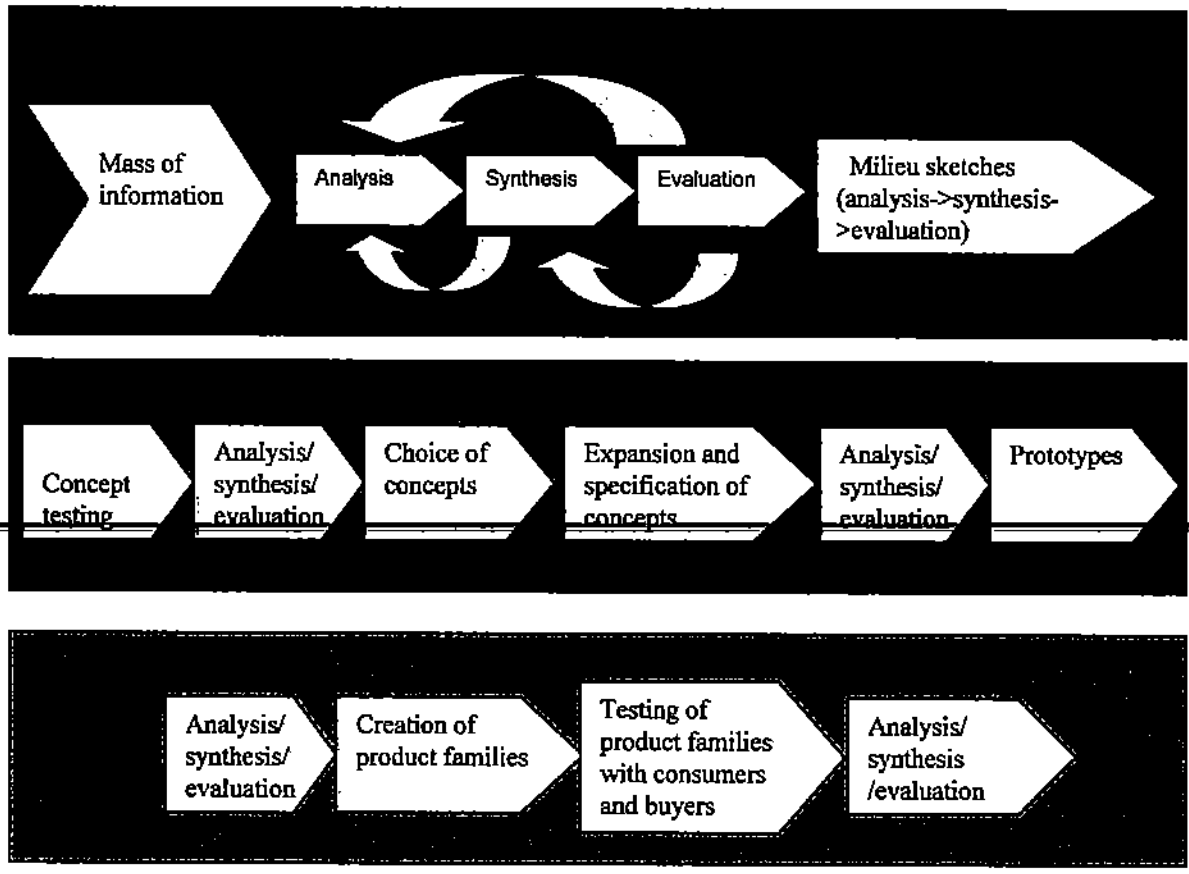

Figure 3.3. Project F as process.

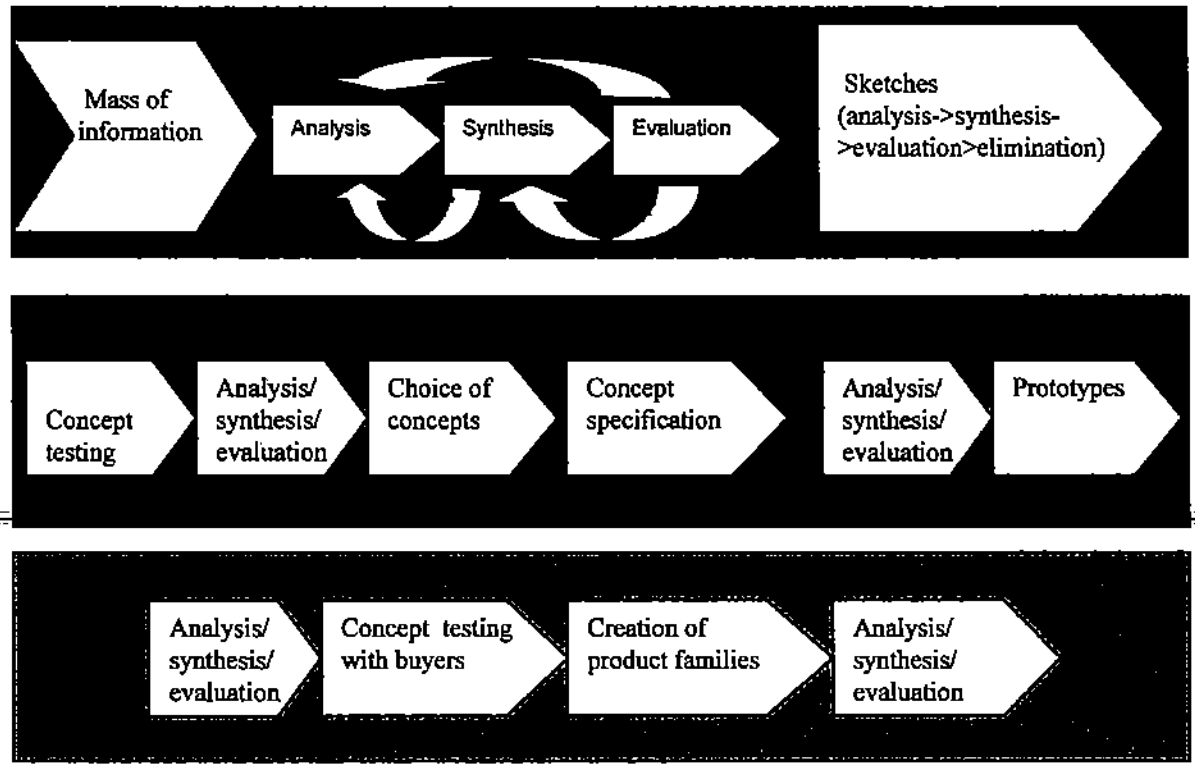

Figure 3.4. Project V as process.

Appendix 4. From data to operations model.

Figure 4.1. From data to operations model.

Appendix 5. Holistic vs. meristic model

The differences between a holistic and a meristic approach can be illustrated by Figure 35. The holistic model is described by the project from the left to the right. First, an overall design concept is defined after which it can be divided into parts. Thus, concept can be perceived as a metaphoric idea of the unity to be created. The meristic model, in its part, is described by the project from right to left: a product is created as a sum of its parts. However, it is probably necessary for the concept maker/s to have a some sort of view of the desired final result. Otherwise, the process will merely be combination of elements without any goal.

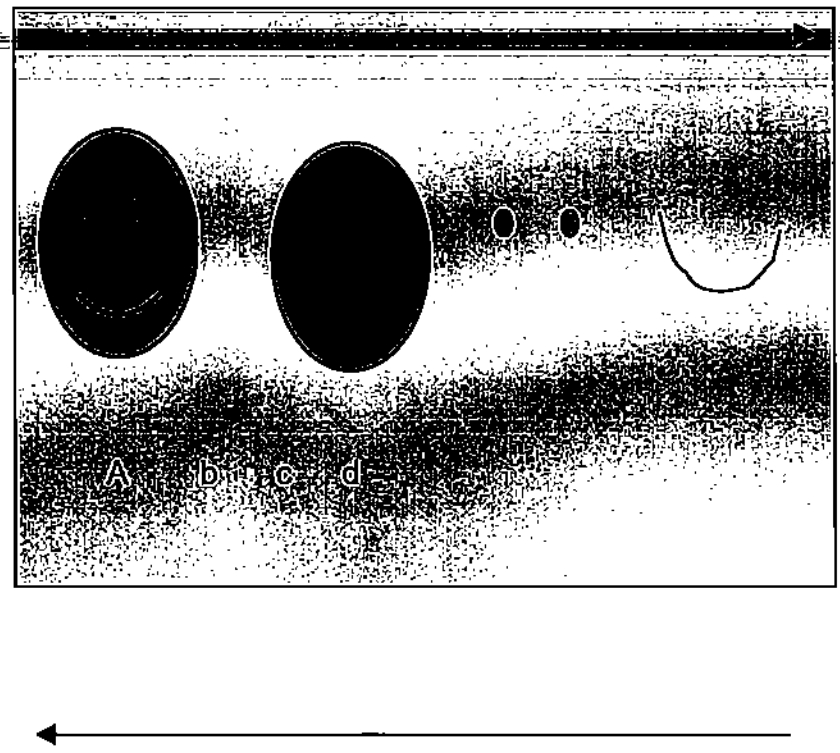

Figure 5.1. Holistic vs. meristic model approach in product design.