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A Methodology for the Integrated Design of Customer Goods

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Introduction: State of problem and research question

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1.1 Introduction

Owing to the world economic crisis, both large and small companies face the business problems. Many companies have to terminate the business. The remaining companies have to struggle to survive and preserve their business. Good design and good quality are not enough to survive in a competitive market. It is important that they have to ready adapt their business with all situations. It reveals that the idea of successful business is able to transform and to develop new products driven by three pillars: customer, competition and environment. Our main objective is to support companies and designers by providing them with the new methods and tools to develop the new products.

Customers: It is well known fact that no business can exist without customers. Customers are important people for any business. They are the resource upon which the success of the business depends. The novelty for the XXIst century is that they mainly ask for personalized products and services. This trend leads to force design method to think a new partnership between designers and customers when designing. The place of customers in the design process is being rethought from design for customers to collaborative design with customers and sometimes to design by customers. Thus, it is important to work closely with customers to make sure that the products will fulfill their needs and requirements.

Competitiveness: In business, a company that makes similar products in terms of products' performance on customer needs or customer requirements is a competitor. The difference from competitors leads to create their own identity. Identity is personal or individual characteristics that are used to distinguish company's products and competitors. It expresses the values of the product with their form and features. It specifies the product's meaning, aim

and self-image and fosters recognition. It realizes that company needs to think about the characteristics of products. The challenge is to create new products that carry identity to foster recognition and differ from competitors.

Environment: Owing to environmental problems such as climate change, pollution, health, working circumstances and safety, the products that do not meet these concerns will be rejected by customers. Products that increase the environmental burden have no future. Recently, this point of view has just originated in Europe, and it will expand to be worldwide soon. Thus, the company is challenged with new questions of what environmental issues are the most relevant for their business and how to consider them in relation to the products that they are developing. In particular, it is quite relevant to understand how design changes can affect the environmental performance of product concepts early in the design process.

In today's market, companies and designers face a wonderful challenge. From the increasing requirement of variety by customers, the intense competitive business environment and the environmental concerns, new products have to be dramatically difficulty designed and manufactured: they are expected to meet the needs and requirements of customers, differ from the competitors and be friendly with the environment. Our focus in this thesis is the new way for designing induced by all these challenges.

1.2 Fashion products

Fashion is the style and custom prevalent at a given time. It can change from one period to the next, from generation to generation. It serves as a reflection of social and economic status, a function that explains the popularity of many styles throughout costume history. Fashion is more related to cultural communities and to plurality of life styles and behaviors. It is also often characterized by "fashions" which spread with a bottom up mechanism and start in the lower level of society.

Based on interviews of industrialists and practitioners, we have summarized the relative position of France, Italy and Thailand in the world of fashion (Figure 1.1).

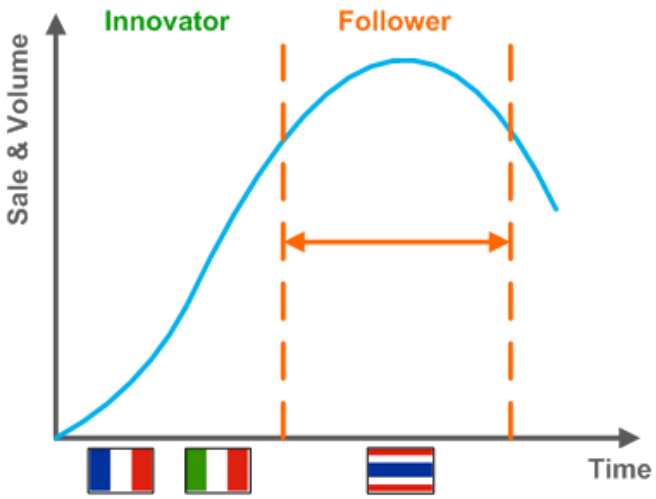

Figure 1.1: The innovator and follower in the world of fashion.

France is the leader and innovator because it has been an important industry and cultural export, and modern "haute couture" originated in Paris. French fashion based on craft production characterized by sophisticated and expensive processes to guarantee high quality and personalized products. It focused on the idea of luxury and distinction. Today, Paris is considered one of the world's fashion capitals. It is home or headquarters to many of the premier fashion houses. Many of the world's top designers and fashion houses have been French, such as Coco Chanel, Christian Dior, Louis Vuitton, Chloé and Yves Saint Laurent.

Italy is recognized as the innovator in fashion. Italian fashion is for everyone society, and is not exclusive like French fashion. It is more rooted in cultural values that are transmitted to products, and is more strongly associated with the trend process. Italian fashion, related to an idea of aesthetic quality, functionality and comfort, constructing a modern and new environment for informal social interaction. On the side of production, this leads Italian fashion to become an industrial sector able to produce massive quantities of products.

Thailand is the follower in fashion because Thai customers easily accept any new trend without any relate to socio-cultural issues. Thus, many manufacturers are more interested in copying already successful products than proposing new products by themselves. It is a risk-free, and it is an easy way for them to succeed in short time.

Leather goods is one of the fashion products. They are the most carried accessories in everyday life. It includes bags for ladies or men, pocket items (wallets, card cases, etc.), sport and travel goods (suitcase, cases, backpacks, etc.), and also belts. This PhD study focuses on the lady handbags.

In Thailand, the leather goods manufacturers make the products for sale both in the local and global market. Because some Thai customers easily accept any new external trend, Thai manufactures always follow the fashion trends from the western side and never focus on the socio-cultural movement of the in domestic customers. They always design the new products for the domestic market from their experience by copying already successful products. Therefore, they are facing other problems such quality of products lower than in France and Italy and image of products not recognized by customers because of lack of identity. Contrary, the socio-cultural movement makes an effect on Western customers, which is the driving influence on consumer's perception, lifestyle and fashion. Thus, it is so difficult for the leather goods industry in Thailand to succeed in the global market with their own products, if they still lack of identity and socio-cultural study [KMUTNB 2007].

To succeed in the both markets, it is necessary to adopt the design and manufacturing strategy coping with higher quality, expression of identity, meeting of needs and requirements of customers, and environment friendly. Thus, this PhD study was dedicated to a specific fashion sector: leather bags, and illustrated on a specific company business: leather bag in a Thailand manufacturer. The main question of this PhD is therefore: how to support Thai leather bag designers in their design of new Thailand-created bags adapted to the global market?

1.3 Needs for new design methods in the leather goods sector

To take advantage over the competitors, a manufacturer needs to adapt the design and manufacturing strategy to respond to continuous change of customers by integrating the emotional design, brand identity and environmental impacts assessment in the design process.

Emotional design: To make sure that the products fulfill the needs and requirements of customers, the designers need to study the behaviors of customers. Emotional design is a

technique to identify correspondences and gap between customer's perception and designer's intention (Figure 1.2). The correspondence is used to guide designers for designing the new product. The gap is removed or modified to be relevant to customer's perception. The advantage of emotional design is that the product designed responses the needs or requirements of customers.

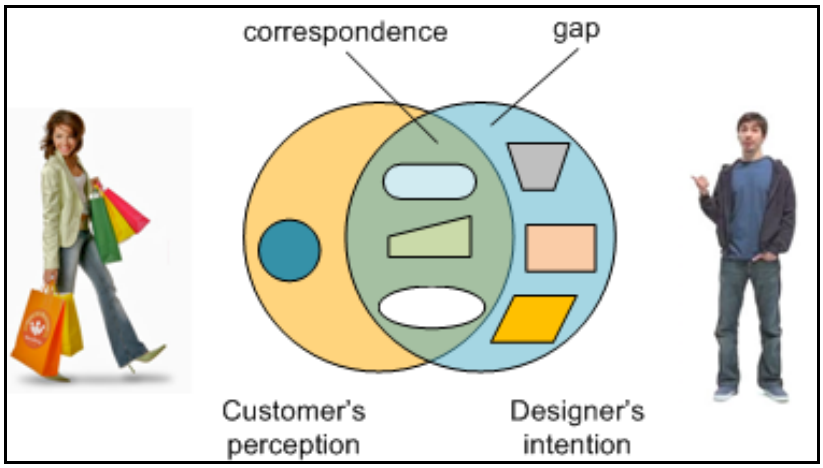

Figure 1.2: Main Emotional Design principle.

Brand identity: To differ from the competitors and express their own identity, the designers need to focus on the identity of products. It may come from the style, manufacture, technology, etc. Brand identity illustrates something that differs from the competitors and expresses the product identity. The advantage of designing by brand identity is that the product easily fosters recognition and creation the heritage.

Figure 1.3: The example of strong brand identity.

Environmental impacts: To understand how design changes affect the environmental performance of product concepts, designers need to focus on the environmental impacts that will occur in each stage of product life cycle. In Europe, many countries have created eco-labels to that guarantee the products do not affect the environment more than accepted (Figure 1.4). Eco-labelling the new product is very challenging for designers.

Figure 1.4: Example of eco-labels.

From these three important challenges for Thai leather goods manufactures, we could say that current manufacturing practices are both ineffective and inefficient, and consequently fail to deliver an optimal result in many aspects. As far as we found both in the literature and our experience in companies, the main issues are the followings:

- Designers cannot get information or requirements directly from customers because the marketing service is between designers and customers for the domestic market and in Europe for the global market. There is a lack of culture on customers' perception and a great need of methods to improve that.
- There are no systematic procedures to guide designers developing solutions to respond to the three new perspectives (emotion, brand identity and environment).

The design activity is still relying on experience of skilled designers only. Thus, there is a need to develop a design methodology that supports the design activity in order to respond to the needs or requirements of modern customers. Our work in this thesis is to develop a system based on company knowledge that helps skilled designers to respond to modern problems by integrating the emotional design, brand identity and environmental impacts to create the new product.

1.4 Research question

The research objective is to develop the design methodology to help designers design the new products that meet the customer's requirements, express their identity and make friendly with the environment.

Two research questions are formulated from the above objective:

- How to explore the correspondence and the gap between the customer's perception and designer's intention?
- How to use the brand identity through the design and the manufacture of the new products?

The work was reduced to the fashion product sector and applied on design and manufacture of leather bags in a Thai company. The PhD was developed within the joint doctoral program between Grenoble-INP and King Mongkut's University of Technology North Bangkok. It also associated ENSAM Paris for their competences in "customer analysis within engineering methods" and was developed based on a case study of a Thai manufacturer.

1.5 Research methodology

The research process is associated with the different activity phases shown in Figure 1.5. The current process started with phase (I) for the formulation of the main research question based on the result from a study of the leather goods industry. It helped define the problem and the needs for improvements. Phase (II) aimed at developing the design methodology by carrying out the literature review in order to find out methods and tools that could solve the defined problem. This state-of-the-art survey discovered a related area with the emotional design and the environmental impact assessment Phase (III) dealt with the implementation of the design methodology proposed on the leather goods industry case study, the analysis of the results and the drawing of the conclusions of the research work. This PhD study was conducted on a sandwich training base. After a period of work within the company (between master and thesis), the first year was in France to formulate the initial design methodology. The second year was in Thailand, both at KMUTNB and within the partner company to adapt the design

methodology to real company practices. Finally, the third year was again in France to formalize the work.

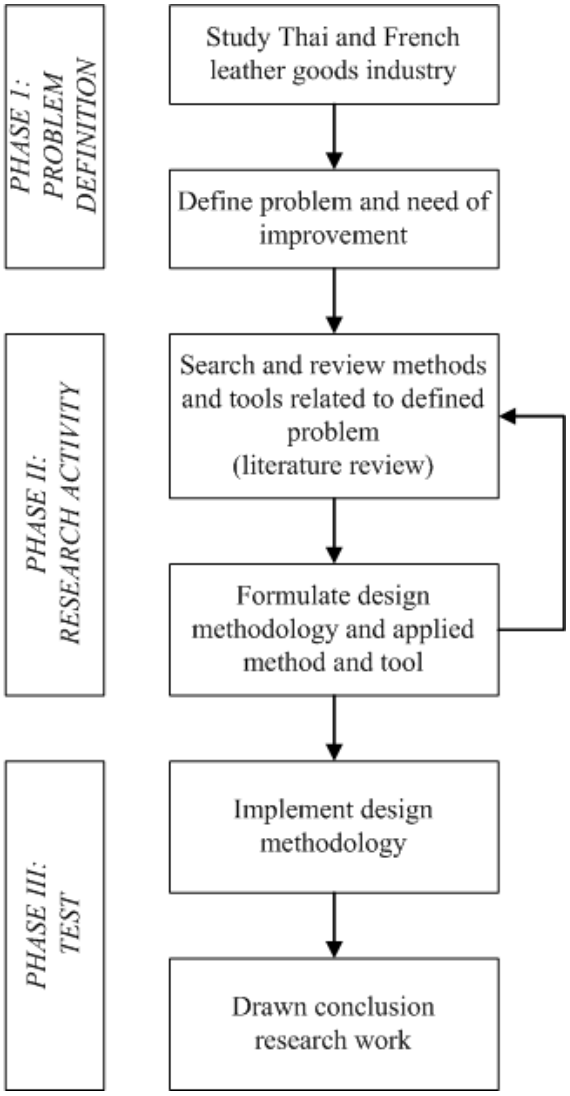

Figure 1.5: Overview of the research work.

1.6 Dissertation structure

This thesis aims at developing a design methodology to help designers designing new products and ensure to meet customer's perceptions, express brand identity and make friendly with an environment. The dissertation is in five chapters. The first one ends here and highlighted the state of industrial and scientific problems to raise the research question. Chapter 2 is dedicated to the survey of literature to understand well this challenge. It will help

to define the real problematic of the system that we would like to develop in this research work. The different techniques are integrated to build the design system. Chapter 3 is the core of the innovative research work. It presents the design methodology we developed. It highlights the main concepts and illustrates them on examples. Chapter 4 deals with applications; the design methodology was applied on the case study to validate the methodology and its implementation. The fifth chapter draws the conclusions of this work and gives some perspective to this research.

Chapter 2

Problematic, literature review and application domain

Chapter 2

Problematic, literature review and application domain

It was highlighted in the first chapter the main challenge of this PhD study: developing a design methodology that meets the properties of the industrial sector: we are looking for an integrated design method focusing on customers' perception of products, brand identity, environmental concerns and based on company knowledge and experience.

Customers are extremely important people for any business. They are the resource upon which the success of the business depends. They only ask for personalized products and services. Thus, it is important that companies have to work closely with customers to make sure that the products will fulfill the needs and requirements of customers.

Presently, customers are influential in the design process, meaning that they participate with designers to determine the direction of new product or concept that is relevant to their needs and requirements. Design and engineering work must react to customers' demand keeping the design and manufacturing optimization that ensures profits. Company and researchers developed different approaches to deal successfully to this new challenge.

Emotional design is a common research field involving both designers and human factors. It is product design targeted to satisfy customer's needs or requirements. By controlling certain design factors, customer's emotion can be evaluated, designed, and satisfied [Choi and Jun 2007]. Brand identity is a unique attribute that aims to foster recognition. It expresses something that differs from the competitor and shares with something else [Warell et al 2006]. Environmental impacts are a new aspect that most customers have just started to consider before purchasing the new product. All approaches are formalized to create the design system that aims to help designers create the new product that meets the needs and

requirements of customer, expresses the brand identity and make friendly with the environment.

The chapter is dedicated to the survey of literature to understand well this challenge. It will help to define the real problematic of the system that we would like to develop in this research work. The different techniques are integrated to build the design system. It is organized as the following. Section 2.1 is related to the new manufacturing paradigm that focuses on the customers in design process. Section 2.2 is related to the concept of integrated design that was originated in Grenoble INP (G-SCOP) at the integrated design research group and that is the philosophy behind this PhD work. Section 2.3 quickly presents some fundamentals of the design process. Section 2.4 explains the methods and techniques that are used for understanding customers in the design process. Section 2.5 is related to the role of brand identity. Section 2.6 explains the environmental impact assessment that designers have to consider in new product development process.

2.1 Personalized production as the new manufacturing paradigm for the XXIst century

The paradigms in consumer goods manufacturing are identified in 4 major paradigms: craft production, mass production, mass customization and global manufacturing which points in regionalized and personalized production [Koren 2010]. Figure 2.1 shows the manufacturing paradigm evolution.

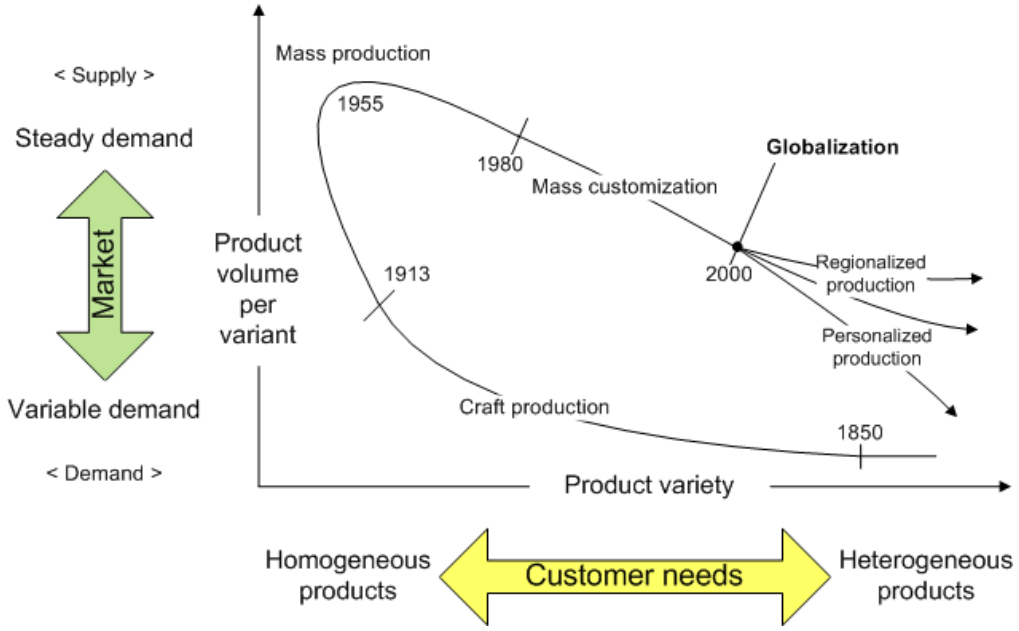

Figure 2.1: The manufacturing paradigm evolution (after Koren 2010).

Craft production: The principle of craft production is summarized as: skilled workers, using general-purpose machines and make exactly the product that the customer paid for; one product at a time. Craft production has a pull-type business model, with the sequence: Sell - Design – Make as shown in Figure 2.2.

Mass production: The principle of mass production is based on production of a limited variety of products in high volume reduces production cost, which, in turn, allows price reduction for the benefit of customers. Reduced product price increases customer demand and sales. The business model of mass production is of a push–type and the business sequence is Design – Make – Sell as shown in Figure 2.2.

Mass customization: The principle of mass customization is production of a wide variety of customized products, at mass production cost, attracts more customers and increases sales. It is a combination Push – Pull type business model and the business sequence is Design – Make – Sell as shown in Figure 2.2.

Global manufacturing: The global manufacturing is the next manufacturing paradigm that points in two directions: regionalized and personalized production. Regionalized production

for global markets is stimulated by exactly the same imperatives as mass customization, but directed more by cultural and regional differentiations.

Personalized production for domestic markets is stimulated by the desire of customers to have exactly the product that they need (rather than merely settling for options) without paying the price of a craft-built product. Personalized production emphasizes timely production. A short delivery time to the customer is an essential component in gaining a competitive advantage in personalized production. The sequence is Design – Sell – Personalized Design – Make as shown in Figure 2.2. The business model is based on make product-to-customer's design, where modules are selected from a pre-designed, given range.

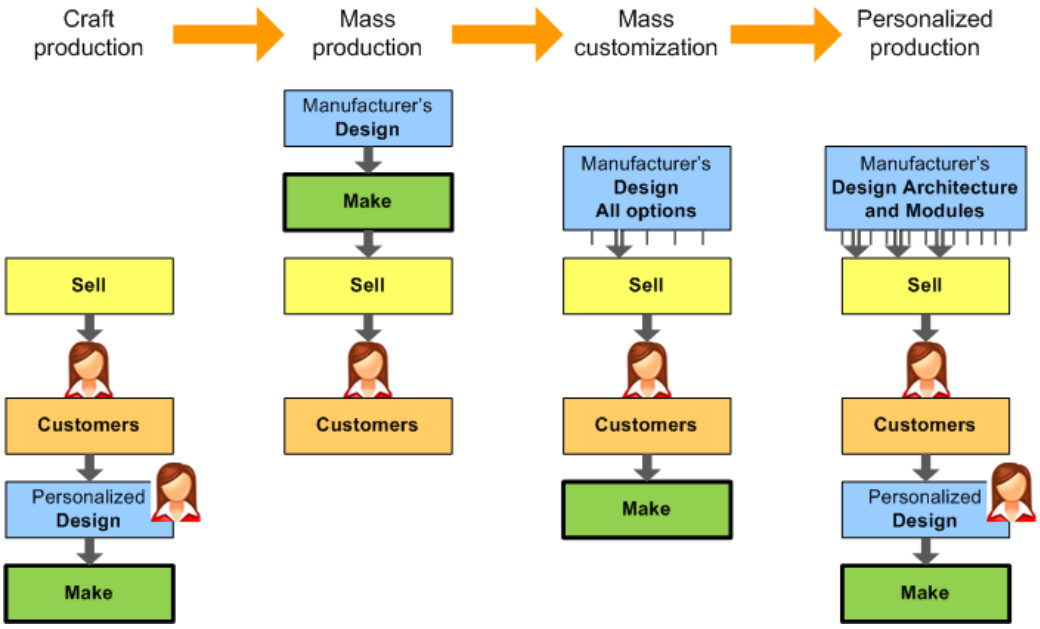

Figure 2.2: The customer role in each manufacturing paradigm (after Koren 2010).

From the manufacturing paradigm evolution as shown in Figure 2.1, the personalized production is the new manufacturing paradigm for the XXIst century and for the leather goods industry. It calls for customers to participate to the design process.

2.2 Integrated design

Integrated design methodology was initiated at the Integrated Design research group in Grenoble INP (G-SCOP) in the latest eighties by Professor Tichkiewitch. It postulated that the design process should integer all the consequences and impacts that the design phase decisions have on the downstream activities of the product during its life. The role of research was to develop this kind of methodologies and all the models, methods and tools that support its implementation and its use in companies.

The first issue was to develop product-process design methods. It initially addressed the simultaneous design of the product and its manufacturing processes [Tichkiewitch and Brissaud 2000]; the design for manufacturing (DFM) approach [Brissaud et al 1997] [Blondaz 1999]. Studies on requirement engineering integrated the different discipline aspects in a transverse evaluation [Prudhomme et al 2003] [Claros et al 2008]. One main issue in product development comes from the product representation that was discussed in [Brissaud and Tichkiewitch 2001] [Grebici 2007] [Noomtong et al 2008]. Finally the overall approach was the fundamentals of the work of the network of excellence VRL KCiP on knowledge for design and manufacturing [Tichkiewitch 2005] [Tichkiewitch et al 2006a].

The second issue deals with collaborative design that supports the integration of the stakeholders themselves in the design process and the system to support this integration through information and knowledge exchanges [Tichkiewitch and Brissaud 2003]. A lot of works were related to knowledge management that became a major topic for the development of products and the way to promote and manage innovation in products, Knowledge lifecycle management [Bernard and Tichkiewitch 2008]. Knowledge management was studied through diverse applications [Tichkiewitch et al 2005] [Tichkiewitch et al 2006b] [Vacher et al 2007] [Butdee et al 2009] and methods and systems were implemented in industry [Pimapunsri et al 2008] [Beylier 2007] [Beylier et al 2009].

The last issue is with the eco-innovation methods of sustainable products [Brissaud et al 2006]. Methods to consider environmental impacts during design were developed [Zwolinski et al 2003] [Zwolinski and Brissaud 2006] [Reyes 2007]. It also addressed the design of the whole lifecycle of products [Gehin 2008] [Gehin et al 2009] and focused on the product end-

of-life [Brissaud and Zwolinski 2004] [Gehin et al 2008]. Specific techniques to evaluate products were developed: design for remanufacturing [Lopez 2004] [Zwolinski et al 2006] [Zwolinski and Brissaud 2008] and design for disassembly [Haoues 2006].

If the work developed in this PhD strongly comes from the integrated design philosophy as it was developed during the years in the research group. It takes also benefit from the vision of the experience in design of the Product Design and Innovation (CPI) research group at ENSAM Paris, practically on the integration of customers' behaviors, practices and emotions within the design process. The global approach on the new product design was developed [Aoussat et al 2000]. It was integrated with Kansei engineering to investigate the emotional of customer [Bouchard et al 2005] [Bouchard et al 2009] and take into account in the design process [Mantelet et al 2003] [Bouchard et al 2003] [Mougenot et al 2008].

Our project starts clearly from the integrated design methodology that must be enhanced and widened to meet the Thai leather goods industry challenges.

2.3 Design process

Conventionally, a new product design is processed through integrating the efforts of design teams in several design stages. The fundamentals of the design process are explained in this section. There are many approaches in the literature. We retained only three of them that contributed to the formulation of our methodology: systematic design approach, axiomatic design approach and transverse innovative design approach.

2.3.1 Systematic design approach

The design process is often described as a number of sequential steps with iteration possibilities included, for example the systematic design approach [Pahl et al 2007], They describe four basic phases: planning and task clarification, conceptual design, embodiment design and detail design as shown in Figure 2.3.

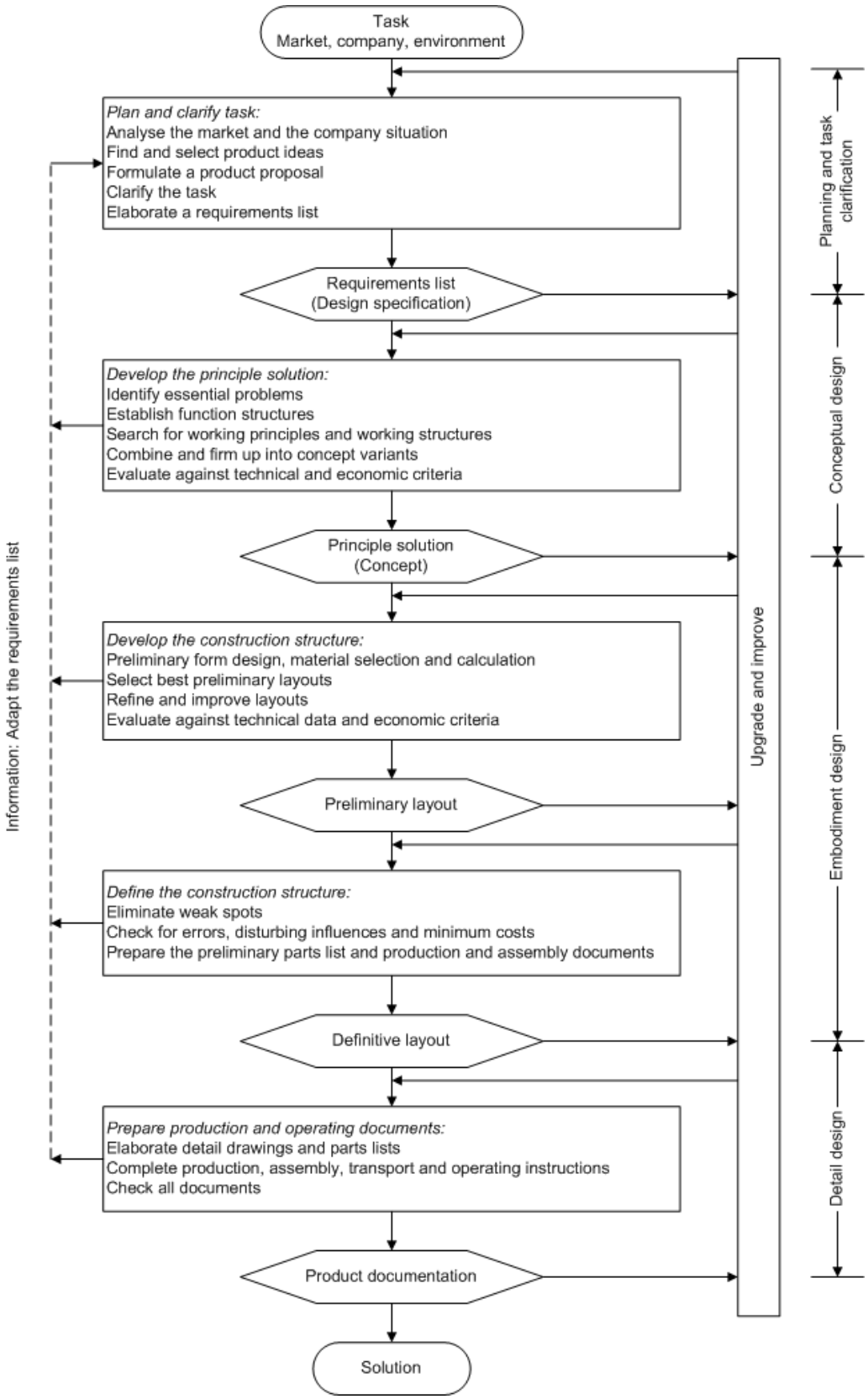

Figure 2.3: The systematic design approach (after Pahl et al 2007).

Planning and task clarification: this phase is to analyze the market and company situation and collect information about the requirements that have to be fulfilled by the product, and also about the existing constraints and their importance. A preliminary requirements list is established. The results from this phase are needed throughout the following phases of the design process. It is the main phase for understanding what the customer wants.

Conceptual design: this phase is to develop the principle solution or concept. It consists of four steps: abstraction, establishment the function structures, development the working structure, and development the concepts. Abstraction is used to solve the problem of fixation and sticking with conventional ideas. Subsequently, the design problem is framed as a function structure and working structures for the individual functions are searched for. The result of conceptual design is the combination of functions with suitable working principles, which is called a concept.

Embodiment design: it is often necessary to produce several preliminary layouts to scale simultaneously or successively in order to obtain more information about the advantages and disadvantages of the different variants. Embodiment design results in the definitive layout of the product.

Detail design: it is the final phase of an engineering design project and comprises the completion of product documentation and finalization of the definitive layout. Detail design leads to the complete documentation required to manufacture a product.

2.3.2 Axiomatic design approach

Axiomatic design is a system design methodology using matrix method to systematically analyze the transformation of customer need into function requirements, design parameters and process variables that was developed by Dr. Suh Num Pyo at MIT, Department of Mechanical Engineering since the 1990s [Suh 1990] [Suh 2001]. In axiomatic design, two axioms give design teams a solid basis for formalizing design problems, conceptualizing solution alternatives, eliminating bad design ideas during the conceptual stages, choosing the best design among those proposed, and improving existing designs.

According to Suh's method, design activity can be divided into four domains: the consumer domain, the functional domain, the physical domain and the process domain. The elements for these four domains are Customer Needs (CNs), Functional Requirements (FRs), Design Parameters (DPs) and Process Variables (PVs), respectively as shown in Figure 2.4. The design process involves interlinking of these two domains by the zigzag mapping process and the multi level decomposition structure in each domain at every hierarchical level of the design process [Suh 2001].

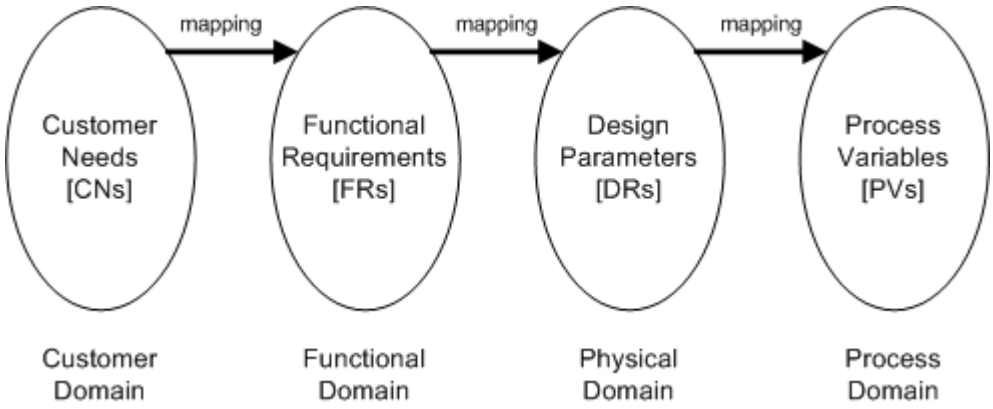

Figure 2.4: The axiomatic design approach (after Suh 1990).

In the functional domain, the customer needs are specified in the terms of FRs and Constrains (Cs). To satisfy the specified FRs, DPs are conceived in the physical domain. The independence axiom, which demands maximizing the independence of the functional requirements, can be used to judge the rationality of design. The information axiom, which demands minimizing the information contents of the design, can be used to select the optimum design.

2.3.3 Transverse innovative design approach

A transverse approach to new product design was developed by Aoussat and researchers of LCPI (ENSAM Paris). It was developed to help managerial staff and project leaders with a global approach enabling the best possible design of new products. This approach, combined with efficient time and resource management (both staff and financial), will increase the likelihood of project success. The objective of this approach is to reduce the number of

hidden stages by making use of tool–player complementary. The approach can be used as a guide for project leaders [Aoussat et al 2000].

This approach to product design is applicable once the need has been identified and up until prototype build is industrially possible. It consists of four phases: translation of needs by company, interpretation of needs, product definition and product validation as shown in Figure 2.5.

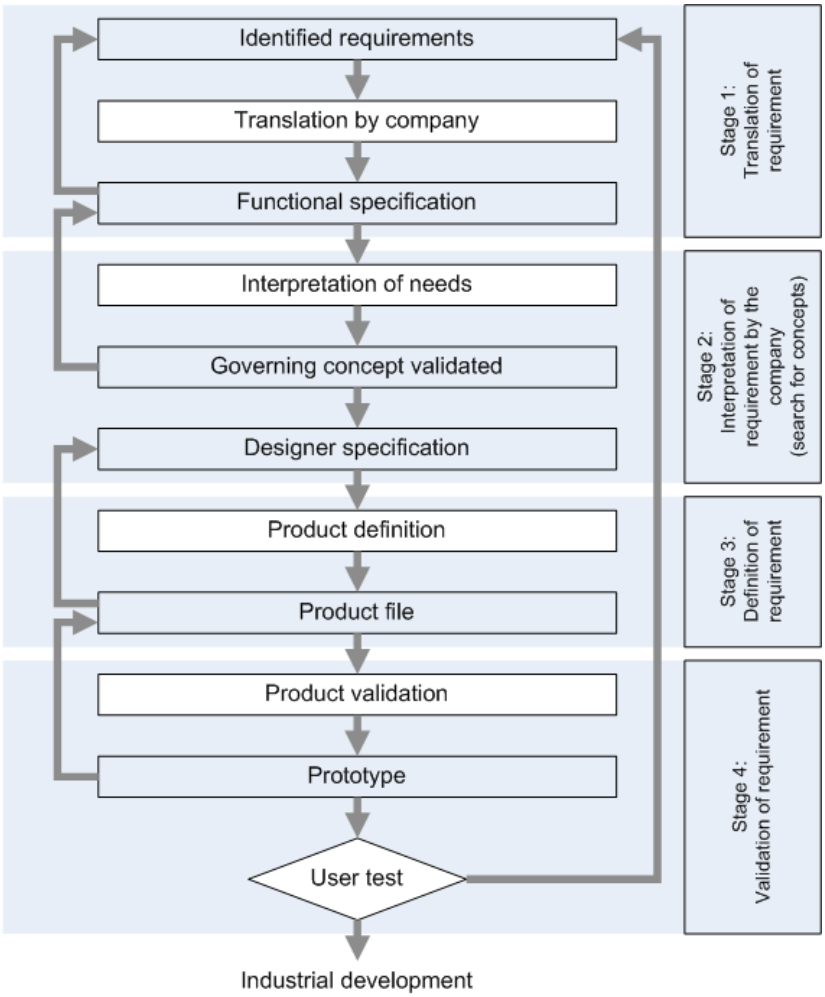

Figure 2.5: The four phase of the transverse innovative design approach (after Aoussat et al 2000).

1. Translation of needs by the company: This phase is to translate product needs identified by the company as a function of its environment. It leads to the establishment of functional specifications. In the needs translation phase, the general environment within which the

project falls must be known, such as expression and validation of needs by the company, market understanding, knowledge of competition and understanding of users.

Two tools are necessary to transit from need identification to validation, the first guaranteeing the need identified falls within the company scope. This tool formulates problems. The second tool is used to express and validate identified needs by way of the functional analysis tool. In terms of qualitative data, for example “be aesthetic” or “be easily used”, it is difficult to validate because they cannot be easily characterized. Thus, a behavioral study would enable the resolution of this problem, and in the process integrate user expectations upstream of the design process and underline needs for new functions the company had not thought of.

2. Interpretation of needs: It is necessary to maximize concept investigation in order to reply to the translation of needs formulated in the functional specifications. The phase aims to provide directives validated as a function of benchmarking and the company strategy so as to establish the designer specifications. Such research takes place using primary and secondary functions as defined in the functional specifications, the objective being to bring forth new concepts in terms of usage and technology, appearing in the “idea forms”. This could be conducted in the form of creativity sessions held by specialists.

3. Product definition: This phase is to define the product to be designed given the information in the designer specifications. The result is a product file that will serve in the construction of an industrially reproducible prototype. As already mentioned, the designer specifications freeze the design, technology used and product performance, and each of these aspects must be taken into account in the resulting product definition. It is essential that the designer and design, production and quality department managers work closely together in order to optimize the design.

4. Product validation: This phase is an intermediary step before product launch, for which the first objective is to validate product design by building an industrially reproducible prototype, and the second is to validate the correct interpretation of needs expressed by way of tests on potential users.

2.3.4 The design activity

The design process can be based on the three following phase: information phase, generation phase, and evaluation and decision phase [Bouchard and Aoussat 2003]. The outcome of an information cycle is an intermediate representation that will be used for the transmission of project information to the other design process players and compared with the previous cycle as a more concrete informative mass as shown in Figure 2.6 and 2.7.

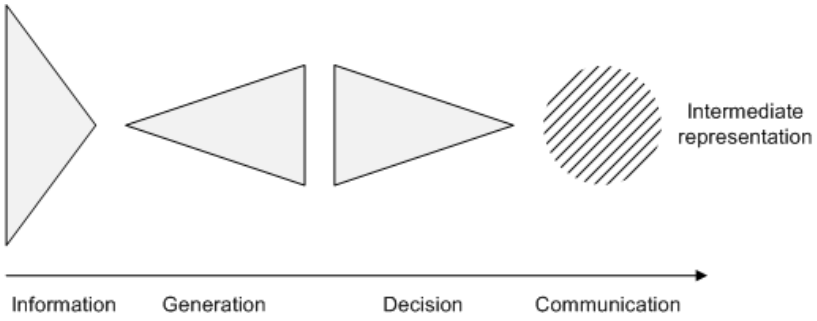

Figure 2.6: The description of an informational cycle (after Bouchard and Aoussat 2003).

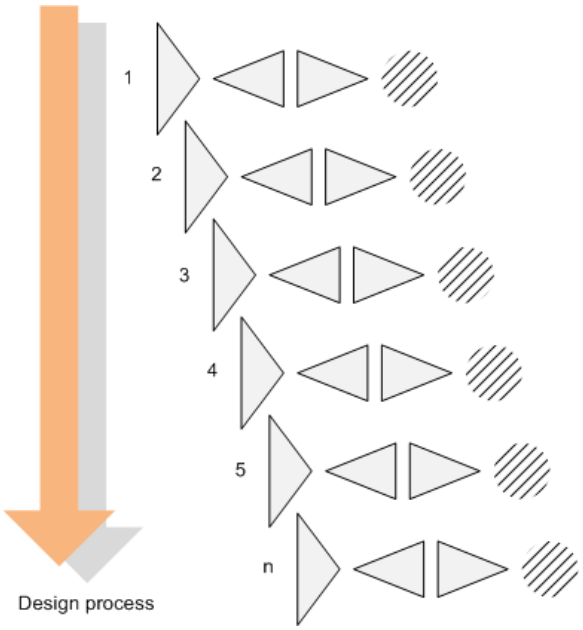

Figure 2.7: The description of the informational process in design activity (after Bouchard and Aoussat 2003).

Information phase: Designers and other players in the design process integrate many categories of information that will be gradually formalized as design solutions throughout the design process. This represents the information contained in the brief and emanates from sources of inspiration and data researched by the designers to complement the brief.

The information and data integrated by the designer can be categorized into information connected to the project, passed on by other players or sought by the designer and the designer's own information or that stemming from the designer's interactions with the surrounding world (notions of references as influences and sources of inspiration) and sometimes dominating over the information connected to the problem. This is both an open and closed phase.

Generation phase: This phase consists in the generation of new ideas and new solutions: by means of numerous mental images and from brief data and other information contained in any design project. Designers can generate physical representations and physical solutions as 2-dimensional and 3-dimensional models. Applied creativity enables the generation of a large volume of ideas, possibly even including the points of view of other non-designer players (ergonomists, engineers, etc.). The generation phase is an open phase.

Evaluation and decision phase: The choice of the right design solutions to be developed physically is achieved by an evaluation and deduction process. It uses criteria from the initial or reviewed brief to help choose the best solutions. The Evaluation and Deduction phases are analytical phases. This phase is a closed phase.

2.3.5 Conclusion

These methods of the design process are now well known and accepted by everybody, either industrialists or academics. They will structure any new method. In this study, we integrated these methods to solve the problems of the Thai leather goods industry. The structure of the systematic design approach was used to be the core of the design process in defining the main phases of "planning the task from customers' expectations"; "proposing the main relevant concept" then "validating the concept by embodying it with manufacturing issue". The zigzag mapping of the axiomatic design approach was used to support the relationship between

customers' items and engineering ones. The "translation of needs" and the "interpretation of needs" phases of the transverse innovative design approach were adapted to support the exploration and the interpretation of the needs of customers.

2.4 Methods to understand customers within designing

Emotion is crucial for everyday decision making [Norman 2004]. It is the complex psychophysiological experience of an individual's state of mind as interacting with biochemical and environmental influences. Emotion fundamentally involves physiological arousal, expressive behaviors, and conscious experience [Myers 2004]. Emotion is associated with mood, temperament, personality and disposition, and motivation.

Customer's satisfaction is an affective behavior of customer. It relies on desires more than needs which desires are mainly depending on aesthetic, semantic and symbolic aspects of cognitive response to design [Crilly et al 2004]. This means that the customer purchases a product based on more subjective terms such as manufacturer image, brand image, reputation, design, impression, etc., although the products seem to be equal. A large number of manufacturers have started development activities to consider such subjective properties so that the product expresses the company image. This demand triggers the introduction of a new research field dealing with the collection of customers' hidden subjective needs and their translation into concrete products. Thus, it is important to work closely with customers to make sure that the products will fulfill the needs and requirements of customers.

There are many methods in the literature. We retained two methods and four technical points that contributed to the formulation of our methodology. The two methods are emotional design and Kansei engineering. The four technical points are semantic differential, Likert scale and principal component analysis.

2.4.1 Emotional design

According to the research theories regarding the aspect of emotion and design that are approached by Desmet and Norman [Desmet 1999] [Norman 2004], the relationship between

emotion and design is classified in three perspectives: emotionalize design, emotional design and emotion design [Ho and Siu 2009].

Emotionalize design: It is relationship between the designers and design outcome. It is the role of the designers that tend to use emotional and intuitive methods in the design process to lead to a design outcome. Designers apply their own knowledge in the concept of design instead of merely focused on the user's point of view. Designers present their emotions from their own perspectives on the issues that they are interested in.

Emotional design: It is relationship between the emotional responses and design appearance that focused on the user's need and experience. It is not only communicated through the style of design, function, form and usability, but also built up experience for the user on their needs and demands. There are three levels of information processing according to the situation and response: visceral, behavioral, and reflective. Visceral design concerns itself with appearances. Behavioral design has to do with the pleasure and effectiveness of use. Reflective design considers the rationalization and intellectualization of a product. They are integrated through any design [Norman 2004].

Emotion design: It is the interaction of designers and users with design objects. The design object is usually given meanings or messages by the designers in the design process. Users probably used the designs with the planned function or emotion domain. The users and the designers would have interaction through the planned function or design.

[Ho and Siu 2009] proposed a new model to explain the relationship between emotionalize design, emotional design and emotion design. It consists of three key core elements: designers, design outcome and users as shown in Figure 2.8. If we look into the whole process of emotion flow, i.e. from the designers who inject their emotion(s) in designing the outcome (Emotionalize Design) to the users get motivated for certain emotional responses due to the consumption of the design outcome (Emotional Design). There are interactions between the designers and the users through the design outcome, hence establish a strong relationship among these three roles. This also becomes the ground for the emotion design.

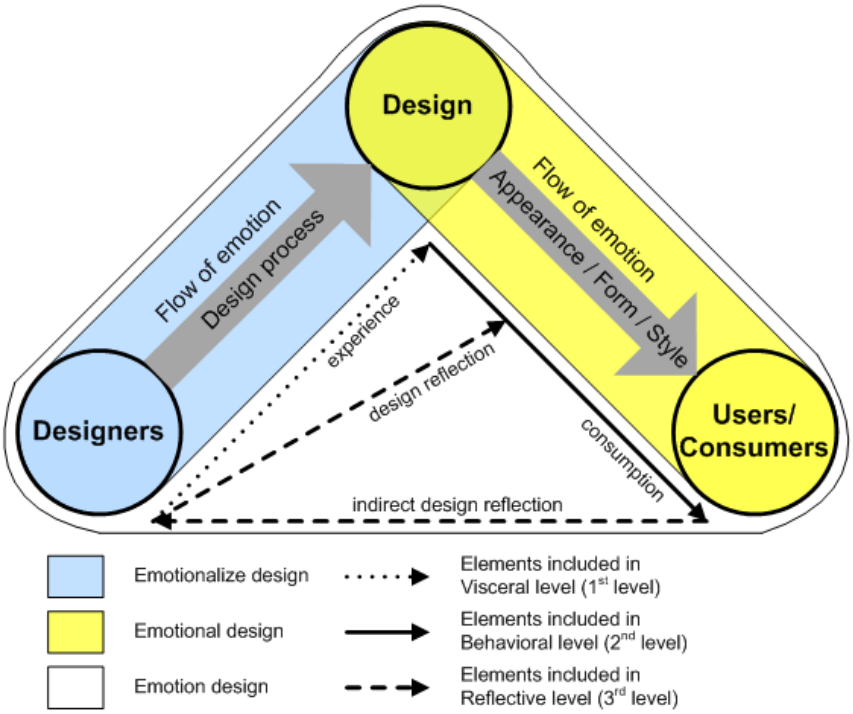

Figure 2.8: The emotion design model (after Ho and Siu 2009).

At this first level of emotion design, the brains of the consumers received the signals by way of the first impression on the design outcome (that resulted from the designers' design experience) and give the emotional responses institutively.

The second level of emotion design, design experience and users consumption actions took place from both the designers and users. Designers inject their emotions in the design process for the design outcome while the consumers consumed the design based on the emotions raised by the design outcome.

The third level of emotion design, the reflective level, people though back about the experiences or tired to prejudge to behavior level. Hence, in the daily application, designers get feedbacks and indirect reflections from the users. This could provide insights for the further developments on their design. The both of the reflections (direct and indirect) could also be found in this third level.

Thus, emotional design is product design targeted to satisfy customer's needs or requirements. By controlling certain design factors, customer's emotion can be evaluated, designed, and satisfied [Choi and Jun 2007]. Emotional design is a common research field involving both designers and human factors. It is focuses on the evaluation and decision-making phase in the design process.

Practically, emotional design is performed with the questionnaire that new product or concept is evaluated by the customers. Semantic differential is used to measure the perceptions or attitudes of customer. The detail of semantic differential is explained in section 2.4.3.

In Europe, initially, the researchers had only to do with semantic analysis [Smet and Overbeeke 1995] [Pasman and Strappers 2000] [Battarbee and Mattelmaki 2003] [Petiot and Yannou 2004]. Today, they tend to integrate explicitly the emotional analysis with the semantic one [Desmet 1999] [Desmet 2000] [Desmet et al 2000] [Bouchard et al 2005] [Bouchard et al 2009].

2.4.2 Kansei Engineering

Kansei Engineering (KE) was introduced by Nagamachi around 1970 at Hiroshima University as a customer-oriented product development method in order to realize products' best fit to customer needs. He has since been engaged in the development of Kansei engineering over the last 35 years and contributed to the development of several Kansei products and Kansei engineering methods [Nagamachi 1989] [Nagamachi 1998] [Nagamachi 2002] [Nagamachi 2008].

Kansei engineering aimed at the implementation of the customer's feeling and demands into product function and design. It is able to grasp the consumers' Kansei on a psychological basis, to analyze the Kansei using statistical methods, and to transfer the analyzed data into the design domain. Kansei engineering, as a kind of human ergonomic technology, can be defined as a methodology for translating human psychological processes such as feeling, sensitivity and emotion related to products into appropriate product design elements such as size, shape, and color. Kansei Engineering can be considered as a methodology within the

research field of "Affective Engineering". It is based upon the analysis of product semantics, the subjective words and phrases used to describe the characteristics of product or service.

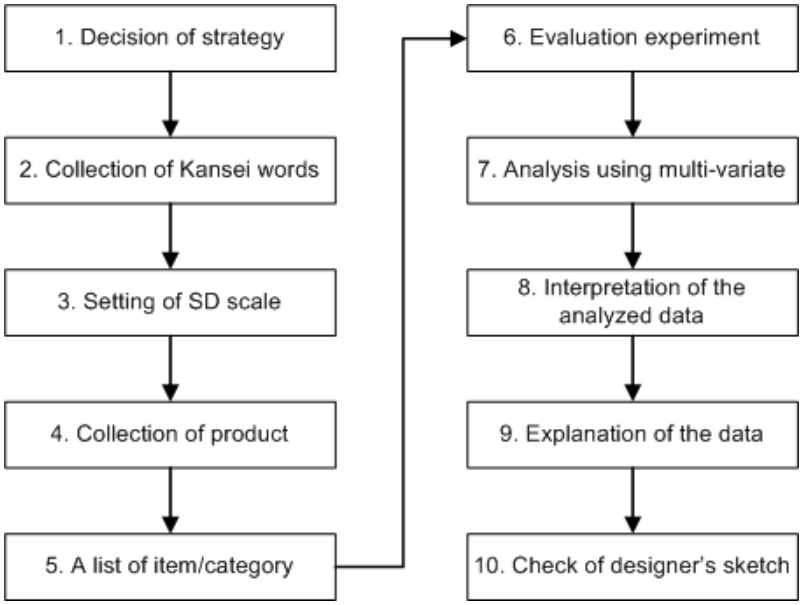

Figure 2.9: The flow of Kansei engineering Type I (after Nagamachi 2008).

Nagamachi proposed the methods of Kansei engineering as shown in Figure 2.9 [Nagamachi 2008]. Kansei engineering Type I, starts from a company's decision of product strategy on the design domain as well as on the target (customer type). Then in step 2 Kansei words are collected which are related to the product domain. Usually, 30-40 Kansei words are collected, adjectives or sentences of feelings related to the product domain, and after that a five-point or seven-point/nine-point SD (semantic differentials) scale is constructed [Osgood et al 1957] [Snider and Osgood 1969].

In step 4 product samples are collected, and after that in step 5 items/categories of each sample are identified. Item means a category like size, width, color, style, function etc., and category implies more detailed features like red, yellow, green, blue for the color item.

The subjects then evaluate in step 6 each product sample on the five-point (or seven-point/nine-point) SD scale sheet and the evaluated data are then analyzed in step 7 using multivariate statistical methods like principal component analysis, factor analysis, regression analysis, cluster analysis, conjoint analysis, etc.

Many studied have followed Kansei engineering to design the new products in various sectors; automobile [Jindo and Hirasago 1997] [Schutte and Eklund 2005], fashion [Chang et al 2003], portable media player [Huang and Chen 2005], polymer-based product [Choi and Jun 2007], mobile phone [Jiao et al 2006], architectural design [Hung and Nieh 2009] and watch [Chang and Chang 2005] and also develop the Kansei engineering system [Yang et al 1999] [Bouchard et al 2003] [Jiao et al 2006] [Zhai et al 2009].

2.4.3 Semantic differential

Semantic differential is a type of a rating scale designed to measure the connotative meaning of objects, events, and concepts. The connotations are used to derive the attitude towards the given object, event or concept. [Osgood et al 1957] developed a method of measuring the emotional content with words more objectively, called “Semantic Differential Technique”.

An actual semantic differential consists of a number of scales, each of which is a bipolar adjective pair. Each scale measures one or two of the basic dimensions or factors. Osgood performed a factor analysis of large collections of semantic differential scales and found three recurring attitudes that people use to evaluate words and phrases: evaluative, potency, activity. Evaluative scales include pairs such as good-bad, bitter-sweet, large-small, and dirty-clean. A second cluster has adjectives that seem to share strength or potency ideas (strong-weak, rugged-delicate). A third scale is called activity because its adjectives seem to express motion and action (fast-slow, hot-cold). These three dimensions of affective meaning were found to be cross-cultural universals in a study of dozens of cultures [Osgood et al 1975]. Figure 2.10 shows the example of semantic differential scale. The respondent is asked to choose where his or her position lies, on a scale between two bipolar adjectives.

Figure 2.10: The example of semantic differential scale.

The semantic differential is today one of the most widely used scales used in the measurement of attitudes. One of the reasons is the versatility of the items. The bipolar adjective pairs can be used for a wide variety of subjects. The semantic differential is a

potential evaluation model determined by the visual evaluation of product images helping designers to understand their own communication models.

Many studied used semantic differential technique to measure the customer's perceptual feeling to various products, such as bag [Hung and Chuang 2003] [Kongprasert et al 2008] [Kongprasert et al 2009], house [Hung and Nieh 2009], automobile [Hsiao and Chen 2006] [Abidin et al 2008], PDA [Chen and Shao 2003], portable media player [Huang and Chen 2005], mobile phone [Chuang et al 2001] and furniture [Chuang and Chen 2008].

2.4.4 Likert scale

The Likert scale is a psychometric scale commonly used in questionnaires, and is the most widely used scale in survey research, such that the term is often used interchangeably with rating scale even though the two are not synonymous [Likert 1932]. It is a bipolar scaling method, measuring either positive or negative response to a statement. The format of a typical five-level Likert scale is Strongly disagree, Disagree, Neither agree nor disagree, Agree and Strongly agree.

2.4.5 Principal component analysis

Principal component analysis (PCA) is a technique used to reduce multidimensional data sets to lower dimensions for analysis. PCA is mostly used as a tool in exploratory data analysis and for making predictive models. PCA involves the calculation of the eigenvalue decomposition of a data covariance matrix or singular value decomposition of a data matrix, usually after mean centering the data for each attribute. The results of a PCA are usually discussed in terms of component scores and loadings [Shaw 2003].

Principal component analysis is mathematically defined as an orthogonal linear transformation that transforms the data to a new coordinate system such that the greatest variance by any projection of the data comes to lie on the first coordinate (called the first principal component), the second greatest variance on the second coordinate, and so on. PCA is theoretically the optimum transform for given data in least square terms [Jolliffe 2002].

Principal component analysis is closely related to factor analysis. PCA and factor analysis differ in the communality estimates that are used. Simplistically, through, factor analysis derives a mathematical model from which factors are estimated, whereas principal component analysis merely decomposes the original data into a set of linear variates. As such, only factor analysis can estimate the underlying factors and it relies on various consumptions for these estimates to be accurate. Principal component analysis is concern only with establishing which linear components exist within the data and how a particular variable might contribute to that component [Field 2005].

Many studied have followed principal components analysis approach to analyze and cluster the customer's perception to products [Bouchard et al 2005] [Bouchard et al 2009] [Kongprasert et al 2008] [Kongprasert et al 2009] [Hung and Nieh 2009].

2.4.6 Conclusion

Both emotional design and Kansei engineering were used to translate the feeling of customers and emotions related to products into the product domain. Their main principles "the analysis of product semantics" and "the subjective words and phrases" were at the origin of the tools we developed to support the characteristics of products or services. From the technical point of view, the semantic differential and the Likert scale were used to measure the perceptions and attitudes of customers. The principal component analysis was used to explore data and make predictive models.

2.5 Brand identity

A brand is not the name of a product. It is the vision that drives the creation of products and services under that name. That vision, the key belief of the brands and its core values is called identity. [Warell et al 2006] transfer identity to the domain product design. First, they define identity as an attribute of a thing, which is shared with something else (i.e., 'similarity'); on the second, identity is seem as a unique attribute of a thing (i.e., 'dissimilarity'). Identity expresses the brand's tangible and intangible characteristics and draws upon the brand's roots and heritage [Kapferer 2008]. Brand identity involves the key identity attributes of the company in a "condensed" form. It expresses the values of the brand with their form. The

purpose of brand identity is to specify the brand's meaning, aim and self-image and is to foster recognition [Karjalainen 2003].

2.5.1 The relation between brand identity and brand image

The relation between brand identity and brand image is described by [Kapferer 2008]. Brand image is on the receiver's side. Brand image research focuses on the way in which certain groups perceive a product, a brand, a politician, a company or a country. Brand identity is on the sender's side. The purpose is to specify the brand's meaning, aim and self-image. Brand image is both the result and interpretation thereof. In terms of brand management, brand identity precedes brand image.

Before proposing an image to the public, the designers must know exactly what they want to propose. Before it is received, the designers must know what to send and how to send it. As shown in Figure 2.11, brand image is a synthesis made by the public of all the various brand messages (e.g. brand name, visual symbols, products, advertisements, sponsoring and articles). An image results from decoding a message, extracting meaning and interpreting signs come from two sources: brand identity and extraneous factors (noise) that are proposed by the competitors.

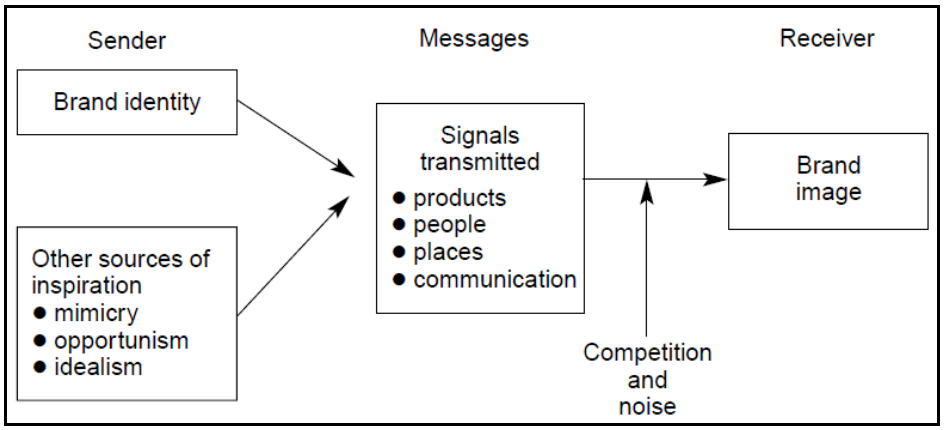

Figure 2.11: The relation between brand identity and brand image (after Kapferer 2008).

2.5.2 The brand identity prism

The six facets of brand identity are proposed to describe what is brand identity made of? [Kapferer 2008]. It is called "the brand identity prism" as shown in Figure 2.12. The six facets define the identity of a brand as well as the boundaries within which it is free to change or to develop. The brand identity prism demonstrates that these facets are all interrelated and form a well-structured entity. The content of one facet reflects that of another.

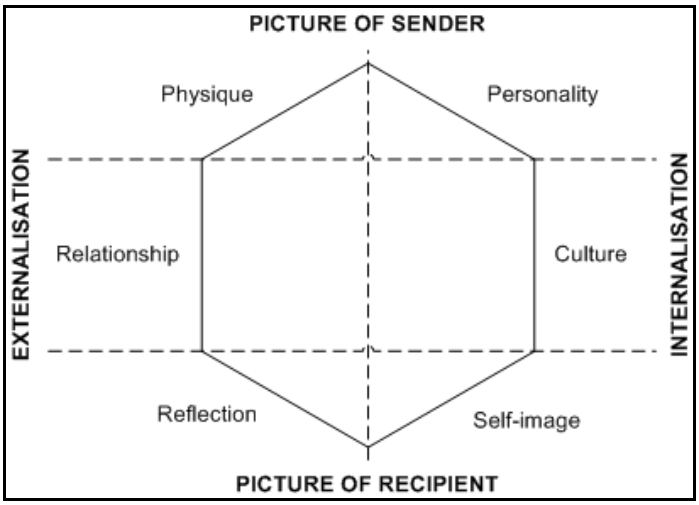

Figure 2.12: The brand identity prism (after Kapferer 2008).

Physique: A brand, first of all, has physical specificities and qualities – its 'physique'. It is made of a combination of either salient objective features (which immediately come to mind when the brand is quoted in a survey) or emerging ones. Physique is both the brand's backbone and its tangible added value.

Personality: A brand has a personality. By communicating, it gradually builds up character. The way in which it speaks of its products or services shows what kind of person it would be if it were human.

Culture: A brand is a culture. There is no cult brand without a brand culture. A brand should have its own culture, from which every product derives. Culture means the set of values feeding the brand's inspiration. It is the source of the brand's aspirational power. The cultural

facet refers to the basic principles governing the brand in its outward signs (products and communication). This essential aspect is at the core of the brand. This facet is the one that helps differentiate luxury brands the most because it refers to their sources, to their fundamental ideals and to their sets of values.

Relationship: A brand is a relationship. This facet defines the mode of conduct that most identifies the brand. This has a number of implications for the way the brand acts, delivers services, relates to its customers.

Reflection: A brand is a customer reflection. A brand will always tend to build a reflection or an image of the buyer or user which it seems to be addressing. Reflecting the customer is not describing the target; rather, the customer should be reflected as he/she wishes to be seen as a result of using a brand. It provides a model with which to identify.

Self–image: Finally, a brand speaks to our self-image. If reflection is the target's outward mirror (they are …), self-image is the target's own internal mirror (I feel, I am …). Through our attitude towards certain brands, we indeed develop a certain type of inner relationship with ourselves.

Many studies have followed a brand identity approach. [Warell et al 2006] studied about how producers and consumers create meaningful identity references through product visual form that it aims to understand the designer's perception and custmer's perception to visual product identity. Karjalinen and his colleagues approached on how to analyze the brand, identity and visual form design of various car brands and transform the brand-specific design elements to design a wholly different product category [Karjalinen 2003] [Karjalainen and Warell 2005] [Karjalainen et al 2006] [Karjalainen 2007]. [Chen and Yang 2003] [Kim and Lim 2003], they studied about how to integrate corporate identity through product design. [McCormack et al 2004] developed a shape grammar to capture the brand essence. It is important to build or maintain a strong brand that fulfills the brand identity and appeals to the customers.

2.5.3 Conclusion

The six facets of the brand identity prism are necessary to create the new products. Among them, “physique” and “personality” were very relevant to our study because they are the only reflecting the identity of product and as such they must be designers’ objects. The other 4 ones are related to customers’ behavior and are not directly related to the tools we are developing. As said before, the main and unique driver for a company to differentiate from competitors and is the “identity”. Therefore, our methodology should focus on the both facets “physique” and “personality” and their interaction.

2.6 Environmental impact assessment

During the development of a new product, or the redesign of an existing one, the product development team is confronted with a variety of design criteria like quality, ergonomics, safety, aesthetics etc.

Sustainable product design, also known as Design for Sustainability (D4S), is one globally recognized way companies work to improve efficiencies, product quality and market opportunities while simultaneously improving environmental performance. Design for sustainability, environmental and social criteria are integrated into the product development process as well, minimizing the impacts of the product throughout its life cycle [UNEP and TUDelf 2009].

The design for sustainability approach is based on taking a life cycle view of a product as shown in Figure 2.13. The product life cycle starts with the extraction, processing and supply of the raw materials and energy needed for the product. It then covers the manufacturing of the product, its distribution, use and its ultimate disposal. Initially, the traditional 3R (reduce, reuse, recycle) concept are used to promote the green technologies. Recently, the 6R (reduce, reuse, recover, redesign, remanufacture, recycle) concept are formed to be the basis for sustainable design [Jaafar et al 2007].

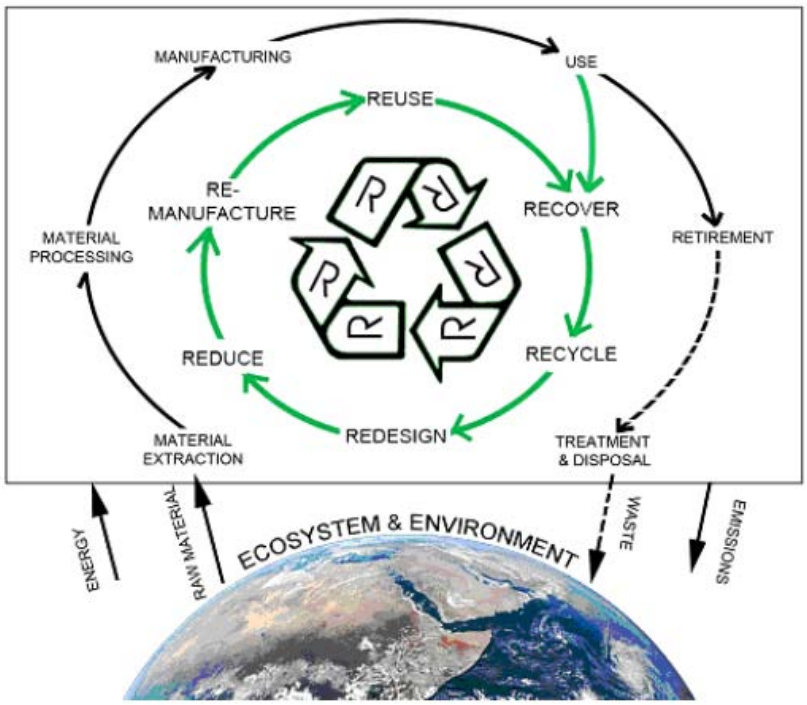

Figure 2.13: The product life cycle stage (after Jaafer et al 2007).

The environmental challenge for sustainable design is to design products that minimize environmental impacts during the entire of the product life cycle. Then, Sustainable design is a concept to help companies rethink how to design and produce products to improve profits and competitiveness and to reduce environment impacts at the same time.

There are many approaches in the literature. We retained only two of them that contributed to the formulation of our methodology: environmental impacts and life cycle assessment.

2.6.1 Environmental impacts

Environmental impacts of all kinds occur in different phases of the product life cycle and should be accounted for in an integrated way. Environmental impacts can be divided into three main categories: ecological damage, human health damage and resource depletion as shown in Figure 2.14 [UNEP and TUDelf 2009].

	Type of impact	Description
Ecological Damage	**Global warming or Climate change**	Addition of greenhouse gases to the atmosphere from burning of fossil fuels, agriculture, industrial practices.
		Effects: temperature change, increased incidence of storms, desertification, tropical disease, ocean current changes, sea level rise.
	Ozone depletion	Scratospheric ozone depletion caused by emissions of CFCs.
		Effects: increased amount of UV radiation leading to increased cancer occurrence, reduced productivity of plants, marine algea and high altitude biota.
	Acid rain	Acidification of precipitation bt emission of sulphuric and other substances, mainly from fossil fuels.
		Effects: dissolves metals from the soil which become toxic to plants and aquatic organisms.
	Water europhication	Addition of excess nutrients to water, leading to algae bloom and consequent reduction of available oxygen.
		Effects: killing of fish and other aquatic organism.
	Habitat alteration (land use)	Physical modification or desrtuction of natural habitats for agriculture, forestry, roads, and urban growth.
		Effects: Primary cause of loss of biodversity
	Ecotoxicity	Exposure of plants, animals and other biota to toxic substances.
		Effects: Wide range of effects.
Human Health Damage	**Smog and air pollution**	Emission of nitrogen oxides and VOCs generates ground level ozone, other air pollutants include dust particles and sulphur dioxide.
		Effects: increased incidence of Asthma and other health disorders.
	Health damaging substances	Non-cancer causing substances include skin irritants, growth inhibitors, endocrine disruptors.
	Carcinogens	Cancer causing substances, Mutagens that cause genetic mutation (most of them are also carcinogenic), Teratogens cause defects in developing embryos.
Resource Depletion	Fossil fuels	Current consumption rates of oil, gas, coal convert fuels into materials, energy and CO2 at a rate million of times faster than nature can replenish the fuel reservoirs
	Fresh water	Consumption of fresh surface or ground water converts theminto forms that are typically nonrecoverable. Access to clean, portable water is a faster growing international problem.
	Minerals	Metal ores are converted into metals and alloys that are eventually oxided or dispersed as waste that is often not recycled.
	Topsoil	In many places, agriculture and forestry erode topsoil at a rate much faster than natural processes replenish it.

Figure 2.14: Environmental impacts (after UNEP and TUDelf 2009).

2.6.2 Life cycle assessment

Life-cycle assessment (LCA) is a methodology that attempts to quantify the overall environmental and economic impact – in terms of material and energy consumption, carbon footprint, etc. – over the entire life-cycle of a product - from material extraction to eventual disposal at the end of life [Jayal et al 2009]. LCA can be used as decision support tools supplying information on the environmental effects of products [UNEP 1996]. The methodological framework for conducting LCA comprises four main phases: definition of goal and scope, inventory analysis, impact assessment and interpretation as shown in Figure 2.15 [ISO 14040 2006].

Goal and Scope: Define and describe the product, process or activity. Establish the context in which the assessment is to be made and identify the boundaries and environmental effects to be reviewed for the assessment.

Inventory Analysis: Identify and quantify energy, water and materials usage and environmental releases (e.g., air emissions, solid waste disposal, waste water discharges).

Impact Assessment: Assess the potential human and ecological effects of energy, water, and material usage and the environmental releases identified in the inventory analysis.

Interpretation: Evaluate the results of the inventory analysis and impact assessment to select the preferred product, process or service with a clear understanding of the uncertainty and the assumptions used to generate the results.

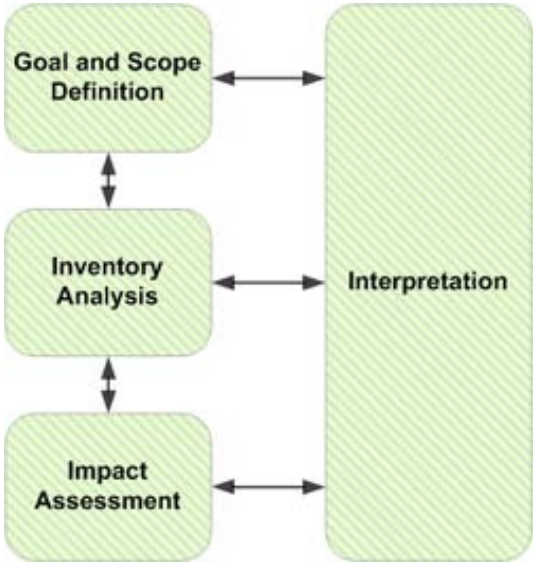

Figure 2.15: Phase of an LCA (after ISO 14040 2006).

LCA has been used for both corporate and public decision making. Some of the more recent examples of LCA applications in corporate decision making such as food packaging [De Monte et al 2005], leather [Canals et al 2002] [Nazer et al 2006] [Bruno et al 2007] [Joseph and Nithya 2009], leather goods [Kongprasert et al 2010], textile [Woolridge et al 2006] [Nieminen et al 2007] and footwear [Mila et al 1998].

2.6.3 Conclusion

Minimizing the environment impacts of the product is one of the main concerns in new product development processes. The whole life cycle of the product must be addressed. The main relevant impact categories must be identified for the leather goods industry and selected. Practically, only LCA are robust enough and complete to give quantitative and exploitable data. Unfortunately running LCA is very time consuming and it needs lots of data. LCA method was used to qualify technologies environmentally (to do only once) then a simplified calculation should be found to be reactive while designing.

2.7 Conclusion of chapter 2

According to the manufacturing paradigm evolution that customers are participated in the design process, the personalized production is the new manufacturing paradigm for the 21th century. Thus, it is extremely important to adapt the design and manufacturing process coping with the needs or requirements of customers. Customers are part of stakeholders to be involved within a design process and supported by the design method. Many design process approaches propose the design methodology to explore and extract the customer's requirements that perform in terms of quantitative data. In terms of qualitative data, the behavioral study is used to enable the resolution of this problem that is an essential activity in information phase. It is integrated in the design process to help designers understand customers.

Emotional design and Kansei engineering are the design methodology that aims to translate the feeling of customers and emotion related to product into the product domain. They mainly based on the analysis of product semantics, the subjective words and phrases used to describe the characteristics of product or service. Normally, emotional design works with the semantic differential, Likert scale and principal component analysis to explore the customer's needs or requirements in the information phase.

Brand identity illustrates the unique attribute that differs from the competitor and is to foster recognition while it is used to illustrate the unique attribute to share something, to transfer to next generation and to create the heritage. It is point 2 of the main requirements of the methodology.

The environment impacts are extremely important to new product development process because they occur in each stage of the product life cycle. When design or manufacturing process changes, they can affect the environmental performance of product concepts. It is point 3.

All techniques and methods that are explained in this chapter are integrated to develop the new design methodology that aims to help designers design the new product meet the customer's requirements, express their identity and make friendly with the environment.

Chapter 3

The “Integrated Design System” proposed

Chapter 3

The "Integrated Design System" proposed

The objective of this chapter is to present the main specific output of the research work: the integrated design system that was developed during this work and the methodology to design new products based on customer's perception, brand identity and environment friendliness.

All techniques and methods that were explained in chapter 2 were integrated to develop the new design methodology that aims to help designers design the new products meeting the customer's requirements, expressing their identity and making friendly with the environment. It is organized as the following. Section 3.1 explains the design system principle. Section 3.2 explains the structure of the integrated design system. Section 3.3 explains about how to use the design system.

3.1 Design system principle

This section describes the principles of the design system. The design system has been developed to help a designer designing new products and ensure to meet customer's perceptions, express brand identity and friendly with an environment.

3.1.1 The classic product cycle

Presently, the product cycle is related to mass customization that has been the reference of the production system since 1980. It is producing goods and services to meet individual customer's needs with near mass production efficiency [Tseng and Jiao 2001]. The product cycle has five elements: customer, marketing, design, manufacturing and retail as shown in Figure 3.1.

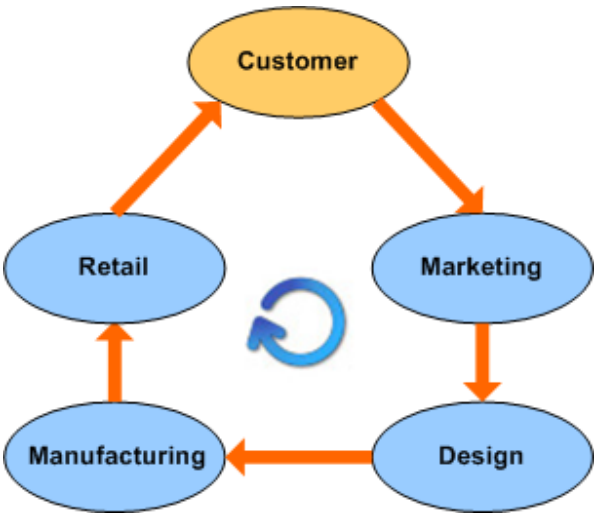

Figure 3.1: The classic product cycle.

Customer: Customers are important people for any business. They are the resource upon which the success of the business depends. They can tell things about products, company and services. It is important to work closely with customers to make sure that the products will fulfill the needs and requirements of customers.

Marketing: Marketing is a connector to link the firm with customers. The role of marketing is to explore the needs and wishes of customers. A firm uses a marketing research to explore the information, requirements and needs from the target customers. The requirements received from customers are analyzed and transferred to designers to create new products.

Design: Designers conceptualize and evaluate ideas, make them tangible through products. The customer's requirements received from marketing are combined with art, science and technology to create tangible products.

Manufacturing: it is to make products for sale to customers. It is processed from the transformation of raw materials to finished goods for sale. The manufacturing process is a sequence of transformation by resources that give the reality of the product and its quality.

Retail: Retailing is another connector that links the firm with customers. It is to distribute the finished products to customers.

As it can be seen, the product goes from the customer, as needs, to the customer, as the expected product, through the marketing, as list of requirements, the design, as the virtual product, and the manufacturing, as physical product. It is a closed loop.

This product cycle has two main properties. First, designers cannot get the information or requirements directly from customers because marketing is between designers and customers. Marketing formalized customer's to design requirements. It is the role and the responsibility of marketers to define the list of design requirements that represents the customers' needs. Second, the formalization is a one-way and irreversible transformation and is the official starting point of the design activity. Marketers will know the customer's response again when the customers have used the product and send feed back to them.

3.1.2 Basic idea: both the customer satisfaction loop and the engineering loop at the core of the design system

It is clear that now the product design activity must be customer-oriented. The knowledge of customers should guide the designers' work. It is assumed that the knowledge of customers given by the marketing services to designers through the list of requirements is a good starting point but that it is not enough to ensure the full satisfaction of customers after design decisions on product creation. The idea is to strengthen the connection between designers and customers by introducing the brand identity (brand image) as a second connector. Brand identity is a marketing tool that is mostly used to communicate between designers and customers. It is used to get the information and requirements directly from customers as shown in Figure 3.2. This role of interface between designers and customers is shared by marketing and brand identity. It has been analyzed and optimized from many years. Many tools and methods are now available to support this interface.

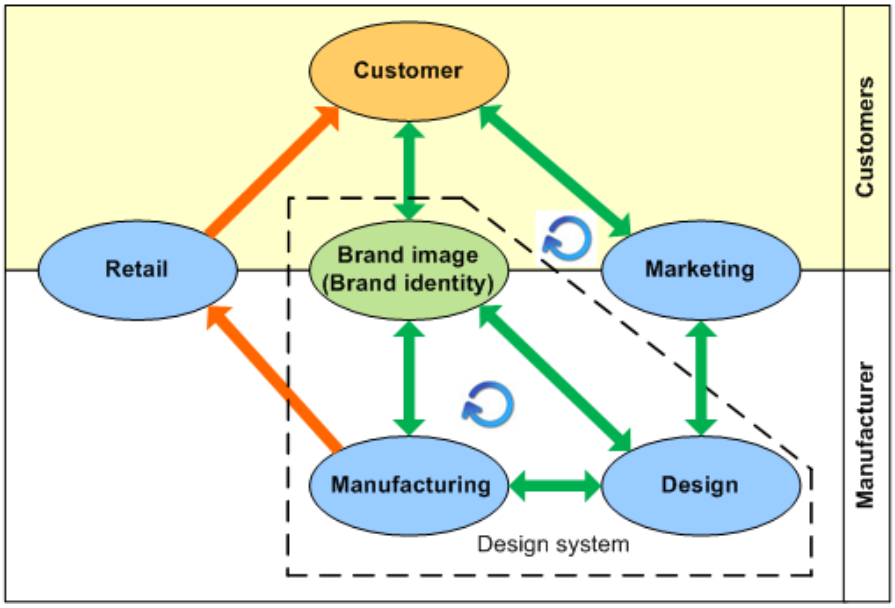

Figure 3.2: The basic idea: the design system principle.

Introducing, brand identity materializes 2 significant cycles: the customer satisfaction loop and the engineering loop as shown in Figure 3.3.

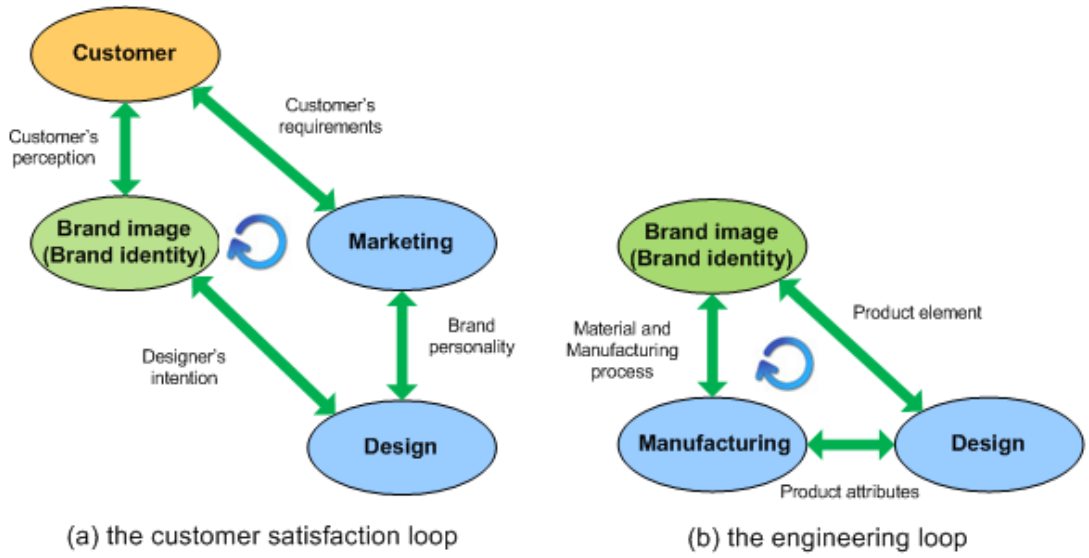

Figure 3.3: The cycles of the design system.

Figure 3.3 (a) shows the relation of customers, marketing, design and brand identity. This cycle is to optimize the customer satisfaction process. The information and requirements of

customers received from the marketing research are transferred to designers to create new products. The customer's requirements are combined with brand personality, ideas, fashion trend and inspiration of designers to create new products. When new products (concept) are designed, they are evaluated by customers to explore the customer's perceptions to product visual form. Brand identity is used to explore and check customers. The customer's perceptions are compared with the brand personality to explore the correspondences and gaps between designer's intention and customer's perception. The customer's perception that corresponds to the designer's intention is used to guide the designer in the design process. After the designer has finished the design the new product, all costs and environmental impact information are transferred to the marketing to prove the new product. The marketer uses the information of the new product to advertising. It is clear that this customer satisfaction loop is bi-directional and multi-directional because the design process is very loose in the loop.

Figure 3.3 (b) shows the relation of design, manufacturing and brand identity. This cycle is used to optimize the engineering process. When designers know the correspondence between designer's intention and customer's perception, it explores the product attributes that express the brand identity and are related to brand personality. They can be a product element, material or manufacturing process. The product attributes will guide the design of new products. Thus, brand identity is used to guide the designer for optimizing the design and engineering process.

3.2 The design system structure

3.2.1 Design system principle

The design system has been developed based on the design principles afore mentioned. The design system is composed of three elements: the design methodology, the database and the tools to support the design methodology as shown in Figure 3.4. The design methodology is the essence of the design system. It needs to integrate some specific tools and database to support the design methodology. The system is designed, initialized and maintained by the system engineer. During the design process, the system is used by the designer to create the

new product from the customer needs. This principle led us to define the design system as it is presented in Figure 3.5 them detailed in the following sections.

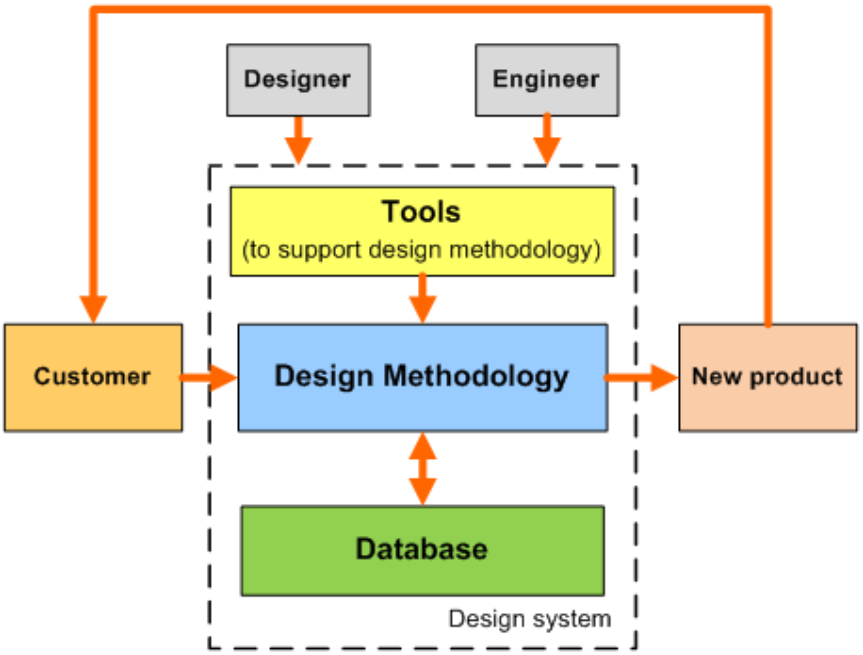

Figure 3.4: Design system principle.

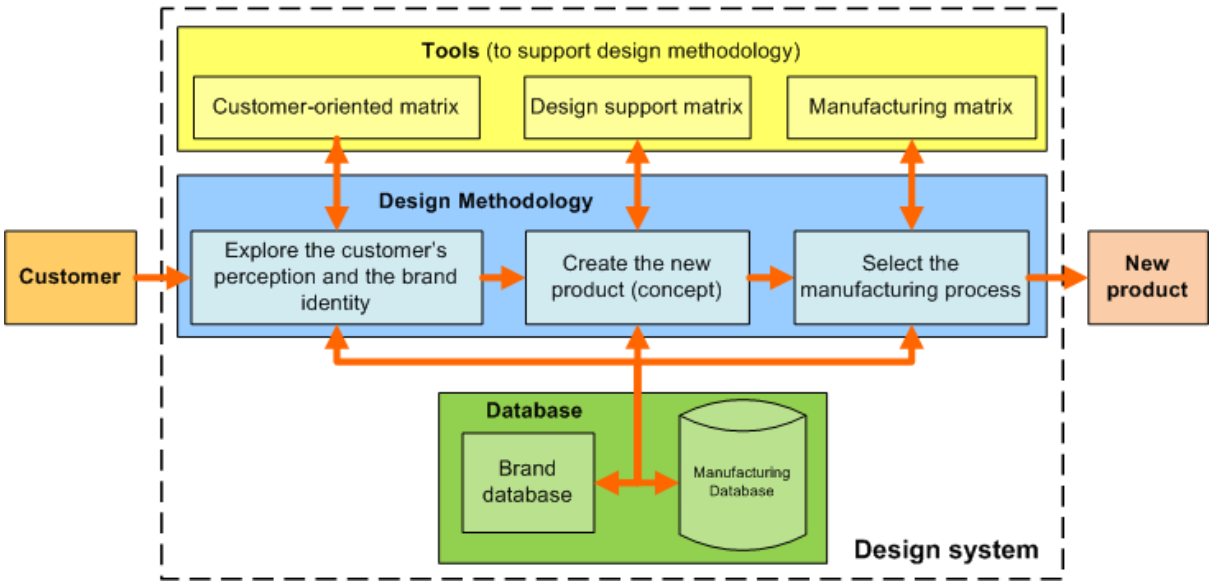

Figure 3.5: The structure of the design system.

3.2.2 Design methodology

The design methodology is the essence of the design system. It has 3 phases: explore the brand identity and the customer's perception, create the new product and select the manufacturing process as shown in Figure 3.6.

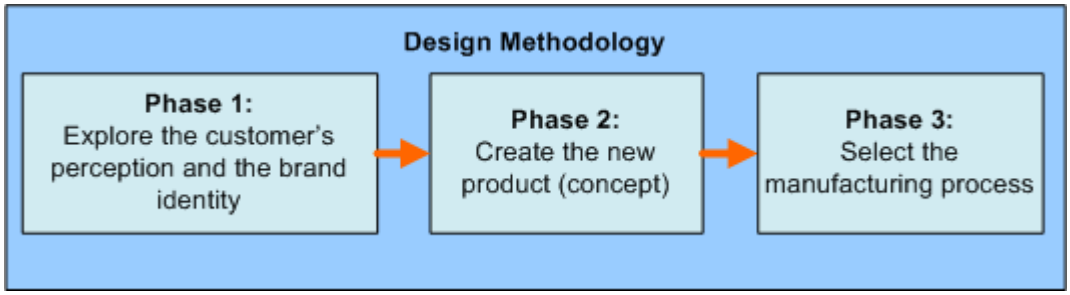

Figure 3.6: The design methodology.

1. Explore the customer's perception and the brand identity: this phase is to explore the correspondence and the gap between designer's intention and customer's perception and explore the product elements that express the brand identity.

The customer's perception that corresponds to the designer's intention is analyzed to explore the brand identity as shown in Figure 3.7. The brand identity comes from product element. It is used to design a new product in the next phase.

The designer expresses the brand personality through a product appearance. Thus, the products are used to be the connector to link customers with designers. Both customers and designers use semantics to describe the characteristics of the product. The two semantic words can be matched together. The method and the tools that are developed are presented in the section "Tools". The customer's perception of product visual forms is compared to the brand personality to determine the correspondence and the gap. The correspondence is used to explore the product elements that express the brand identity as shown in Figure 3.7. The gap is used to achieve the modification of the new product that aims to cope with the customer's perception.

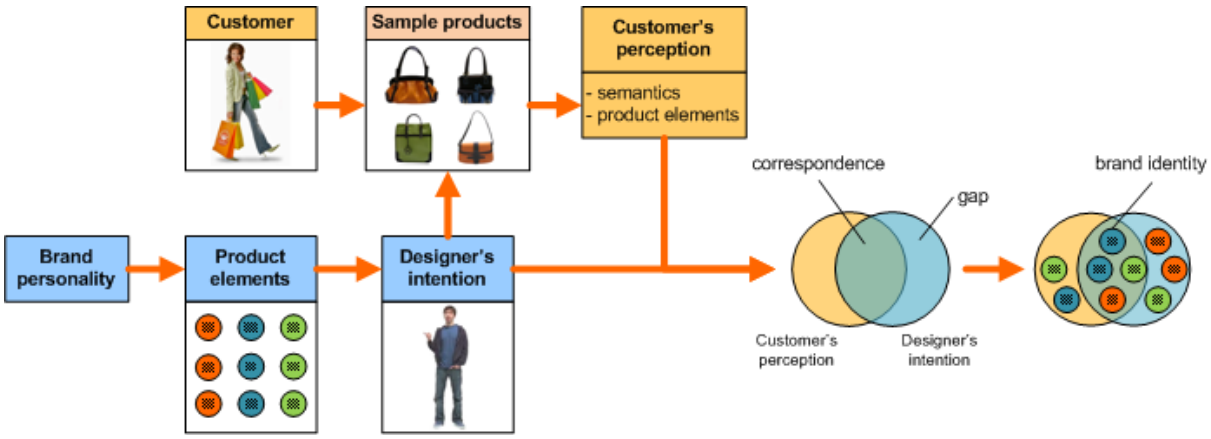

Figure 3.7: Explore the customer's perception and the brand identity.

2. Create a new product: this phase is to create a new product. It aims to design a new product (new concept) that is involved with the brand personality and expresses the brand identity. The product elements that express the brand identity are used to design a new product. Contrary, the product elements that do not express the brand identity and are not related to customer's perception are removed or modified in order to cope with the customer's perception. The design support matrix is created to help a designer designing a new product. This tool is explained in section "Tools".

This phase is directed by two principles: similarity and combination. By similarity, we say that existing products are related to brand identity are used to guide the design of new product. The product element that is not related to the brand identity and has minimum semantic value is removed to be replaced by another product element with better "identity" properties. This new product element may come from other products or be specifically create. This principle is called "Similarity principle" as shown in Figure 3.8.

The combination principle is for the design of new products from combinations of the product elements. The product elements that define the brand personality and have maximum values are combined to create a new product. This principle is called "Combination principle" as shown in Figure 3.8.

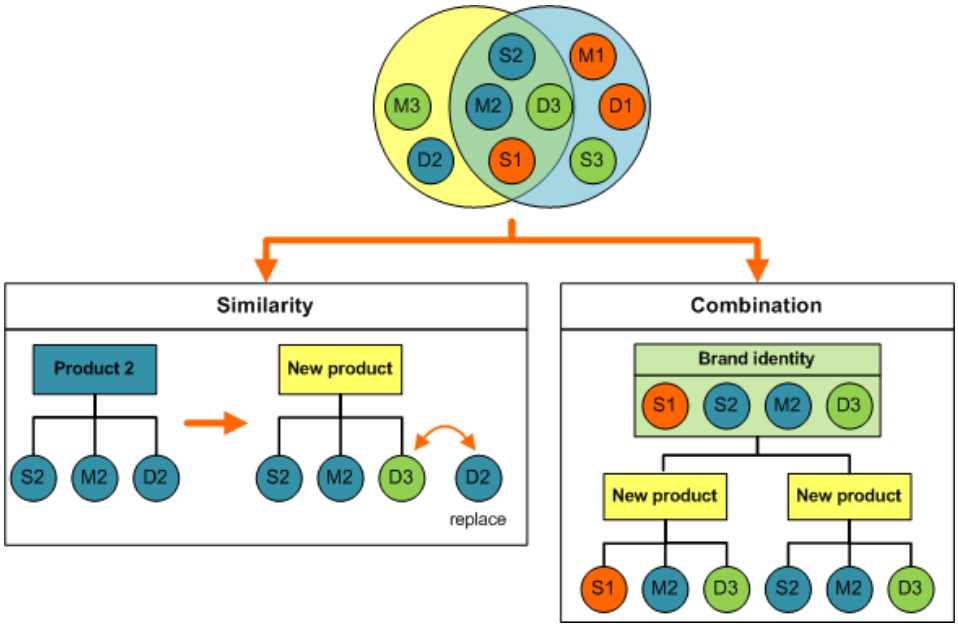

Figure 3.8: Similarity and combination principle.

3. Select the manufacturing process: this phase aims to explore a suitable manufacturing process that is relevant to the brand personality and expresses the brand identity alongside with meeting the design requirements. The selection is guided by the performance expected on quality, time, cost and environmental impacts. The principle exploration of the manufacturing process is shown in Figure 3.9.

From the new product that is created from the previous phase of the design methodology, the product elements are extracted and the manufacturing processes are explored for each of them. Each of the product elements can be produced from different techniques. The techniques are various and lead to different characteristics that meet or not the brand personality. The technical conditions are used to scope the limits of each technique and reduce the conflicts between techniques that make an effect on images and values of products. They mainly come from the experience of expert designers and engineers and are fundamentals for the selection of manufacturing processes. If designers and engineers select unsuitable techniques, the images and the values of the product change. As in every design process, the selection of the manufacturing process and the product design are simultaneous and there are lots of zigzags among those phases. The manufacturing steps are mature and were studied to formalize both the know-how of workers and the scientific data available.

The manufacturing process is a construct from elementary technique and process know-how. It leads to select a known and mastered process most of the time but sometimes needs to develop a new technique or a new organization. This knowledge was arranged to make useful information available for designer. The detail of this tool "the manufacturing matrix" is explained in section "Tools". The selection process is a classical one based on three steps: the identification of the techniques candidate, the generation of several process solutions, then the evaluation of every solution to draw selection. We defined four criteria of evaluation: "quality", "time", "cost" and "environmental impact".

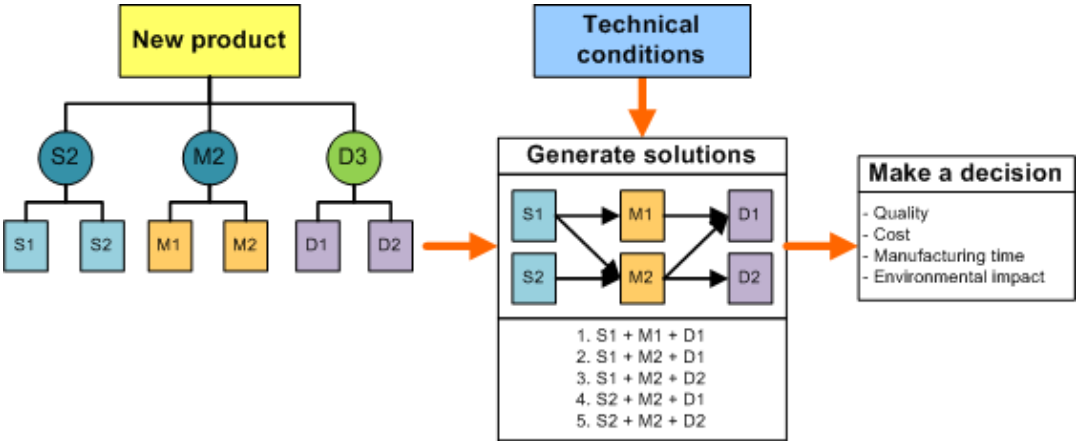

Figure 3.9: The principle exploration of the manufacturing process.

3.2.3 The brand database

The database can be divided in 2 sections: the brand database and the manufacturing database as shown Figure 3.10. The data is stored in Microsoft ACCESS.

The brand database directly supports the design process because of the important relations between the brand personality and the product attributes, and contributes to the creation of the product. The manufacturing database is engineering-oriented and supports engineering information useful in the design process. The both databases are connected together with the product attributes. The brand database is composed of two elements: brand personality and semantic. The semantics is used to be a connector to link the brand personality with the product attributes.

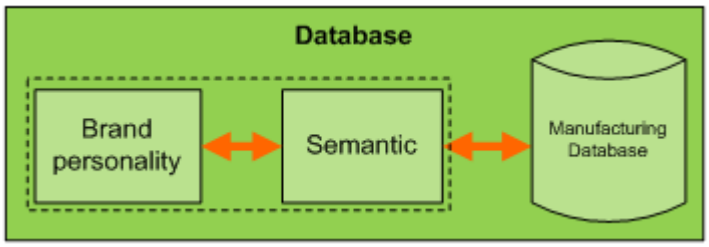

Figure 3.10: The brand database.

3.2.3.1 Brand personality

A brand has a personality afore mentioned in chapter 2. The brand personality is created from a characteristic or lifestyle of customers. It is used to speak of what kind of person the product would be if it were human. "The Nature of Human Values", which is written by Rokeach 1973, is used to determine the brand personality. He proposed two kinds of values: terminal values and instrumental values as shown in Figure 3.11. The terminal values refer to desirable end-states of existence. These are the goals that a person would like to achieve during his or her lifetime. These values vary among different groups of people in different cultures. The instrumental values refer to preferable modes of behavior. These are preferable modes of behavior, or means of achieving the terminal values. This study focuses on the instrumental values because they are more concrete and understandable for the designers than the terminal values. They are used to guide the designer determine the characteristics of the target customers and the brand personality.

Instrumental values		
Honesty	Ambition	Responsibility
Forgiving nature	Open-mindness	Courage
Helpfulness	Cleanliness	Competence
Self-control	Affection / love	Cheerfulness
Independence	Politeness	Intelligence
Obedience	Rationality	Imagination
Terminal values		
World peace	Family security	Freedom
Happiness	Self-respect	Wisdom
Equality	Salvation	Prosperity
Achievement	Friendship	National security
Inner peace	Mature love	Social respect
Beauty in art and nature	Pleasure	Exciting, active life

Figure 3.11: The terminal values and the instrumental values (after Rokeach 1973).

3.2.3.2 Semantic words

The semantics is often used in ordinary language to denote a problem of understanding that comes down to word connotation. The semantic word has 2 roles. First, it is a connector to link the brand personality to the product attributes within the design methodology. Second, it is a connector to link the brand personality to the product attributes. The semantic words that are used in this study were collected in a personal survey from the fashion magazines and the fashion websites. We finally proposed the list of the semantic words as shown in Figure 3.12.

List of the semantic words

Antique	Compact	Exotic	Modern	Simple
Authentic	Complicated	Fashionable	Musculine	Smart
Avant-garde	Contemporary	Feminine	Natural	Sportive
Basic	Delicated	Formal	Official	Stylish
Bright	Deluxe	Funtional	Original	Subtle
Casual	Dressed	Glamourous	Oversize	Traditinal
Chic	Dynamic	Grand	Precious	Trendy
Classic	Elegant	High-class	Luxurious	Unique
Comfortable	Elite	Innovative	Serene	Urban

Figure 3.12: The list of the semantic words.

3.2.3.3 The relationship between brand personality and semantic words

The objective is to connect the brand personality implemented by the instrumental values and that is brand-oriented with the customers' semantic words. Experts, the fashion designers, combine instrumental values to illustrate both the characteristics of the target customer and the brand personality according to the various behaviors of customers they know. An example of the brand personality and semantic words relation proposed by the fashion designer is shown in Figure 3.13. It is very expert activity.

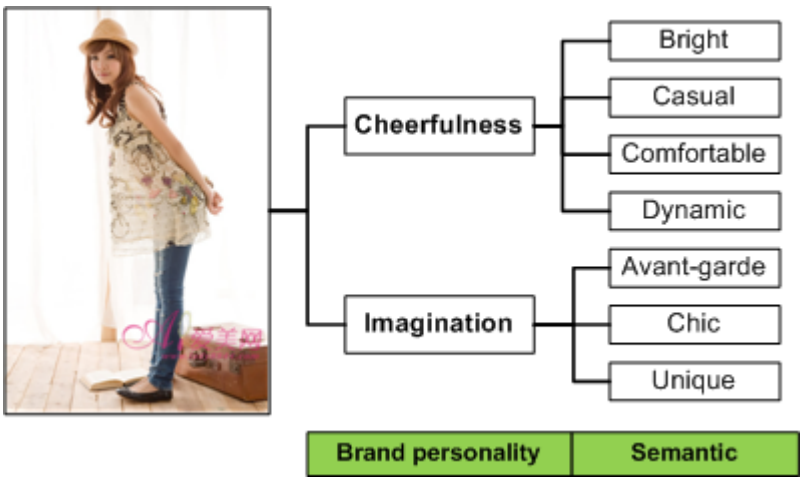

Figure 3.13: An example of the brand personality and semantic words relation.

3.2.4 The manufacturing database

The manufacturing database consists of three elements: product data, material data and manufacturing process data as shown in Figure 3.14.

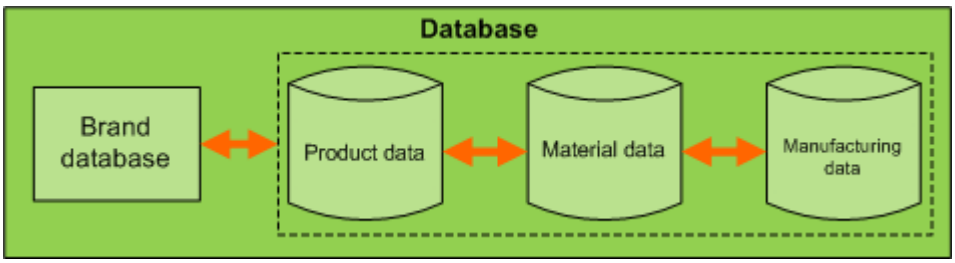

Figure 3.14: The manufacturing database.

3.2.4.1 Product data

A bag is composed of four types of elements: shape, handle, accessories and details as shown in Figure 3.15. The product data stored in the database to support the design methodology are classified based on these types.

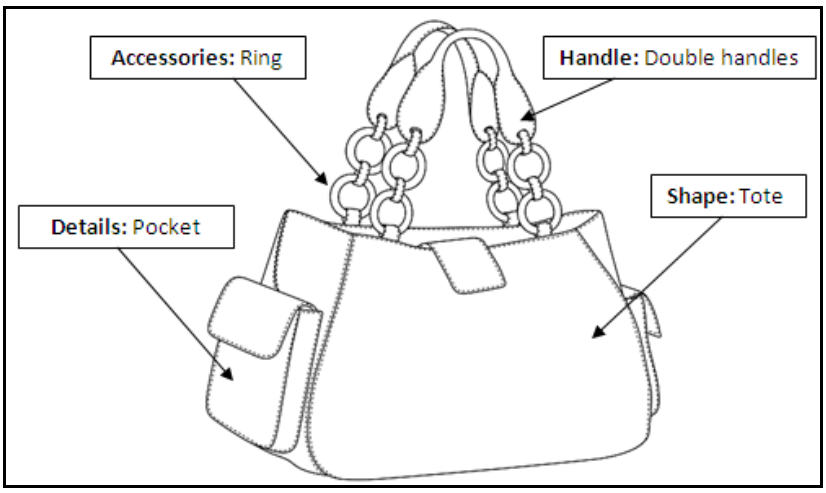

Figure 3.15: The elements of the bag.

Element 1: Shape

Shape: Bags appear in many shapes and sizes. They are clustered by their general types. [AHL 2007], proposed nineteen types that are recognized by the professionals as shown in Figure 3.16. The detail of each type is the following:

Figure 3.16: The shapes of bags (after AHL 2007).

- BACKPACK - is a knapsack that distributes weight between the shoulders. Worn across the back or slung on either shoulder, backpacks tend to have draw tops with flap-over or are dome shaped with zip top closures.
- BARREL- is a horizontal cylindrical purse shape with a zip top closure. Also referenced as a 'Roll Bag'.
- BUCKET- is a stiff shoulder bag shaped like a bucket with a wide open top entry and oval or round bottom. It originated in France that was originally made for champagne and the company's patenting of a treatment to strengthen monogrammed canvas, their signature material.
- CAMERA- is a rectangle bag with rounded corners. It has a top zip closure and usually has outside pockets. The camera shape originated from the bags that were used to carry photographic equipment.
- CLUTCH- also known as a 'Pouchette' is a small bag with no straps or handles worn tucked under the arm. May have detachable shoulder straps or wristlets.
- DOUBLE HANDLE- is a small to medium size bag with double handles that are worn over the shoulder.
- DRAWSTRING- is a bag that has a cord woven through eyelets to gather the top for the closure. Also referenced as a 'Pull-Tie'.
- FACILE- is a bag that has a covered frame that snaps together as the closure.
- FLAP- is a bag that has a flap-over as its closure.
- FRAME- is a bag that has a metal top fastening with a snap, knob or clasp closure.
- HOBO - is a crescent shape shoulder bag with a zip top closure that dips in the center.
- LUGGAGE FRAME- is a top fastened bag with a frame of metal like a suitcase, popular in the 50's.
- LUGGAGE HANDLE- is a bag with covered hard structured cut-out handles originating in the 60's.
- SATCHEL- is a square or dome shaped bag with a zip top closure. Known for its wide flat bottom and gusset, this short handled bag is carried over the crook of the elbow or in the hand.
- SHOULDER- is a small to medium sized bag with long chains or thin straps that is carried over the shoulder or strung across the body. Today Short- Shoulders are Trending. Shoulder bags liberated the hands and made their stylistic debut in the 1930's.

- STRUCTURED - is how you would describe a hard constructed handbag.
- TOTE- is a medium to large square bag with an open top entry and two handles. This carry-all originated in the 40's. Also referred to as a 'Shopper'.
- TRAPEZOID- is a bag with an A-line shape inverted either way. Another term used is a 'Four-Poster'.
- WIREFRAME- is a zip top bag with wire piping running along the top to hold its frame like shape.

Element 2: Handle

Handle: The handle is composed of the main handle, the handle tab and the connector (accessories) shown in Figure 3.17. It is characterized by the type of handle. The detail of each attribute is shown in Figure 3.18. The detail of the connector is explained in section "Accessories".

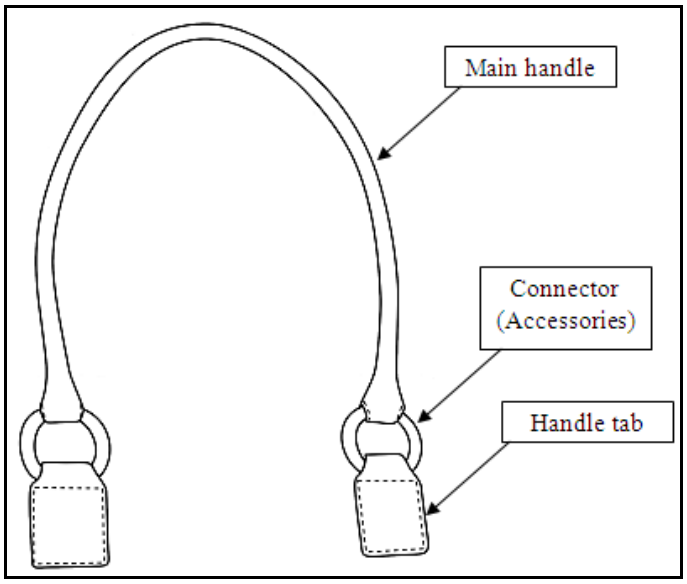

Figure 3.17: The components of a type of handle.

Type of handle	Double handle	
	Top handle	
	Shoulder handle	
	no handle	

Type of main handle	no tab	
	with tab	
	with buckle tab	

Type of handle tab	ring tab	
	buckle tab	

Figure 3.18: The detail of the handle attributes.

Element 3: Accessories

Accessories: The accessories are the elements that add color, style and class to an outfit, and create a certain look, but they may also have practical functions. They can be classified in 3 groups: lock system, connecting and decorate as shown in Figure 3.19.

Accessories	Lock system	buckle	
		knob	
		lock	
		zip	
		zip puller	
		... (pad lock, magnet, press button, clasp, snap)	
	Connecting	strap holder	
		chain	
		ring	
		snap hook	
	Decorate	stud	
		rivet	
		corner	

Figure 3.19: The detail of the accessory attributes.

Element 4: Details

Details: They are the elements that add functions or decorate a bag. They differ from the accessories because they are not made from metal as shown in Figure 3.20.

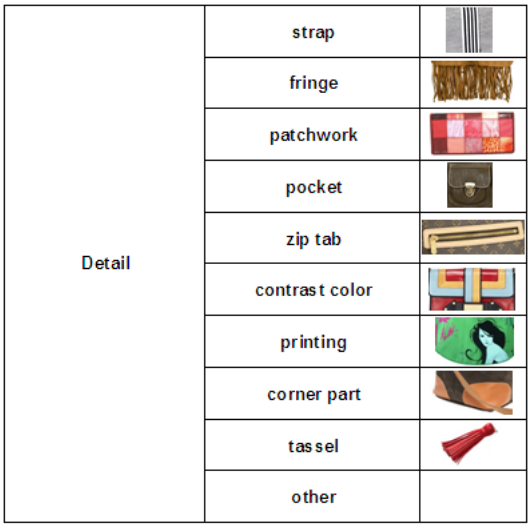

Figure 3.20: The detail of the detail attributes.

Each product element of a brand is implemented in many styles for a given season. Figure 3.21 shows four different styles of two product elements: TOTE shape and no-tab main handle. The style is the second level of classification of the product element: for example for the product shape, TOTE is level 2 and the style is level 2.

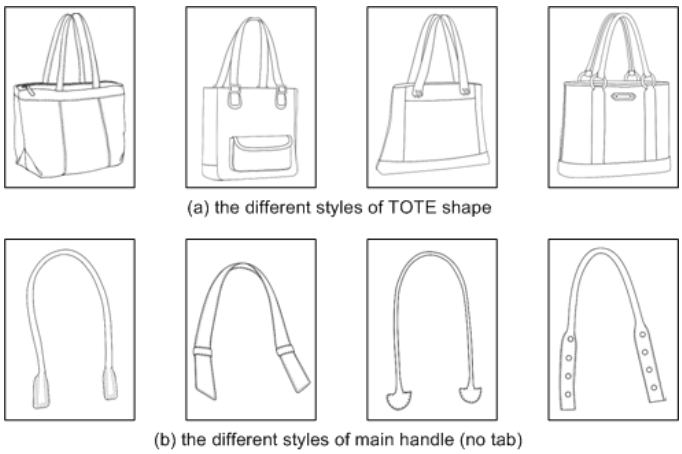

Figure 3.21: The example different styles of product elements.

3.2.4.2 Material data

Material that is used to make a leather bag can be classified in three groups: outside material, inside material and support material as shown in Figure 3.22.

Outside material: It is main material of the bag that contributes to the visual of the bag. In this study, leather bags are addressed and different types of leather are use in this industry.

Inside material: It is material of the bag that stays inside the bag and is not leather. It is called "lining". It is used to make an inside bag and conceal the support material. The shape of an inside bag is similar to the outside shape but simplified meaning that the details are generally removed and the size is smaller than outside.

Support material: It is material of the bag that is used to add performances that are not brought the outside and inside material. These properties are mechanical (strength, weight and straight) and behavioral (softness). It is put on between the outside material and the inside material.

Outside material	Leather	Cow leather	full grain
			top grain
			suede
		python leather	
		fish leather	
		crocodile leather	
		ostrich leather	
	not leather	Cotton	
		Silk	

Inside material	silk
	cotton
	other

Support material	Texon
	sponge
	paper
	other

Figure 3.22: The detail of the material data.

3.2.4.3 Manufacturing process data

The manufacturing process of leather bags can be classified in nine steps: pattern cutting, cutting, splitting, skiving, assembling, coloring, stitching (sewing), fastening accessories and finishing as shown in Figure 3.23. The sequence is generally the one of the Figure 3.23 but can be different when some steps are unnecessary. The sequence and the manufacturing time of each product element are stored in the manufacturing database. The detail of each step is the following:

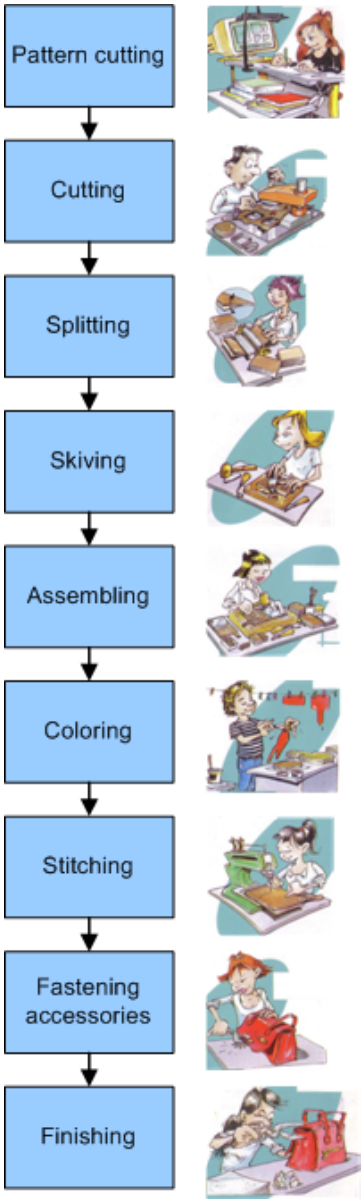

Figure 3.23: The manufacturing process of leather bag.

Pattern cutting: The pattern maker creates the flat model, either manually or using CAD, that will be used in the making of the press-knives used for cutting.

Cutting: The cutter starts cutting the pieces by hand on a press or by automatic cutting.

Splitting: It is vital to obtain the ideal thickness and to allow components to be put together in the best way possible.

Skiving: Skiving, which consists in regularly thinning the edges either manually or mechanically, make it easier to carry out edge turning and binding.

Assembling: Assembling pre-glued pieces calls for accuracy and skill from the operator; it remains a manual operation. Once the pieces have been super-imposed, an overcut tool is used to eliminate any excess material and to obtain sharp edges.

Coloring: To conceal the raw edge of the leather every part is covered with a layer of dye.

Stitching: All components are stitched using a sewing machine, a flat bed machine, a cylinder bed machine or a post-bed machine.

Fastening accessories: The product is almost finished; the accessories (buckles, press buttons or clasps) are fastened.

Finishing: Finishing is a delicate operation that requires great skills. It gives to the final touch to the product.

Let us illustrate here the relationship between manufacturing processes and brand values. It is important that the designers and engineers select the suitable manufacturing process. If they selected the unsuitable techniques and manufacturing process, the images or values of the product would change. Then, the designers and engineers have to understand the technical conditions of each technique. These technical conditions limit the manufacturing process uses. They result from the experience of designers and engineers.

The handle tabs in Figure 3.24 are produced from two different techniques: HT1 edge is obtained by the folding technique; HT2 edge is obtained by the painting technique. Folding edge technique is more manufacturing time consuming because it needs to fold the edge before stitching (sewing). Painting edge technique is a very easy technique that leads to a lower manufacturing cost. Both techniques express the images and values of the product: HT1 sounds "official" and "formal"; HT2 "casual" and "comfortable". Thus, both techniques are not used in the same bag. It is very common today to use the painting edge technique is used to make more attractive luxury products by changing the color of the edge to play with contrasts [LV 2010]. The rationale does not systematically come from cost minimization.

Figure 3.24: The example of assembly technique.

3.2.5 The product attribute

The product attributes are the product entities that typically characterized the product. They are composed of product elements that make sense for the product and their associated, manufacturing processes and materials that give the properties of these elements. They are the output of the design process. It is the classical output of integrated design where the product elements chosen by the designers can exist only because they come from an existing and acceptable (most of the time economically) manufacturing process and the material associated with. What is specific to the luxury field is that many properties of the elements like touch perception, light reflection, visual surface, etc. directly come from specific conditions when running processes and materials. The connections of product elements with manufacturing processes and materials, and their running conditions are also very expert.

The issue is to connect engineering properties (product elements, manufacturing processes and materials) with customer and brand properties (brand values, semantic words), what is

really the activity of design that ensures the feasibility in fact. Figure 3.25 shows the mapping to relate the brand personality to the product attributes. It connects together the customer-oriented information (brand database) and engineering information (manufacturing database). Brand personality is used to illustrate the characteristics of the target customer. It is determined by the fashion experts and fashion designers. Brand personality can be combined from various behavioral values. Each value is composed of several semantics. Each semantic can come from different product elements. Each product element can be produced from different materials or manufacturing processes. Finally the objective of the design is to create the best "tree" of those 4 elements. In practice it is more a network than a tree because two different reasons may lead to the choice of a common element (it is true at each level: 2 brand values may lead to the common "comfortable" semantic word; two semantic words may lead to the same product element.

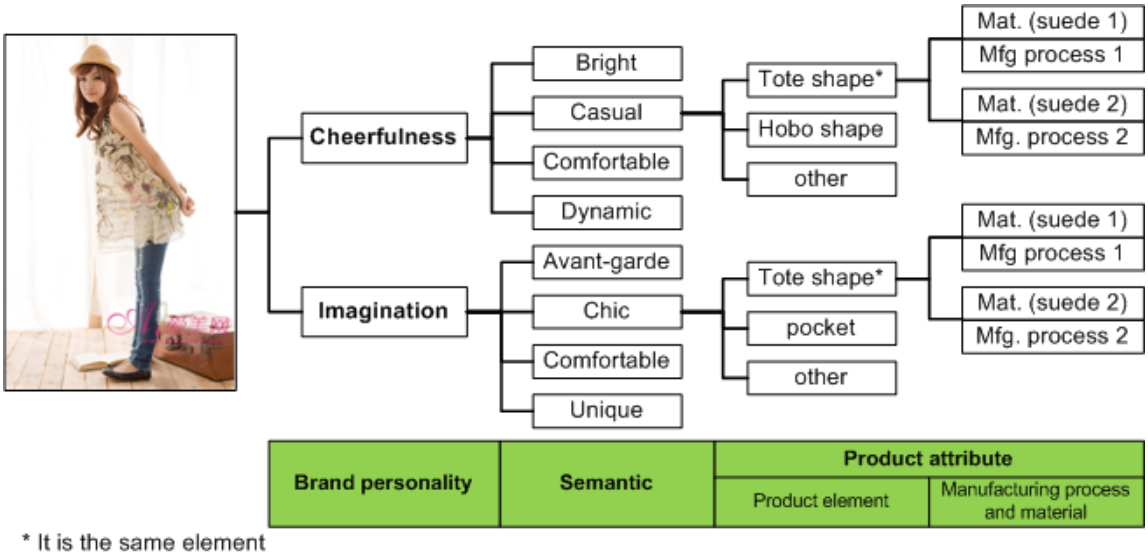

Figure 3.25: The relation between the brand personality and the product attributes.

3.2.6 Tools

It has three tools that were developed to support the design methodology: the customer-oriented matrix, the design support matrix and the manufacturing matrix as shown in Figure 3.26.

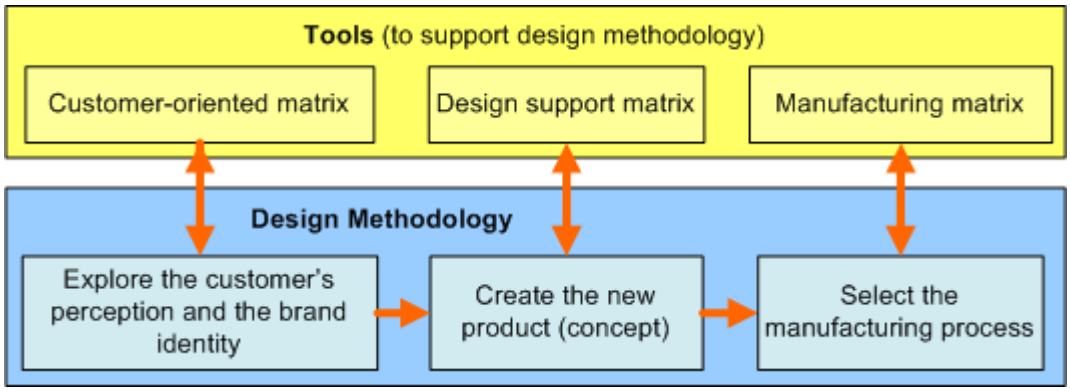

Figure 3.26: Tools to support the design methodology.

Tool 1: The customer-oriented matrix

The objective of tool 1 is to provide designers with a fine understanding of customer's perceptions. The customer-oriented matrix supports the exploration of the customer's perception of product visuals. It was created to help the designer interview the targeted customers. It is used to interpret the customer's perception of product visual forms. It both measures semantics and examines the links between semantics and parts of product attributes. The structure of the customer-oriented matrix consists of three parts: semantic, product attributes and the relationships between semantic and product attributes as shown in Figure 3.27. The customer-oriented matrix includes closed questions and is distributed under a paper form but could be computerized of course.

Semantic: Semantics is often used in ordinary language to denote a problem of understanding that comes down to word connotation. It is used to describe the characteristics of the product from the customer's point of view. It is composed of two opposite semantic words and a 5-level scale. The semantic words that are used in the customer-oriented matrix are selected from the list of semantic words as shown in Figure 3.12. Ten pairs of the opposite semantic

words that are related to brand personality are selected by fashion experts and fashion designers [Chuang and Chen 2008][Hung and Chuang 2003][Hsiao and Chen 2006]. This selected list is brand-dependant and every bag visual of the brand will be tested against the same list of semantic words.

Likert scale: The Likert scale is a psychometric scale commonly used in questionnaires, and is the most widely used scale in survey research, such that the term is often used interchangeably with rating scale even though the two are not synonymous [Likert 1932]. The scale uses for evaluation is a 5 degree Likert scale (-2, -1, 0, 1, 2).

Product attribute: The product attribute is the product element, material or manufacturing process that is related to brand personality and expresses the product identity. All product attributes of each leather bag are extracted. It is recognized in the literature [Cappetta et al. 2006][Warell 2001][Karjalainen 2007][Karjalainen et al. 2006] that a bag identity is defined by only five relevant product attributes. This list of five relevant product attributes is product dependant and is defined for one bag of the brand. Consequently the list of product attributes is different for each bag, even if some attributes could be common. The relationships between a semantic word and product attributes are values that are interpreted from customer's perception of product visual forms. It used to describe the characteristics of the product.

Product	Semantic						Product attribute				
							tote shape	contrast color	patch piece	pocket	printing
	-2	-1	0	1	2		S17-1	D6-1	D10-1	D4-1	D7-1
	Basic	x				Luxurious	x				
	Chic	x				Comfortable					x
	Musculine				x	Feminine			x		
	Classic				x	Trendy			x		
	Elegant			x		Functional				x	
	Casual	x				Formal	x				
	Dynamic	x				Serene	x				
	Traditinal				x	Original					x
Bag No. 5	Compact			x		Oversize	x				
	Simple			x		Complicated					x

Figure 3.27: The customer-oriented matrix (customer form).

The data that are filled in the customer-oriented matrix come from an interview of the targeted customers. The method for filling the data in the matrix is in 2 steps. First of all, the

targeted customers select the semantic words that illustrate the characteristics of the leather bag and score them on the Likert scale. Second, customers indicate the main product attribute that is relevant to the semantic words from their own point of view. Each semantic word must correspond to only one product attribute. An example as shown in Figure 3.27, this bag is related to "trendy" (line 4 on classic-trendy). The value given by the customer is 2 (meaning very trendy and not classic at all). The product attribute that mainly expresses "trendy" from the given customer point of view, is the patch pieces (D10-1: every product element is encoded. D is for details (S for shape, H for handle, A for accessories), 10 is the 10^{th} candidate for this attribute in the database list and 1 is for the first style in the list of the database). D10-1 is for bag n°5 (Figure 3.27) and is flowers and woman's shirt patch pieces.

Figure 3.27 gives the form to fill in with a given customer for a given bag. To support design by knowing well the customers' perception, all the forms are aggregated to give a general overview to the designers. The customer's perceptions of a given product visual are summarized in Figure 3.28 based on the answers acquired from the interviews of the customers. All product visuals can be assessed against the customers' perceptions like shows Figure 3.29.

This aggregation is in 2 phases. First, the average semantic values of a product visual, alongside with the range of answers, are calculated. It gives a general view of the perception of customers for each semantic word. Second, the general link of the semantics with product attributes is given by the percentage of customers having selected this specific attribute to match the given semantics.

Summarize the range and average semantic values: The data from the customer-oriented matrix are interpreted to explore the range and average semantic values of each bag. The range semantic value comes from the maximum and minimum of each semantic value. The average semantic value of a bag can be calculated as follows (Equation 3.1).

$$S_{bag(aver)} = \frac{\sum_{i=1}^{n} S_{bag(i)}}{n}$$

Where

$S_{bag(aver)}$ = the average semantic value of a bag

$S_{bag(i)}$ = the semantic value of the bag for customer i

n = number of data (number of customers' forms)

Equation 3.1: The average semantic value of a bag.

Summarize the percentage of the product attribute of a semantic: The product attributes that are selected are interpreted to explore the percentage of the product attribute of a semantic. The percentage of the product attributes of a semantic can be calculated as follows (Equation 3.2).

$$PA_{per} = \frac{n_{sel}}{n_{all}} \text{ x } 100$$

Where

PA_{per} = the percentage of the product attribute selected for a given semantics

n_{sel} = number of data that are selected (number of customers' forms where the product attribute A was selected for the given semantics)

n_{all} = number of all data (number of customers' forms)

Equation 3.2: The percentage of the product attributes of a semantic.

Figure 3.28 shows the results for the bag n°5 based on forms like Figure 3.27. If we consider again the line 4 (semantics: Classic-Trendy). The average mark is 1.29 (very Trendy) and the range of answers is [1-2] as it can be seen with the light-blue highlighted zone. 56% of the

customers said that this trendy quality came from the patch piece, 27% that it came from the printing and 16% from the pocket.

Product	Semantic							Product attribute				
								tote shape	contrast color	patch piece	pocket	printing
		-2	-1	0	1	2		S17-1	D6-1	D10-1	D4-1	D7-1
	Basic			0.07			Luxurious	87.34%			12.66%	
	Chic		-1.29				Comfortable		35.47%	40.66%		23.87%
	Musculine				1.29		Feminine			87.23%		12.77%
	Classic				1.29		Trendy			56.23%	16.23%	27.54%
	Elegant			0.57			Functional	10.77%			89.23%	
	Casual		-1.29				Formal	100%				
	Dynamic		-1.07				Serene	89.45%				10.55%
	Traditinal			0.79			Original			32.02%		67.98%
Bag No. 5	Compact			0.21			Oversize	100%				
	Simple			0.36			Complicated			31.93%	23.04%	45.03%

Figure 3.28: The customer-oriented matrix (aggregated values for one bag).

These overviews of customers' perceptions for a given visual are very useful to understand the customers. We would also like to visualize the whole set of product visuals to understand the coherency of the set against customers' perceptions. Figure 3.29 only summaries the values of the semantics for all bags. This matrix is also created to prepare data before clustering the products.

Semantic			Product						
									
			No.1	No.2	No.3	No.4	No.5	No.6	No.7
Basic	-	Luxurious	-0.14	0.21	0.00	0.93	0.07	0.21	0.43
Chic	-	Comfortable	-0.64	-0.43	-0.71	-0.93	-1.29	-0.93	-0.36
Musculine	-	Feminine	0.57	1.29	0.57	1.43	1.29	1.43	1.93
Classic	-	Trendy	-0.14	-0.07	0.36	1.07	1.29	0.71	0.64
Elegant	-	Functional	-0.21	-0.14	-0.21	-0.57	0.57	0.79	0.14
Casual	-	Formal	-0.71	-0.29	0.07	-1.43	-1.29	-0.21	-0.43
Dynamic	-	Serene	-0.43	-0.29	-0.29	-1.07	-1.07	-0.36	-1.07
Traditinal	-	Original	-0.21	0.21	-0.14	0.71	0.79	0.29	-0.07
Compact	-	Oversize	0.14	0.00	0.00	-1.29	0.21	-0.57	-0.79
Simple	-	Complicated	-0.14	-0.07	-0.07	0.43	0.36	0.21	0.07

Figure 3.29: The customer-oriented matrix (Semantic values for all bags: extract of the first 7).

The clustering of visuals based on the customer's perceptions is the last sub-tool of tool 1. It is done with the principal component analysis (PCA) technique. PCA is a multivariate technique for transforming a set of related (correlated) variables into a set of unrelated (uncorrelated) variables that account for decreasing proportions of the variation of the original observations [Landau and Everitt 2004]. PCA is mostly used as a tool in exploratory data analysis and for making predictive models. It is closely related to factor analysis; indeed, some statistical packages deliberately conflate the two techniques.

We used STATBOX as statistical tool that enables to process a statistical analysis with PCA tools. The result from STATBOX enables to visualize through a PCA mapping. It shows the bags that act on with semantic words as shown in Figure 3.30. It shows the relationship within the same collection and different collections. This result is interpreted and compared to the brand personality to determine the correspondences and the gaps.

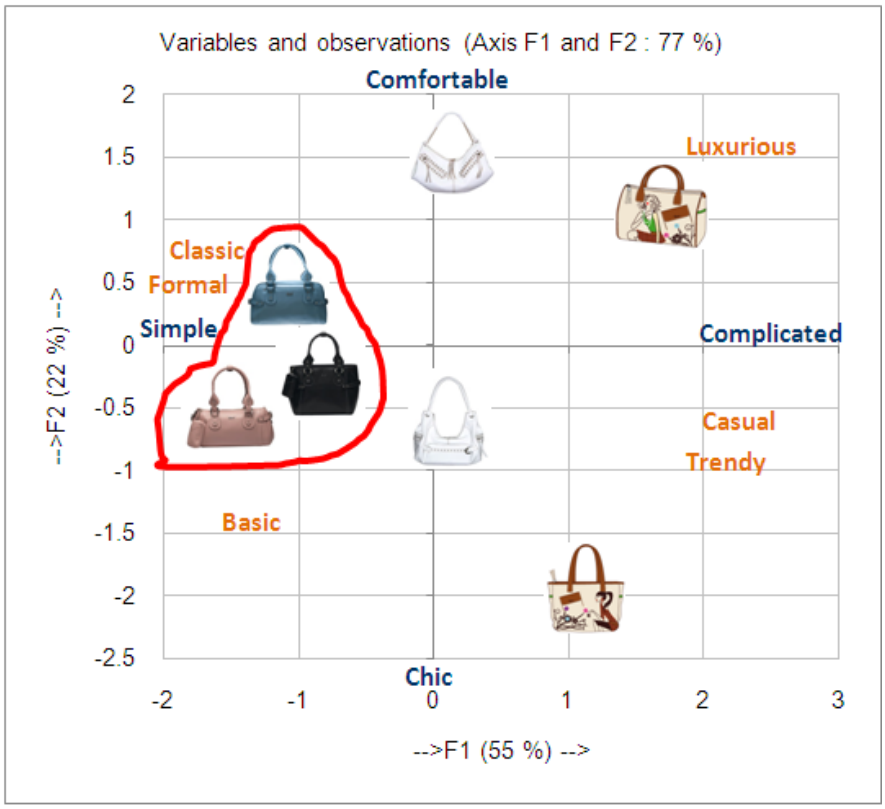

Figure 3.30: The customer-oriented matrix (PCA mapping of the products).

Tool 2: The design support matrix

The objective of tool 2 is to provide designers with an understanding of how to move the product attributes to meet the customer's perceptions. The design support matrix is to help the designer create a new product. It maps semantic words of customer's perceptions and product attributes to be manufactured. It is to evaluate the relationship between semantic words and product attributes. The design support matrix is composed of semantics, product attributes and the relationship between semantics and product attributes as shown in Figure 3.31.

The objective of the designer is to design a new collection of bags, meaning a set of bags of the brand. Tool 2 was dedicated to analyze and summarize the customers' perceptions for a given product visual. Tool 3 must give information to designers from all the visuals that were presented to customers. It is an issue of aggregating the information across the bag visuals.

The semantics that is used in the design support matrix are the same as the semantics used in the customer-oriented matrix; they are brand-dependant. The product attributes are product-dependant and they must be aggregated to cover all the visuals: they were arranged in the three previous defined groups: product element, material and manufacturing process. Let us remind you that a product attribute can be implemented in several styles. Columns are product attributes at level 2 to discriminate their characteristics and be relevant to designers. Figure 3.31 gives just a sub-set of the product attributes for the product collection. A column is relevant for one or several visuals. The last line of the matrix gives the number of bags where this attributes is relevant.

The first information (Figure 3.31 left side) is the perceptions of customers for each semantic word. It is given by the average value of the perception calculated for each visual in tool 2. The average semantic value of the perception can be calculated as follows (Equation 3.3).

$$S_{visuals} = \frac{\sum_{vs=1}^{l} S_{(vs)}}{l}$$

Where

$S_{visuals}$ = the average semantic value of the collection of visuals

$S_{(vs)}$ = the average (all customers) semantic value of a visual vs

l = number of data (number of visuals)

Equation 3.3: The average semantic value of the perception.

This information is also coupled with the range of perceptions across the visuals (the zone highlighted in light-blue).

Semantic						Product Attribute										
						Product element								Material		Mfg. proces
	Values					Shape				Main handle		Handle tab	Pocket	Leather		Printing
	-2	-1	0	1	2	Hobo (S11)		Satchel (S14)	TOTE (S17)	No tab (MH1)	with tab (MH2)	ring tab (HT1)	(D4)	Cow full grain (M1)		(D7)
						S11-1	S11-2	S14-1	S17-2	MH1-1	MH2-1	HT1-1	D4-1	M1-1	M1-2	D7-1
Basic			0.25			0.56	0.75	1.34	0.24	0.51	0.78	0.79	-0.14	0.67	1.05	0.78
Chic		-0.76				-1.21	-0.67	-1.34	-1.09	0.34	-1.67	-1.34	0.25	-0.9	1.31	-1.11
Musculine				1.21		1.45	1.56	1.35	1.45	1.2	1.56	1.18	0.23	0.56	0.93	1.59
Classic			0.55			0.71	0.64	0.98	1.34	0.34	1.03	0.89	1.07	0.02	0.97	1.68
Elegant			0.05			0.79	0.14	-0.67	1.26	-1.05	-0.23	-0.22	1.88	0.06	-0.6	-0.14
Casual		-0.61				-0.45	-0.78	0.06	-0.98	0.87	-0.56	0.11	-0.78	0.36	-0.7	-1.08
Dynamic		-0.65				-1.34	-1.32	-0.45	-1.21	-0.67	0.05	-0.67	-1.24	0.45	-1.1	-1.24
Traditinal			0.22			0.29	-0.07	1.45	0.97	0.23	0.12	0.38	0.12	0.23	0.79	0.12
Compact		-0.33				-0.45	-0.27	-0.24	0.65	0	0	0	0.28	0	0	0
Simple			0.11			0.21	0.07	-1.13	-1.07	-0.79	0.21	0.19	-1.33	0.14	0	0.78
						Bag No.	6	7	4	5	4	1,2,3	1,2,3	4,5	1,2,3	6,7	4,5

Figure 3.31: The design support matrix.

The second objective (Figure 3.31 right side) is to give a general semantic value to a product attribute. It is done in two steps (interpret data and summarize data) based on the customer's perceptions acquired within tool 1.

Interpret data: The data from the customer-oriented matrix are interpreted to explore the semantic values of each product attribute. The semantic value of a product attribute can be interpreted as follows (Equation 3.4).

$$S = V \times L$$

Where

S = the semantic value of the product attribute for a given visual and a given customer

V = the score of the product attribute on the semantic scale given by the customer for this visual

L = the level of significance of the product attribute given by the customer

The level of significance of a product attribute L is used to illustrate the relationship between the semantic word and the product attribute. Two levels are used.

0 = the product attribute does not relate to the semantic word

1 = the product attribute relates to the semantic word

Equation 3.4: The semantic value of a product attribute.

Summarize data: The data are summarized to explore the range and average semantic values of all visuals and the average semantic values of each product attribute. The range of the semantic value comes from the maximum and minimum of each semantic value. It is the average for a given visual and for all the customers. The average semantic value of all visuals can be calculated as follows (Equation 3.5).

$$S_{all} = \frac{\sum_{i=1}^{n} S_{(i)}}{n}$$

Where

S_{all}	=	the average semantic value of a product attribute of a visual
S_i	=	the semantic value of the product attribute for a customer
n	=	number of data (number of customers)

Equation 3.5: The average semantic value of all visuals.

Practically, there are one, two or more visuals only relevant to an attribute. For example (Figure 3.31), attribute S11-1 is relevant for bag n°6 only and attribute HT1-1 is relevant for both bag n°1, 2 and 3. The average semantic value of each product attribute can be calculated as follows (Equation 3.6).

$$S_{all(aver)} = \frac{\sum_{v=1}^{m} S_{all(v)}}{m}$$

Where

$S_{all(aver)}$	=	the average semantic value of a product attribute A
v	=	the visuals where the attribute A is relevant
m	=	number of data (number of A relevant visuals)

Equation 3.6: The average semantic value of each product attribute.

The average semantic value of each product attribute can be positive or negative or zero. A negative (-) value means that it is related to the left semantic word. On the contrary, a positive semantic value (+) means that it is related to the right semantic word. A zero (0) means that it is no related to the semantic word.

The third objective is to cluster the average semantic values of a product visual of the product attributes from the design support matrix is clustered by PCA in the techniques already used in Tool 1. STATBOX enables to visualize results through a PCA mapping. It shows the product attributes that act on with semantic words (Figure 3.32) within the same collection and different collections. This result is interpreted by designers to explore the product attributes that express the brand identity and are relevant to the brand personality.

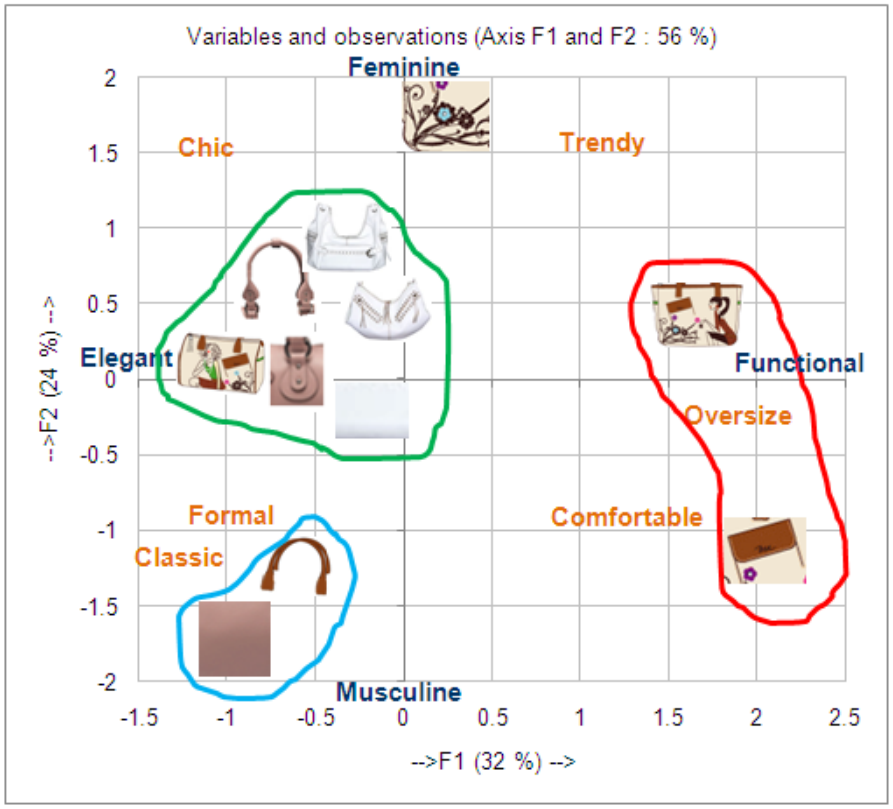

Figure 3.32: The design support matrix (PCA mapping of the product attributes).

Tool 3: The manufacturing matrix

To help the designer decide to select a suitable manufacturing process that ensures to meet customers' perceptions, the manufacturing matrix was created. It has intended to make a decision on process performance parameters such as a quality, time, cost and environmental impact.

Quality: It focuses on basic functions. They are related to customer's feeling such as soft, strong and straight [KMUTNB 2007]. "Soft", a soft feeling of leather gained value from tactile dimension. "Strong", a strong structure and proportional dimensions gained value from visual and tactile dimension. "Straight", smooth outside of the bags like a straight line that gained from visual dimension. They are quality characteristics that are associated directly with manufacturing processes and materials.

Time: It focuses on the manufacturing time of each product element.

Cost: It focuses on the direct labor and the material costs.

Environmental impact: Life cycle assessment (LCA) is used to identify and assess the environmental impacts of leather goods industry. Finally, four environmental criteria were retained as relevant for the product life cycle as shown in Figure 3.33. Based on the literature, the relevance was ranked from +++ as maximum dependence to 0 where the dependence was considered to be under the threshold of relevance.

Environmental Criteria	Raw material	Manufacturing	Use	EOL
Water consumption	+++	0	0	0
Energy consumption	+	++	0	0
Toxic emission	+	+++	0	0
Recyclability	0	0	0	++

Figure 3.33: The impact matrix (relevance of environmental criteria against lifecycle phases).

Leather and cotton are usually raw material for making leather bags. Water consumption is very significant impact of the manufacturing processes of leather and cotton because they are chemical intensive industry [European IPPC Bureau 2009][US EPA 1996]. The other impacts were considered to be less critical in the raw material stage. Thus, water consumption was selected.

The manufacturing and assembly stage is characterized by using lots of machines alongside with manual techniques. Energy consumption was selected as the most critical impact of this phase. Most of the electricity produced in Thailand is not based on renewable and clean technology, but on thermal power plants because they have high efficiency and capacity and long service life [EGAT 2009]. This industry is also considered for its.

Toxic emissions produced from gluing and painting processes. The adhesive is used to assemble components through stitching (sewing) and the most frequently used are solvent based. Lacquer and thinner, which are solvent based, are mostly used in painting processes. Solvent based conveys to risks such as environment impact and harmful effects for the human body. Then, toxic emission was also selected for the manufacturing stage.

Use stage was decided not to have environmental impacts because the leather bags don't need energy when used.

We can address End-of-Life (EOL) of leather goods by recondition, reuse, recycling and energy recovery. Recycling of post-consumer finished leather is not currently available [SMART 2007]. Only accessories of leather goods can be reused and recycled due to their production from metal or plastic. Thus, EOL stage focuses on recyclability of accessories. It can be defined in 2 directions: reuse and recycling. Reuse depends on the difficulty of disassembly. Recycling focuses on the process to separate materials. It depends on the difficulty to separate, the existence of the recycling process and the difficulty to recover.

The manufacturing matrix maps the product elements and the process parameters (quality, time, cost and environmental impact). It is to evaluate the relationship between the manufacturing process of each product elements and process parameters. The manufacturing matrix is composed of the manufacturing process of each product elements, process

parameters and the relationship between the manufacturing process of each product elements and process parameters.

This study uses various methods to evaluate the relationship between the manufacturing process of each product elements and process parameters. It is done in two steps (evaluate data and summarize data) based on the manufacturing process of each product elements.

First of all, the relationship between the manufacturing process of each product elements and process parameters must be highlighted. It can be evaluated as follows.

Machine usage: The machine usage is 1 when the manufacturing process needs the machine and 0 when not.

Raw material area: Quantity of material used in each process. The unit of measure is square centimeters (cm^2).

Quality: The Likert scale is used to evaluate the quality factor of product attributes. This data are evaluated by the designers. The scale value has five levels. It is done for each of the 3 quality criteria.

1 – strongly disagree
2 – disagree
3 – neither agree nor disagree
4 – agree
5 – strongly agree

Time: The standard time of each process is used to calculate the manufacturing time. The unit of measure is minute.

Cost: The standard costs of each process are used to calculate the direct labor cost. This study assigns the average direct labor cost. It is 5 baht per minute. The material area that is used in each process is used to calculate the material cost. It can be calculated as follows (Equation 3.7).

$$C_{mat} = M_{area} \times C_{unit}$$

Where

C_{mat} = material cost (Baht)

M_{area} = material area (cm^2)

C_{unit} = material cost per unit (Baht/ cm^2)

Equation 3.7: The material cost.

Environmental impact:

- The water consumption focuses on amount of water (liter) per material (1 kg) in the manufacturing process as follows (Equation 3.8).

$$W_{cons} = M_{area} \times W_{mat}$$

Where

W_{cons} = water consumption (liter)

M_{area} = material area (cm^2)

W_{mat} = water consumption of each material (liter/cm^2) [European IPPC Bureau 2009]

Equation 3.8: The water consumption.

- The energy consumption depends on the machining time of each process as follows (Equation 3.9).

$$E_{cons} = T_{mac} \times P$$

Where

E_{cons} = electricity consumption (kWh)

T_{mac} = machining time (hour)

P = electric power of the machine (kW)

Equation 3.9: The electricity consumption.

- The toxic emission focuses on the Volatile Organic Compounds (VOCs). VOCs are organic chemical compounds that may also be harmful or toxic. This study, VOCs emissions depends on gluing time and painting time as follows (Equation 3.10). The VOCs values come from the Material Safety Data Sheet (MSDS).

$$Toxic = W_{VOC} \times T_{mfg} \times U_{hour}$$

Where

$Toxic$ = VOCs emissions (g)

W_{VOC} = weight of VOCs (g/liter)

T_{mfg} = manufacturing time (hour)

U_{hour} = hourly usage (liter)

Equation 3.10: The VOCs emissions.

- The recyclability focuses on reuse and recycling of accessories. Four sub-criteria are relevant: difficulty of disassembly, separation, recovery and recycling. The Likert scale is used to evaluate the difficulty of disassembly, separate and recover. The scale value has five levels.

1 – strongly difficult

2 – difficult

3 – neither difficult nor easy

4 – easy

5 – strongly easy

The recycling difficulty is 1 when recycling processes exist and 0 when not.

To illustrate, Figure 3.34 shows the relationship between the manufacturing process of a handle tab (HT1 and HT2) and the process parameters. HT1 and HT2 were proposed in Figure 3.24: they have the same style but are made from two different techniques (folding and painting edge techniques). Lacquer and thinner are used in the painting edge process which makes an effect on the toxic emission. HT1 uses more raw material (120 cm^2) than HT2 (88 cm^2). The quantity of raw material used makes an effect on the water consumption.

			Process parameters															
					Quality				Cost (Baht)		Environmental Impacts							
											Raw Mat.	Manufacturing		EOL				
			Machine usage	Raw material area (cm2)	Soft	Strong	Straight	Time (min)	Material	Labor	Water consumption (litre)	Energy Consumption (kWh)	Toxic emission (g)	Dissassembly	Separate	Existing recycling process	Recover
Product element	HT1	Cut leather	yes	120	3	4	5	0.5	180	2.5	1.116	0.00625		2	3	1	2
		Splitting	yes					1		5		0.05					
		Skiving	yes					1		5		0.0125					
		gluing	no					1		5			13.33				
		Folding Edge	no					5		25							
		Assembly with ring	no					1	30	5							
		Stitching	yes					3		15		0.0375					
	HT2	Cut leather	yes	88	4	4	5	0.5	132	2.5	0.8184	0.00625		2	2	1	2
		Splitting	yes					1		5		0.05					
		gluing	no					1		5			13.33				
		Assembly with ring	no					1	30	5							
		Stitching	yes					3		15		0.0375					
		Painting	no					3		15			84.52				

Figure 3.34: The example of the relationship between the manufacturing process of handle tab and process parameters.

Second, the relationship between the manufacturing process of each product element and the process parameters must be highlighted. It can be summarized as follows.

Time:

The total of manufacturing time is calculated as follows (Equation 3.11).

$$T_{total} = \sum_{i=1}^{n} T_{(i)}$$

Where

T_{total} = the total of manufacturing time

$T_{(i)}$ = the manufacturing time of the product element

n = number of product elements

Equation 3.11: The total of manufacturing time.

Cost:

- The total of material cost is calculated as follows (Equation 3.12).

$$C_{mat(total)} = \sum_{i=1}^{n} C_{mat(i)}$$

Where

$C_{mat(total)}$ = the total of material cost

$C_{mat(i)}$ = the material cost of the product element

Equation 3.12: The total of material cost.

- The total of labor cost is calculated as follows (Equation 3.13)

$$C_{lab(total)} = \sum_{i=1}^{n} C_{lab(i)}$$

Where

$C_{lab(total)}$ = the total cost

$C_{lab(i)}$ = the labor cost of the product element

Equation 3.13: The total of labor cost.

Environmental impact:

- Energy consumption – The total of energy consumption is calculated as follows (Equation 3.14).

$$E_{total} = \sum_{i=1}^{n} E_{cons(i)}$$

Where

E_{total} = the total of energy consumption

$E_{cons(i)}$ = the energy consumption of the product element

Equation 3.14: The total of energy consumption.

- Toxic emission – The total of toxic emission is calculated as follows (Equation 3.15).

$$Toxic_{total} = \sum_{i=1}^{n} Toxic_{(i)}$$

Where

$Toxic_{total}$ = the total of toxic emission

$Toxic_{(i)}$ = the toxic emission of the product element

Equation 3.15: The total of toxic emission.

- Recyclability - The final parameter of recyclability is calculated as follows (Equation 3.16)

$$\text{Recyclability} = \frac{\left[\frac{D_d}{5} + \frac{D_s}{5} + \frac{D_r}{5} + E_e\right]}{4}$$

Where

D_d = difficulty of disassembly

D_s = difficulty of separate

D_r = difficulty of recover

E_r = difficulty of recycling

Equation 3.16: The final parameter of recyclability.

Figure 3.35 shows the relationship between the product elements and process parameters. The product elements are composed of the individual part and assembly part.

				Process parameters									
				Quality			Time (min.)	Cost (Baht)		Environmental Impacts			
										Raw Mat.	Manufacturing		EOL
				Soft	Strong	Straight		Material	Labor	water consumption (litre)	Energy consumption (kWh)	Toxic emission (g)	Recyclability
Product elements	Individual part	Body	B1	5	3	2	32	252	160	19.53	0.2	26.66	0
			B2	3	3	4	25	280	125	16.926	0.1375	167.5	0
		Corner	C1	3	5	4	11	21	55	1.5345	0.1025	13.33	0
			C2	3	4	5	8	25	40	1.209	0.0975	154.2	0
		Main handle	MH1	3	4	3	46	100	230	6.51	0.325	26.66	0.65
			MH2	3	4	3	38	110	190	5.673	0.285	167.5	0.55
		Handle Tab	HT1	3	4	5	12.5	180	63	1.116	0.1063	13.33	0.6
			HT2	4	4	5	9.5	162	48	0.8184	0.0938	97.85	0.55
		Lining	L1	4	3	4	27	45	135	4.8825	0.0255	13.33	0
			L2	3	5	5	22	45	110	4.2315	0.0225	13.33	0
		Flower	F1	4	4	3	13.5	25	68	0.465	0.1875	97.86	0.25
	Assembly	Body set (body + corner)	BS1	3	4	3	24	20	120	0	0.45	26.66	0.35
			BS2	3	4	3	21	30	105	0	0.385	83.01	0.4
		Handle Set (main handle + handle tab)	HS1	4	4	4	18	35	90	0	0.1875	13.33	0.4
			HS2	4	5	5	13	15	65	0	.0.1255	41.5	0
		Last Assembly	LA1	4	5	5	20	10	100	0	0.5625	26.66	0.65

Figure 3.35: The manufacturing matrix.

3.3 How to use the design system

Now that the design system has been presented and detailed, we would like to focus on how the designer uses it to create new products. This section is to detail the design methodology. The design methodology has three phases: explore the customer's perceptions and brand identity, create the new product and select the manufacturing process, as shown in Figure 3.36.

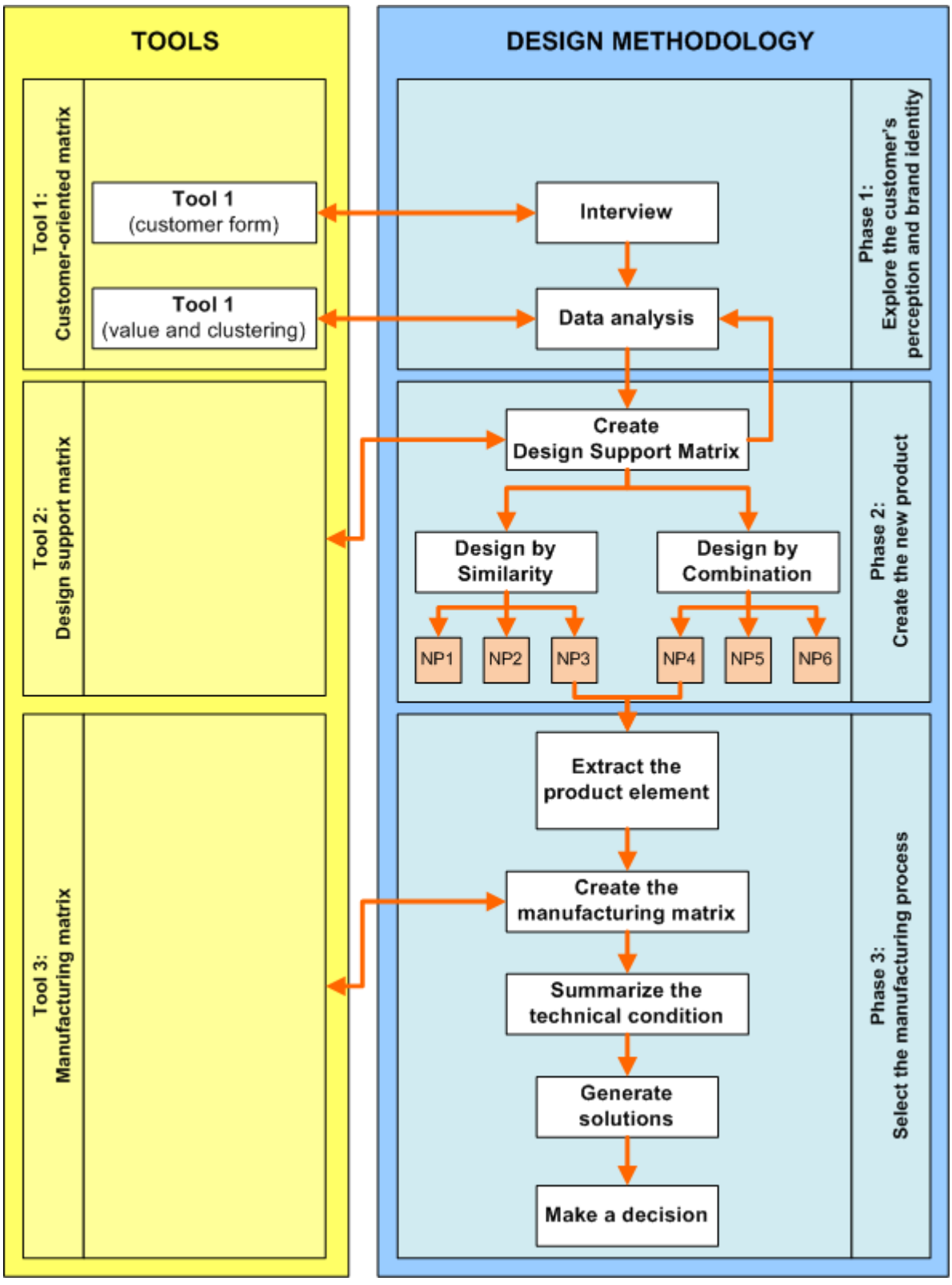

Figure 3.36: The design methodology overview.

3.3.1 Explore the customer's perceptions and brand identity

This phase is to explore the customer's perceptions of all the product visual forms that brand designers have initially designed to launch the process of creating a new collection of products. It aims to explore the correspondence and gap between designer's intentions and customer's perceptions and explore the product attributes that illustrate the brand identity. It has two steps: definition, interviews and data analysis as shown in Figure 3.37.

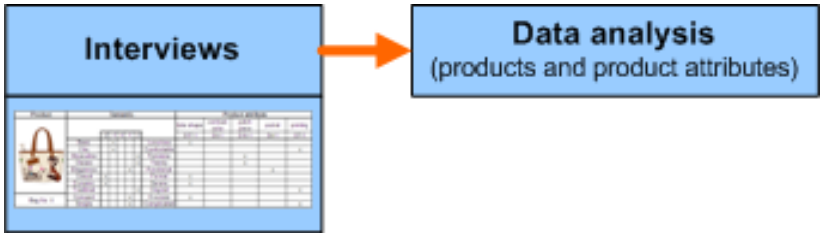

Figure 3.37: Method for exploring the customer's perceptions and brand identity.

3.3.1.1 Interviews

This step is to interview the target customers. The customer-oriented matrix (Tool 1: customer forms) is used to interview the target customers.

3.3.1.2 Data analysis

This step is to interpret data from interviews the target customer and analyze data by using statistical tools (STATBOX). It aims to explore the correspondence and the gap between the customer's perceptions and designer's intention and explore the product attributes that illustrate the brand identity. The data from the customer-oriented matrix are used to explore the correspondence and the gap between the customer's perceptions and designer's intention. The data from the design support matrix are used to explore the product attributes that illustrate the brand identity.

3.3.2 Create new product

This phase is to create a new product (concept). It aims to design a new product that expresses the brand identity and meets to customer's perception. It has two steps: create the design support matrix and design the new product as shown in Figure 3.38.

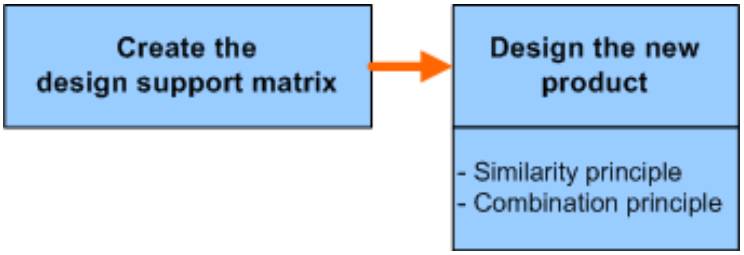

Figure 3.38: Method for designing the new product.

3.3.2.1 Create the design support matrix

This step is to create the design support matrix. The data of the interviews of the target customers summarized in the customer-oriented matrix are interpreted and summarized to create the design support matrix (Tool 2).

3.3.2.2 Design the new product

This step is to design the new product. The design support matrix is used to create the new product. It is based on two design principles: similarity and combination.

Similarity principle: It is to design the new product by modifying the product attributes from the existing products. The summary of semantic values for all bags as shown in Figure 3.39 is used to explore the product that is relevant to the brand personality. The product that has maximum value and be related to the brand personality is selected to modify and create the new product. The product attributes of selected product that have a maximum value and be relevant to the brand personality are kept. On the contrary, the product attributes of selected product that have a minimum value are modified or removed and replaced by another one.

For example, the characteristics and lifestyle of the target customers is "trendy". The semantic words that are relevant to this characteristic are "chic" and "trendy". Then, the product that is the most related to "chic" and "trendy" is the bag n°4 as shown in Figure 3.39. The "chic" value is 1.53. The "trendy" value is 1.32. It is selected to guide a designer for designing a new product.

Semantic			Product				
							
			No.1	No.2	No.3	No.4	No.5
Musculine	-	Feminine	1.45	1.87	2.08	1.67	1.87
Traditional	-	Original	-0.79	0.34	0.87	0.12	0.09
Elegant	-	Functional	0.45	-0.22	0.31	1.45	1.03
Oversize	-	Compact	1.98	2.05	0.08	0.63	0.43
Comfortable	-	Chic	-0.04	0.89	1.53	1.56	-0.77
Complicated	-	Simple	1.78	1.29	1.01	1.78	2.08
Trendy	-	Classic	-0.44	0.67	-1.32	-1.51	-0.13
Serene	-	Dynamic	1.78	1.79	2.1	1.87	1.67
Basic	-	Luxurious	-0.78	0.11	0.07	-0.44	-0.81
Casual	-	Formal	0.34	0.45	-0.99	-1.21	-0.33

Figure 3.39: The example of semantic values for all bags.

From Figure 3.40, the product attributes that are relevant to "chic" and "trendy" are kept. On the contrary, the product attributes (M3-3, HT2-4 and D4-2) that are not related to "chic" and "trendy" are removed and replaced by another one as shown in Figure 3.41.

Product	Semantic						Product attribute				
							tote shape	Cow suede	Handle tab	pocket	flower
		-2	-1	0	1	2	S17-4	M3-3	HT2-4	D4-2	D11-1
	Musculine			1.67			1.37		1.34		1.64
	Traditional			0.12				0.84		0.16	
	Elegant				1.45		1.25			0.78	
	Oversize			0.63			0.63				
	Comfortable				1.56		1.36				1.46
	Complicated				1.78		1.45		1.05		
	Trendy		-1.51				-1.39				-1.26
	Serene				1.87		1.67			1.57	
	Basic		-0.44				-0.35		-0.67		0.07
Bag No. 4	Casual		-1.21				-1.08	-0.85			

	Feminine	
	Original	
	Functional	
	Compact	
	Chic	
	Simple	
	Classic	
	Dynamic	
	Luxurious	
	Formal	

Figure 3.40: The average semantic values of sample bag.

The product attributes that are added can come from the existing product attributes or be created as new ones. They have to be relevant to "chic" and "trendy". They are handle, handle tab, corner part and material. The values (chic and trendy) of handle are 1.35 and -1.67. The values (chic and trendy) of handle tab are 1.25 and -1.07. The values (chic and trendy) of corner parts are 1.51 and -1.35. The values (chic and trendy) of material are 1.09 and -1.01. Although, their values may be lower than the average value of tote shape and flower, but they can support "chic" and "trendy" values in overview.

Figure 3.41: The example of design by using a similarity principle.

Combination principle: This principle is used to design a new product from a combination of existing product attributes. The design support matrix is used to explore the product attributes that have a maximum semantic value and be relevant to the brand personality. The product attributes that have a maximum semantic value and be relevant to the brand personality are combined to design the new product as shown in Figure 3.42.

Figure 3.42 shows the new products that are created from the combination of the product attributes. New product 1 is created from the combination of TOTE shape (S17-4), main handle with tab (MH2-1), corner part (D8-1) and flower (D11-1). The "chic" and "trendy" values are 1.27 and 0.59. Although, the "trendy" value of corner part (D8-1) is -0.37 that makes an effect on the average value of the bag, but it supports the "chic" and "trendy" in overview.

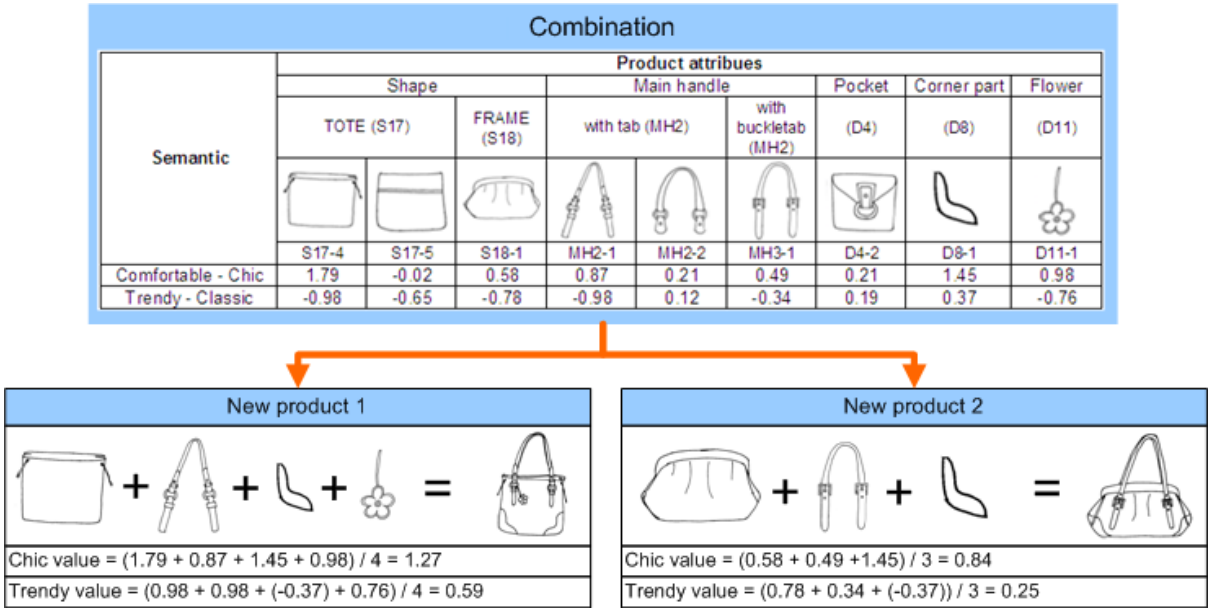

Figure 3.42: The example of design by using a combination principle.

3.3.3 Select the manufacturing process

This phase is to select the manufacturing process. It aims to explore the suitable manufacturing process that is the most relevant to the brand personality and expresses the brand identity. The decision depends on the process parameters (quality, time, cost and environmental impacts.) It has four steps: extract product elements, create the manufacturing matrix (tool 3), generate solution and make a decision as shown in Figure 3.43.

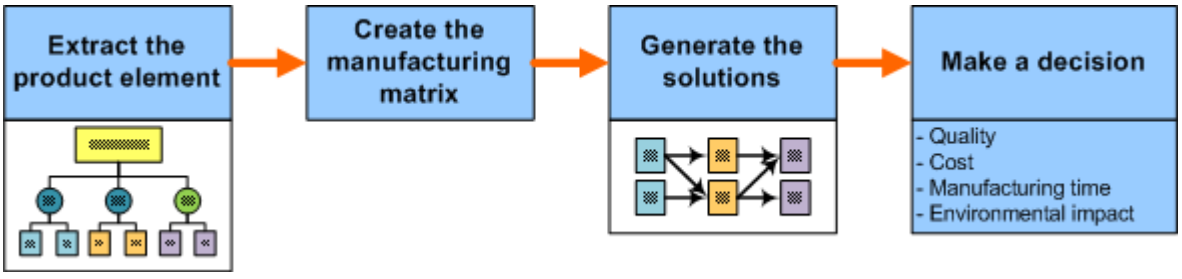

Figure 3.43: Method for selecting the manufacturing process.

3.3.3.1 Extract the product elements

This step is to extract the product elements that are designed from the previous phase. The product elements can be classified in two groups: individual part and assembly set as shown in Figure 3.44. Each product elements can be made from the different manufacturing processes.

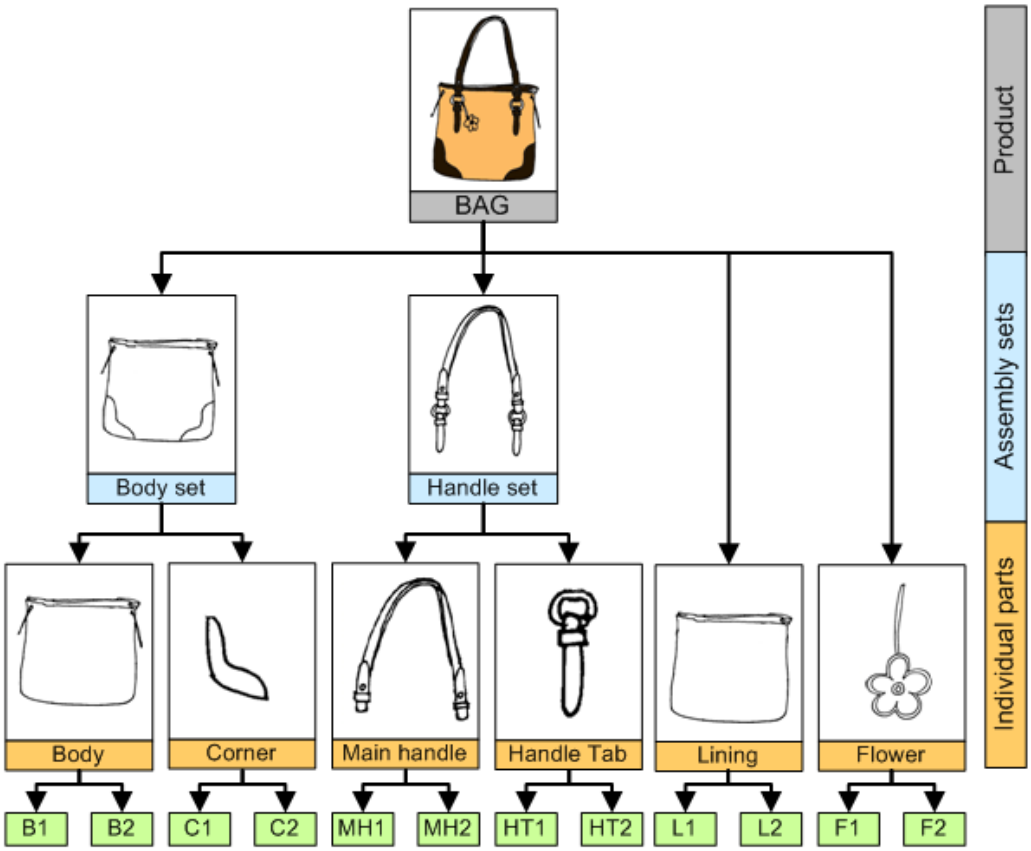

Figure 3.44: The example of product elements.

3.3.3.2 Create the manufacturing matrix

This step is to create the manufacturing matrix. The detail of creating the manufacturing matrix is explained in Tool 3.

3.3.3.3 Generate the solutions

The product elements as shown in Figure 3.44, are combined to generate the manufacturing process solutions. This step is composed of two sub-steps.

First, the individual parts are selected to generate solutions. The assembly sets are not selected because their manufacturing processes usually follow the product individual parts. For the example, the individual parts can generate 32 solutions.

Second, all solutions are reduced by using the technical conditions embedded in the manufacturing database. The technical conditions of folding and painting edge techniques in Section 3.2.4.4 are used in this case study to reduce the solutions. The folding edge technique is used with C1, MH1 and HT1. The painting edge technique is used with C2, MH2 and HT2. Owing to the technical conditions, solutions are reduced from 32 to 8 solutions as shown in Figure 3.45.

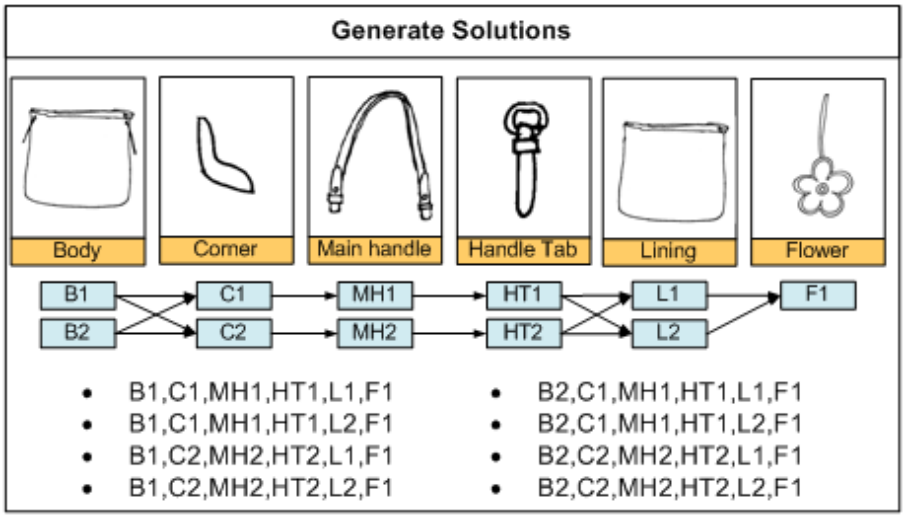

Figure 3.45: Generate the solutions.

3.3.3.4 Make a decision

This step is to make a decision to select the most suitable manufacturing process. The decision depends on the process parameters (quality, time, cost and environmental impact).

The data from the manufacturing matrix are aggregated to summarize the values of each solution as shown in Figure 3.46.

From Figure 3.46, solution 8 is the shortest manufacturing time (170 minute). However, it has got harmful effects on workers, because this solution releases lot of toxics (849.5 g). Thus, the results from Figure 3.46 are only used to guide designers and engineers to the selection of the solution. The suitable solution depends on the process parameters that designers and engineers selected.

		Quality			Time	Cost (Baht)		Environmental Impacts			
								Raw Mat.	Manufacturing		EOL
	Solutions	Soft	Strong	Straight	(min.)	Material	Labor	water consumption (litre)	Energy consumption (kWh)	Toxic emission (g)	Recyclability
1	B1+C1+MH1+HT1+L1+F1+BS1+HS1+LA1	3.67	4	3.67	204	688	1020	34.04	2.1468	257.8	0.32
2	B1+C1+MH1+HT1+L2+F1+BS1+HS1+LA1	3.56	4.22	3.78	199	688	1020	33.39	2.1438	257.8	0.32
3	B1+C2+MH2+HT2+L1+F1+BS2+HS2+LA1	3.78	4	3.89	182	674	910	32.58	1.8368	708.6	0.27
4	B1+C2+MH2+HT2+L2+F1+BS2+HS2+LA1	3.67	4.22	4	177	674	885	31.93	1.8338	708.6	0.27
5	B2+C1+MH1+HT1+L1+F1+BS1+HS1+LA1	3.44	4	3.89	197	716	985	31.43	2.0843	398.7	0.32
6	B2+C1+MH1+HT1+L2+F1+BS1+HS1+LA1	3.33	4.22	4	192	716	960	30.78	2.0813	398.7	0.32
7	B2+C2+MH2+HT2+L1+F1+BS2+HS2+LA1	3.56	4	4.11	175	702	875	29.97	1.7743	849.5	0.27
8	B2+C2+MH2+HT2+L2+F1+BS2+HS2+LA1	3.44	4.22	4.22	170	702	850	29.32	1.7713	849.5	0.27

Figure 3.46: The example values of each solution.

3.4 Conclusion of chapter

This chapter has presented the integrated design system that was developed during this work and the methodology to design new products based on customer's perception, brand identity and environment friendliness. Owing to the communication problems between the designers and customers, brand identity was proposed to be a second connector to link the designers with the customers. The role of brand identity in the design system is two folds. First, it is used as the interface between designers and customers to catch the information and requirements directly from customers. The customer's perceptions are compared with the brand personality to explore the correspondences and gaps between designer's intention and customer's perception. Second, it is used to guide optimization the engineering process. The product attributes that express the brand identity and are related to brand personality are used to design a new product and select the suitable manufacturing process.

The design system is composed of three elements: the design methodology, the database and the tools to support the design methodology. The design methodology is the essence of the design system. It has three phases: explore the customer's perception the brand identity, create the new product and select the manufacturing process. We have developed three tools to support the design methodology: the customer-oriented matrix, the design support matrix and the manufacturing matrix.

The customer-oriented matrix was developed to support the designers exploring the customer's perception of product visuals. It was used to interview the target customer. The data from interview were summarized and analyzed to determine the customer's perception

The design support matrix was developed to support the designers exploring the brand identity and creating the new product. It was created to support the similarity and the combination design principles.

The manufacturing matrix was developed to support the designer decide to select a suitable manufacturing process that ensures to meet the customers' perceptions, expresses the brand identity and makes friendly with the environment.

Chapter 4

Illustration of the integrated design system

Chapter 4

Illustration of the integrated design system

The objective of this chapter is to illustrate the integrated design system proposed. The case study related to leather goods design is used.

4.1 Case study: Champ Ace company and bag design objectives

In Thailand, the leather goods manufacturers are facing many problems both in the local and global market. Products do not meet the needs and requirements of customer. Quality of products is lower than in France and Italy. Image of products does not recognize by customers because of lack of identity.

Champ Ace Co., LTD is one of the Thai leather goods manufacturer that is facing these problems. It founded in 1969. The company mission is to manufacture all types of sports (inner ware, sports ware, swim ware, sport bags and golf bags) and leather goods (handbag and wallet). Champ Ace produces the products under licensed brands (Lacoste, Lancel, Le Coq Sportif, Speedo, Gant and Mizuno) and also their own brands (BSC and Sarini).

This study focuses on BSC brand that is an own brand for leather goods. The brand concept of BSC is chic and elegant leather bags for Thai woman. The target customers are between 20-32 years old, and they are working woman with a salary around 15,000-30,000 Baht per month. They are a representation of the new modern woman who lives in the capital. They are fashionable and confident. They like to participate to party and social community.

Figure 4.1: The target customer of BSC.

The leather bags of BSC are created to response all activities of the target customers. They can be classified in 3 production lines: working, relax and holiday as shown in Figure 4.2.

First, “Working” is designed to be suitable at working time. The color of the bag is monotone. The product identity comes from the shape, handle and handle tab that illustrate “elegant”. It is made of 100% leather. The price is between 2,000-4,900 Baht.

Second, “Relax” is designed to the activities after work (such as party). The color of bag is two-tone. The product identity comes from the shape, material, patch pieces, printing, handle and handle tab that illustrates “fashionable” and “elegant”. It is made of both leather and other materials. The price is between 2,200-2,900 Baht.

Third, “Holiday” is designed to be suitable for vacation. The bag is colorful. The product identity comes from the accessories, material, patch pieces, printing and other details that illustrate “colorful” and “fashionable”. It is made of PVC or other materials. The price is between 1,200-1,900 Baht.

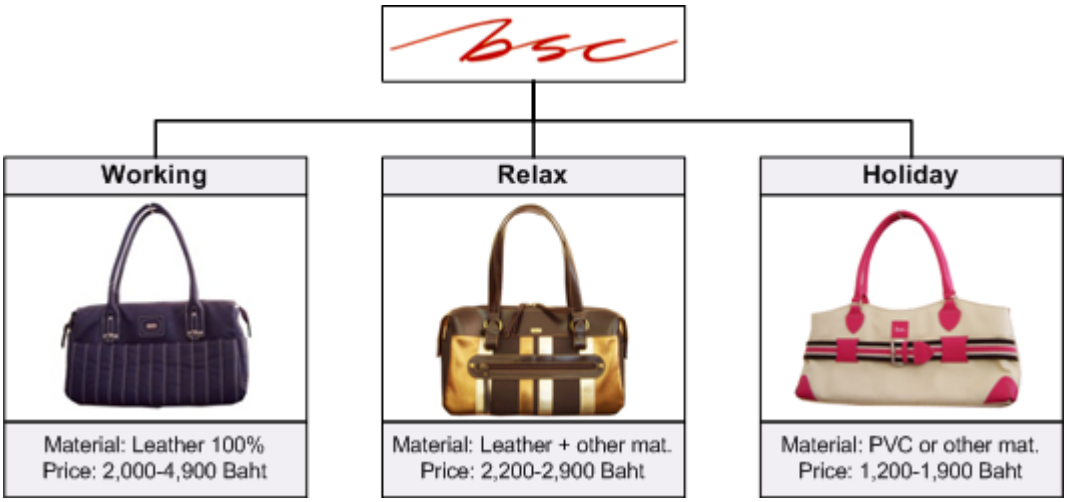

Figure 4.2: The production lines of BSC.

4.2 Step1: Explore the customer's perception and brand identity

We will now follow the design methodology presented in Chapter 3 to illustrate how it practically uses and how the tools developed can support it. The presentation follows general methodology of Figure 3.6, then the tools presented in section 3.26. This phase is to explore the correspondence and the gap between designer's intention and customer's perception and explore the product elements that express the brand identity.

4.2.1 Case study elements

Semantics: They are selected from the list of semantic words as shown in Figure 3.13. Ten pairs of the opposite semantic words that are related to brand personality were selected by fashion experts and fashion designers. They are "Basic – Luxurious", "Chic - Comfortable", "Musculine - Feminine", "Classic - Trendy", "Elegant - Functional", "Casual - Formal", "Dynamic - Serene", "Traditional - Original", "Compact - Oversize" and "Simple - Complicated".

Target customers: This study focuses on Thai women with the objectives defined in section 4.1.

Sample bags: The company has never made a marketing research about the brand identity. The leather bags have nevertheless a good reputation. A set of bags was selected to interview the target customers. This set comes from the different collections and production lines as shown in Figure 4.3.

Figure 4.3: The sample leather bags of BSC.

Product attributes: All the product attributes of leather bags were extracted. Each leather bag was defined by only five relevant product attributes that illustrated the product identity. Figure 4.4 shows the list of the product attributes used in this case study.

Figure 4.4: The list of product attributes.

4.2.2 Interview protocol

The customer-oriented matrix (customer form) was created to interview the target customers. Figure 4.5 shows the sample of the customer-oriented matrix (customer form). Fifty-two women who have the characteristics similar to the target customers with the objectives defined in section 4.1 were interviewed.

Product	Semantic						Product attribute				
							Satchel shape	Main handle	Handle tab	Zip tab	Strap
		-2	-1	0	1	2		S14-1	MH2-3	HT1-2	D6-1	D12-1
	Basic						Luxurious					
	Chic						Comfortable					
	Musculine						Feminine					
	Classic						Trendy					
	Elegant						Functional					
	Casual						Formal					
	Dynamic						Serene					
	Traditinal						Original					
Bag No. 9	Compact						Oversize					
	Simple						Complicated					

Figure 4.5: The customer-oriented matrix (customer form).

4.2.3 Results: the product design strategy

The fifty-two forms lead to determine the average semantic values of all the 15 bags (Figure 4.6). The clustering of the product was then carried out by PCA mapping. It shows the products that act on with semantic words within the same collection and different collections (Figure 4.7).

Semantic			Product													
																
			No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	No.13	No.14	No.15
Basic	-	Luxurious	1.16	0.84	1.20	0.21	0.79	-0.52	-0.12	-0.28	0.32	0.16	0.07	0.43	1.36	-0.79	-0.50
Chic	-	Comfortable	-0.60	-0.44	-0.64	-0.86	-0.93	-0.16	-0.84	-0.52	-0.64	-0.32	-0.07	-0.14	-0.79	-0.50	0.29
Musculine	-	Feminine	1.80	1.80	1.88	1.71	1.29	1.76	1.84	1.56	1.64	1.72	1.79	1.71	1.36	1.00	1.14
Classic	-	Trendy	0.16	-0.16	0.28	-0.29	0.00	0.28	0.80	0.60	0.24	-0.08	-1.14	-0.79	-0.07	0.14	-0.21
Elegant	-	Functional	-0.48	-0.60	-0.57	-0.71	-0.86	0.80	0.08	-0.08	0.32	1.12	-0.76	-0.50	-0.05	1.00	1.21
Casual	-	Formal	0.96	0.80	0.92	0.14	0.86	-0.96	-1.00	-0.84	-0.36	-0.68	-0.14	-0.14	1.00	-0.50	-1.14
Dynamic	-	Serene	1.00	0.92	1.20	0.50	1.00	-0.64	-0.96	-0.60	-0.12	-0.56	-0.29	0.00	1.07	0.00	-0.57
Traditinal	-	Original	0.60	0.68	0.68	-0.43	-0.36	-0.20	0.00	-0.20	0.16	0.12	-0.07	-0.29	-0.86	-0.14	-0.07
Compact	-	Oversize	-0.32	-0.28	-0.48	-0.36	0.50	0.40	-0.68	-1.00	-0.04	0.36	-0.07	-0.93	0.07	0.36	-1.29
Simple	-	Complicated	-0.04	-0.04	0.00	0.07	0.07	-0.36	-0.48	-0.68	0.96	0.76	-1.21	-1.29	0.36	-1.21	-0.86

Figure 4.6: The customer-oriented matrix (semantic values for all bags).

The PCA mapping helps extract the correspondences and the gaps between the customer's perceptions and the designer's intention. The expert clustered the bag sample in 3 groups.

"G1", this first group is related to the brand personality: fashionable. The semantic words that are closed to fashionable are "trendy" and chic". The shape of bags illustrates "casual" and "dynamic". The color of bags illustrates "trendy" and "chic".

"G2", this second group is related to the brand personality: elegant. It is relevant to "elegant", "formal" and "luxurious" that is expressed by the shape of the bags.

"G3", this group of bags, accepted and bought by customers, does not fit the brand personality. It represents the gap between the customer's perceptions and the designer's intention. It is not related to the brand personality because the style of bags illustrates more "classic" and "comfortable" that are the opposite semantic words of brand personality.

"G4", we then defined as the ideal group of BSC bags. It is a combination of "fashionable" and "elegant" as Champ Ace designers would have to get. In fact, the bag n°13 is excluded in the G4 because it illustrates the strong identity of Hermes style. The bag n°1, 2 and 3 are excluded in the G4 because they illustrate more "elegant". The bag n°9 is included in G4 because other bags in G1 are more "casual" and "dynamic" that are expressed from belt and shape of the bag.

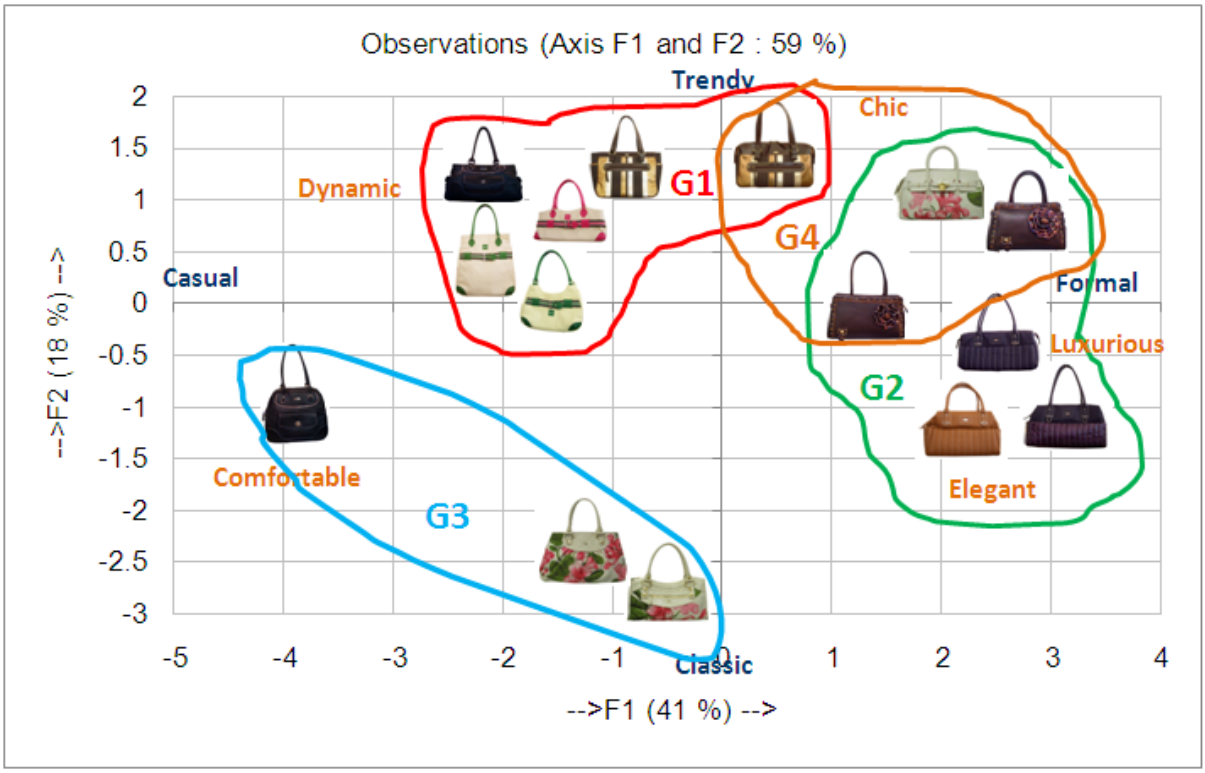

Figure 4.7: The customer-oriented matrix (PCA mapping of the products).

4.2.4 Interpretation by expert to define the product design strategy

From Figure 4.7, that illustrates the correspondences between the customer's perceptions and the designer's intention, the Champ Ace experts saw. In fact, only the product line "Relax" suits to the brand personality ("elegant" and "fashionable"). The two other lines are only partially suitable: "Working" only relates to "elegant" and "Holiday" only relates to "fashionable". Thus, the design strategy needs to be adapted to be relevant to the brand personality. The Champ Ace experts decided that the new design strategy should be a combination between "elegant" and "fashionable" as shown in Figure 4.8. Each production line needs to combine "elegant" and "fashionable": the level of each value (elegant, fashionable) depends on the characteristics of each line.

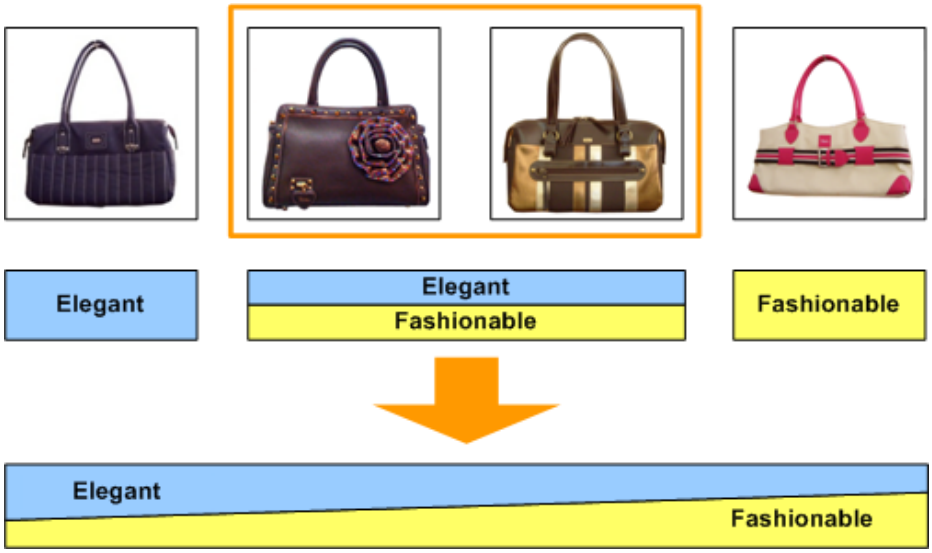

Figure 4.8: The new design strategy.

4.3 Step 2: Create the new product

4.3.1 The design support matrix

The design support matrix (Tool 2) was created for the customer-oriented matrix of Figure 4.6 as shown in Figure 4.9.

Semantic						Product Attribute																		
						Product element																		
						shape												Main handle				Handle tab		
						Double handle							Hobo	Satchel	Tote			no tab	with tab			ring tab		
	-2	-1	0	1	2	S6-1	S6-2	S6-3	S6-4	S6-5	S6-6	S6-7	S11-1	S14-1	S17-1	S17-2	S17-3	MH1-1	MH2-1	MH2-2	MH2-3	HT1-1	HT1-2	HT1-3
Basic		0.29				1.52	0.15	-0.06	0.2	1.56	-0.75	-0.44	-0.4	0.21	-0.13	-0.62	0.71	-0.5	0.78	-0.3	0	1.38	0	1
Chic		-0.48				0	-0.43	0	0.17	-0.67	0.5	1.33	0	0	0.5	0	0	0	-1.11	0	0	-0.33	-1.14	-1.5
Musculine					1.60	1.88	2	1.91	2	1.13	1.67	1.57	1.69	1.81	1.4	1.9	1.87	1.5	0	1.43	1.62	0	0	2
Classic		-0.02				0	-1.17	0	-0.67	0.25	0.5	-1	0	0	-1.67	0	0	0	0	0	0	0.31	-0.19	0
Elegant		-0.05				0.74	-0.14	0	-1	0	1.33	1	0.43	0.29	0	1.38	0	0	0	-0.8	0	-0.94	0	-0.75
Casual		-0.07				1.24	0.33	-1.43	-0.11	1.5	0.83	-1.11	0	-0.58	0.4	0	-0.67	0.38	0	0	-0.65	0	0	1
Dynamic		0.13				0	1.54	-0.93	0	2	0.33	-0.33	-1	-0.6	1.33	-1	-0.15	-0.43	1.2	-0.2	-0.77	0	-0.6	1
Traditinal		-0.02				0	0.14	0	-1	-0.71	-0.11	0.57	0	0	-0.33	0.33	0	0	0	0	0	0.79	0.33	1.25
Compact		-0.25				-0.39	-0.46	-0.67	-1.6	-0.25	0.86	-1.6	-1.2	-0.07	-0.13	0.53	0.29	0	0	0	-0.14	0	0	-1
Simple		-0.26				0	-0.43	-0.29	-1	-0.33	-1.25	-1.25	-0.73	0.71	-1.7	-0.14	0	-1	0	0	0.85	0.13	1.14	0
						Bag No.	1,2,3	4,5	12	13	7	14	15	8	9	11	6	10	4,5	1,2,3	6,7	9,10	1,2,3	9,10	12

then

Semantic						Product attribute																		
						Product element																Mat.	Mfg.	
						Detail															Accs.			
						Pocket		Zip tab		Corner part		Flower	Front part			Strap	Belt	logo tab	logo piece	Rivet		Printing	stitching	
	-2	-1	0	1	2	D5-1	D5-2	D6-1	D6-2	D8-1	D8-2	D10-1	D11-1	D11-2	D11-3	D12-1	D14-1	D15-1	D16-1	A18-1		D7-1	D13-1	
Basic		0.29				0.5	0	0	2	0	0	0.8	1	1.2	1	0.2	-0.67	0	1.5	-1		-0.2	0	
Chic		-0.48				0.82	-0.8	0	1	0.14	-2	-1	-1	-2	-0.5	-0.5	-0.61	0	-1.71	-0.5		-0.55	0	
Musculine					1.60	-1	0	0	-1	0	0	2	1	2	0	0	0	0	0	0.43		1.68	0	
Classic		-0.02				0.5	0	0	-2	0.43	1	-0.4	-0.5	1	-2	0.5	0.84	0	1	0.18		-0.94	0.48	
Elegant		-0.05				0.7	1.4	0.92	0	0.44	0	-0.8	-1.25	-0.83	1.33	0.86	0	0	-1.38	-0.6		-1.22	0	
Casual		-0.07				-1.38	-1	0	0.25	-0.88	0	0.67	0.17	0.8	-1.5	0	-1.58	1.1	0.83	0.86		0.3	0.83	
Dynamic		0.13				-0.13	-1	0	1	-0.85	0.75	0	-0.67	1.25	0.5	0	0	1.32	-1	0.17		-0.29	0	
Traditinal		-0.02				0.5	0	0	-0.8	0	0.25	-0.67	-1	-0.71	-0.17	0	-0.12	1.1	-0.57	-0.33		0	0	
Compact		-0.25				1	1	0	2	0	0.5	0.6	0	1.5	1	0	0	0	1	2		1	0	
Simple		-0.26				0	-1.75	0	-1	-0.33	-1.67	0.77	2	1.5	-1	1.17	-0.81	0	0.45	0.83		-1	-0.32	
						Bag No.	14,15	14	9,10	12	6,7,8	14	4,5	11	13	14,15	9,10	6,7,8	1,2,3	4,5	4,5		11,12,13	1,2,3	

Figure 4.9: The design support matrix.

4.3.2 Explore the brand identity

Figure 4.10 shows the PCA mapping of the products attributes. It expresses the variety of product attributes. The Eigen values of both axis was only 42% that is low. The product attributes were clustered in 6 groups.

“F1”, it is related to “trendy” and “chic” that is relevant to the brand personality. It comes from handle tab, rivet, patch piece and logo piece.

"F2", it is related to "chic" and "elegant". The product attribute that illustrates "elegant" is gold accessories. It comes from the accessories of handle tab, logo pieces and includes the normal accessories (rivet).

"F3", it is related to "functional" that comes from the pocket, shape and zip.

"F4", it is related to "dynamic" and "casual" that come from the shape of bag and belt. Especially, the belt always expresses "casual".

'F5", it is related to "classic" and "simple' that come from the shape of bag and front part.

"F6", it is product attributes that illustrate the strong identity of Hermes style. They express "elegant" and 'luxurious". Champ Ace does not want to use Hermes style for the next collection.

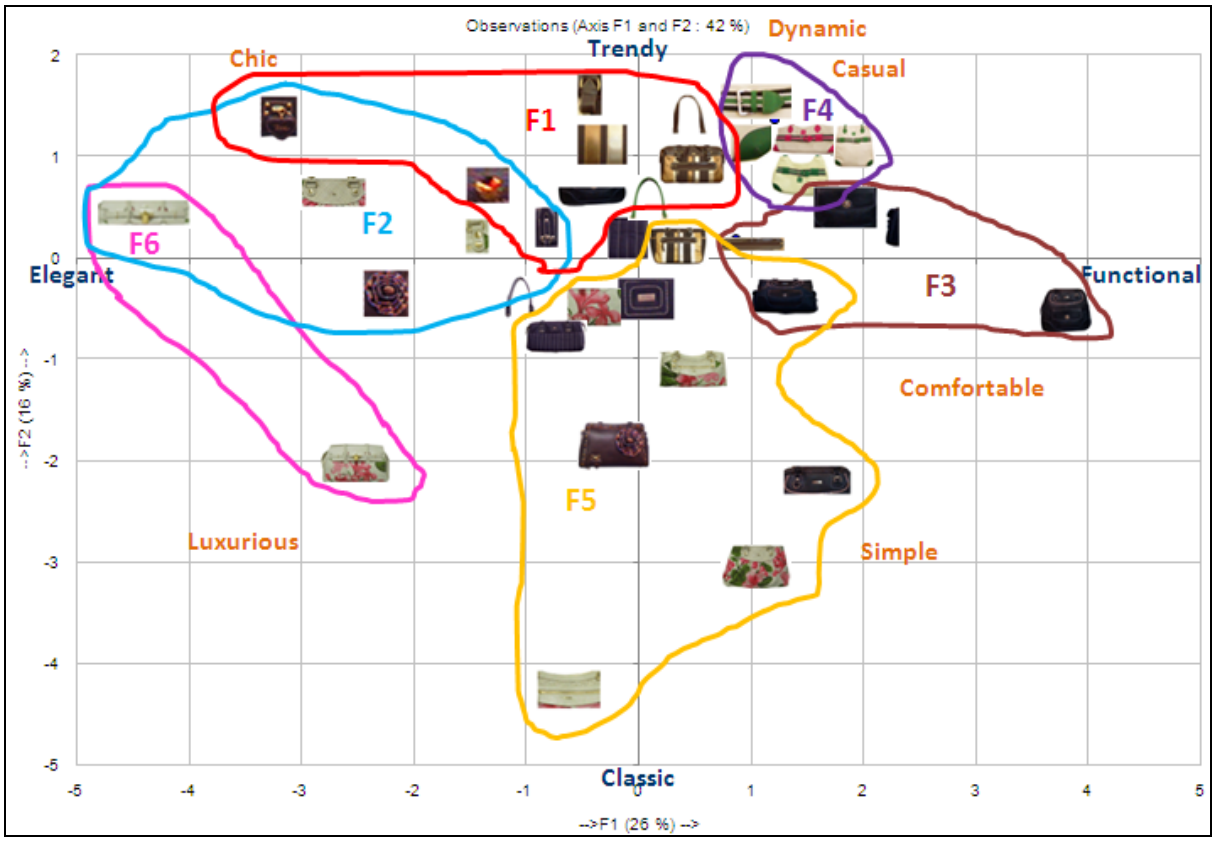

Figure 4.10: The design support matrix (PCA mapping of the product attributes).

Interpretation by experts: Figure 4.10, highlights the variety of product attributes. The Champ Ace experts deducted four guidelines for design.

First (F1), the designers should select the shape of bags more related to “fashionable” than in the past.

Second (F2), to get “elegant” values, designers should add gold accessories.

Third (F3), “fashionable” comes from the details of all the product attributes that are different from the other brands.

Forth (F4), designers have to be careful with using belts because the image and the values of bags could be affected.

4.3.3 Design the new product

To illustrate the design methodology, we will present two different designs. The first one is based on the similarity principle and the second one on the combination principle.

4.3.3.1 Design by similarity

From the customer-oriented matrix (Figure 4.6), the product that most relates to “elegant” and “fashionable” was bag n°5. The “elegant” value is 0.86. The “trendy” value is 0. The “chic” value is 0.93. This bag was selected to guide the designer create a new product. This case focuses on design “Relax” bag.

The product attributes (S6-2, D10-1, D16-1 and A18-1) that are relevant to “elegant”, “trendy” and “chic” were kept (Figure 4.11). The main handle (MH1-1) was not related to “elegant”, “trendy” and “chic”, was removed and might be replaced by a new one. The new main handle should be more “trendy” and “chic”.

Product	Semantic						Product attribute				
							Double handle shape	Main handle no tab	Flower	Logo piece	rivet
	-2	-1	0	1	2		S6-2	MH1-1	D10-1	D16-1	A18-1
	Basic			0.79		Luxurious	0.15	-0.5	0.8	1.5	-1
	Chic		-0.93			Comfortable	-0.43	0	-1	-1.71	-0.5
	Musculine				1.29	Feminine	2	1.5	2	0	0.43
	Classic			0		Trendy	-1.17	0	-0.4	1	0.18
	Elegant		-0.86			Functional	-0.14	0	-0.8	-1.38	-0.6
	Casual			0.86		Formal	0.33	0.38	0.67	0.83	0.86
	Dynamic			1		Serene	1.54	-0.43	0	-1	0.17
	Traditinal		-0.36			Original	0.14	0	-0.67	-0.57	-0.33
Bag No. 5	Compact			0.5		Oversize	-0.46	0	0.6	1	2
	Simple		-0.07			Complicated	-0.43	-1	0.77	0.45	0.83

Figure 4.11: The average semantic values of bag n°5.

Figure 4.12 illustrates the step of design by using the similarity principle. First, the shape of the bag (S6-2) is related to “chic” and “elegant” but not relevant to “trendy”. Initially, we focused on only shape. We modified the shape to be related to “trendy” by removing the trim part around the edge of the bag.

Second, the main handle (MH1-1) that was not related to “elegant”, “trendy” and “chic”, was removed and be replaced by a new one. The new main handle is related to the “trendy” and “chic”. It was created to be the new style.

Third, according to the fashion trend in Spring-Summer 2010 that made more accessories coming out and most expert designers focused on the printing technique [Style 2010]. Flower (D10-1), logo piece (D16-1) and rivet (A18-1) were removed and replaced the printing technique, though they are related to “elegant”, “trendy” and “chic”. The concept of a flower was transformed from the piece of a flower to the printing flower as shown in Figure 4.12. Brand logo also used the printing technique.

Forth, the belt that illustrates “elegant” and “fashionable” was added to the new bag. The new belt is a new style that is created from the weaving technique with contrast color.

Fifth, the new material that illustrates “elegant” and “fashionable” was added to the new bag. The new material is related to the spring-summer 2010 colors [Trendselection 2009].

Figure 4.12: The step of design by using the similarity principle.

Figure 4.13: The new bag that design by using the similarity principle.

4.3.3.2 Design by combination

The design support matrix (Figure 4.9) was used to explore the product attributes that had a maximum semantic value and were relevant to the brand personality. The selected attributes were combined to design the new product. The set of attributes shown in Figure 4.14 was selected for the combination process.

Semantic	Product attribues											
	Shape		Main handle		Handle tab			Corner part (D8)	Flower (D10)	Front part (D11)	logo piece (D16)	Rivet (A18)
	Double handle shape (S6)		with tab (MH2)		Ring tab (HT1)							
												
	S6-2	S6-5	MH2-1	MH2-2	HT1-1	HT1-2	HT1-3	D8-2	D10-1	D11-1	D16-2	A18-2
Chic - Comfortable	-0.43	-0.67	-1.11	0	-0.33	-1.14	-1.5	-2	-1	-1	-1.71	-0.5
Classic - Trendy	-1.17	0.25	0	0	0.31	-0.19	0	1	-0.4	-0.5	1	0.18
Elegant - Functional	-0.14	0	0	-0.8	-0.94	0	-0.75	0	-0.8	-1.25	-1.38	-0.6

Figure 4.14: The average semantic value of the product attributes that are related to the brand personality.

The new bag to be designed is a “Relax” product line. S6-2, S6-5 and D11-1 were selected to be combined together. According to the “trendy” values of S6-2, it was integrated with S6-5 to create the new shape that illustrates “elegant”, “trendy” and “chic” as shown in Figure 4.15. The front part (D-11) was modified to response to the new shape of the bag. The new zip, main handle and patchwork were then selected and added to increase “trendy” and “chic” values (Figure 4.16).

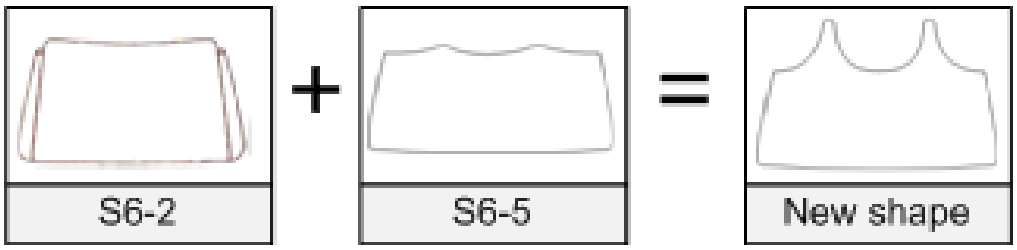

Figure 4.15: The integration of S6-2 and S6-5 shape.

Figure 4.16: The new bag that design by using the combination principle.

4.4 Step 3: Select the manufacturing process

This phase is to select the manufacturing process that is the most relevant to the brand personality and expresses the brand identity. The decision depends on the process parameters (quality, time, cost and environmental impacts.) The bag designed by similarity (Figure 4.13), is used in this case study.

4.4.1 Extract the product elements

The product elements of the bag Figure 4.13 were extracted (Figure 4.17), then classified in 2 groups: individual parts and assembly set. According to this bag that is a “Relax” product line, the folding edge techniques and painting edge techniques can be used. Thus, each product element can be made from the both techniques.

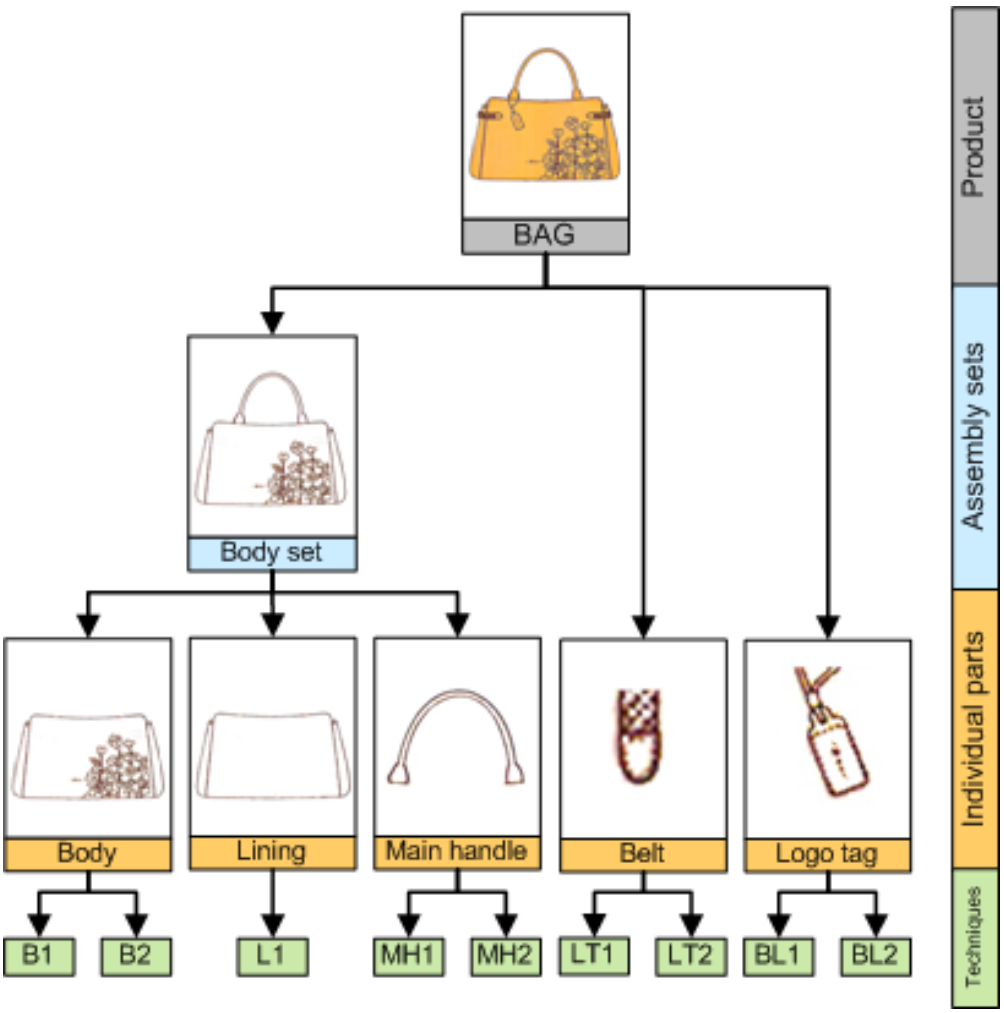

Figure 4.17: The product elements of the new bag.

4.4.2 Create the manufacturing matrix

The manufacturing matrix is created to help the designer decide to select a suitable manufacturing process that ensures to meet customers' perceptions. It has intended to make a decision on process performance parameters such as a quality, time, cost and environmental impact.

First, the relationship between the manufacturing process of each product elements and process parameters were summarized in Figure 4.18.

				Process parameters															
						Quality				Cost (Baht)		Environmental Impacts							
												Raw Mat.	Manufacturing		EOL				
				Machine usage	Raw material area (cm2)	Soft	Strong	Straight	Time (min)	Material	Labor	Water consumption (liter)	Energy Consumption (kWh)	Toxic emission (g)	Dissassembly	Separate	Existing recycling process	Recover
Individual part	Body	B1	Cut leather	yes	2700	4	5	4	5	270	25	25.11	0.0625		3	2	0	2
			Splitting	yes					3		15		0.15					
			Skiving	yes					10		50		0.125					
			printing	no					1		5			28.17				
			gluing	no					2		10			26.67				
			Folding Edge	no					4		20							
			Stitching	yes					5		25		0.0625					
		B2	Cut leather	yes	2504	4	5	5	5	250	25	23.29	0.0625		2	2	0	2
			Splitting	yes					3		15		0.15					
			printing	no					1		5			28.17				
			gluing	no					2		10			26.67				
			Stitching	yes					5		25		0.25					
			Painting	no					3		15			84.51				
	Lining	L1	Cut cotton	yes	2376	4	5	4	0.3	47.5	1.5	14.73	0.04		3	2	0	1
			gluing	no					1		5			13.33				
			Folding Edge	no					2		10							
			Stitching	yes					3		15		0.0375					
	Main handle	MH1	Cut leather	yes	350	4	4	5	1	35	5	3.26	0.0125		2	2	0	2
			Splitting	yes					1		5		0.05					
			Skiving	yes					2		10		0.025					
			gluing	no					1		5			13.33				
			Folding Edge	no					5		25							
			Stitching	yes					3		15		0.0375					
		MH2	Cut leather	yes	250	4	4	5	1	25	5	2.33	0.0125		2	2	0	2
			Splitting	yes					1		5		0.05					
			gluing	no					1		5			13.33				
			Stitching	yes					3		15		0.0375					
			Painting	no					3		15			84.51				
	Belt	BL1	Cut leather	yes	130	3	4	4	1	13	5	1.21	0.0125		2	2	0	3
			Splitting	yes					1		5		0.05					
			Skiving	yes					1		5		0.0125					
			gluing	no					1		5			13.33				
			Folding Edge	no					1		5							
			Stitching	yes					2		10		0.025					
		BL2	Cut leather	yes	75	4	3	4	1	7.5	5	0.70	0.0125		2	2	0	3
			Splitting	yes					1		5		0.05					
			gluing	no					1		5			13.33				
			Stitching	yes					1		5		0.0125					
			Painting	no					3		15			84.51				
	Logo tag	LT1	Cut leather	yes	70	4	5	4	1	7	5	0.65	0.0125		3	2	0	2
			Splitting	yes					1		5		0.05					
			Skiving	yes					2		10		0.025					
			Stamping	yes					1		5		0.04167					
			gluing	no					1		5			13.33				
			Folding Edge	no					2		10							
			Stitching	yes					2		10		0.025					
		LT2	Cut leather	yes	30	4	5	5	1	3	5	0.28	0.0125		2	2	0	2
			Splitting	yes					1		5		0.05					
			Stamping	yes					1		5		0.04167					
			gluing	no					1		5			13.33				
			Stitching	yes					2		10		0.025					
			Painting	no					3		15			84.51				
Assembly set	Body set 1	B1+L1+MH1	gluing	no		4	5	5	1		5			13.33	2	2	0	2
			Folding Edge	no					1		5							
			Stitching	yes					5		25		0.0625					
	Body set 2	B2+L2+MH2	gluing	no		4	5	5	1		5			13.33	2	2	0	2
			Stitching	yes					5		25		0.0625					
			Painting	no					2		10			56.34				
	Final 1	Body set 1+BL1+LT1	Stitching	yes		4	5	4	1		5		0.0125		4	2	0	2
			Fastening	no					0.5		2.5							
	Final 2	Body set 2+BL2+LT2	Stitching	yes		4	5	4	1		5		0.0125		4	2	0	2
			Fastening	no					0.5		2.5							

Figure 4.18: The parameters of the manufacturing process of the bag elements (extract from the manufacturing database).

Second, the manufacturing matrix was constructed (Figure 4.19).

				Process parameters									
				Quality			Time (min)	Cost (Baht)		Environmental Impacts			
										Raw Mat.	Manufacturing		EOL
				Soft	Strong	Straight		Material	Labor	Water consumption (liter)	Energy Consumption (kWh)	Toxic emission (g)	Recyclability
Product elements	Individual part	Body	B1	4	5	4	30	270	150	25.11	0.4000	54.84	1.75
			B2	4	5	5	19	250	95	23.29	0.4625	139.35	1.5
		Lining	L1	4	5	4	6.3	47.5	31.5	14.73	0.0775	13.33	1.5
		Main handle	MH1	4	4	5	13	35	65	3.26	0.1250	13.33	1.5
			MH2	4	4	5	9	25	45	2.33	0.1000	97.85	1.5
		Belt	BL1	3	4	4	7	13	35	1.21	0.1000	13.33	1.75
			BL2	4	3	4	7	7.5	50	0.70	0.0750	97.85	1.75
		Logo tag	LT1	4	5	4	10	7	50	0.65	0.1542	13.33	1.75
			LT2	4	3	4	9	3	45	0.28	0.1292	97.85	1.5
	Assembly set	Body set 1	B1+L1+MH1	4	5	5	7		35		0.0625	13.33	1.5
		Body set 2	B2+L2+MH2	4	5	5	8		40		0.0625	69.68	1.5
		Final 1	Body set 2+BL1+LT1	4	5	4	1.5		7.5		0.0125		2
		Final 2	Body set 1+BL2+LT2	4	5	4	1.5		7.5		0.0125		2

Figure 4.19: The manufacturing matrix.

4.4.3 Generate the solutions

The product elements (Figure 4.17), are combined to generate the manufacturing process solutions. The individual parts were selected to generate solutions. For this case study, the individual parts generate sixteen initial solutions (Figure 4.20).

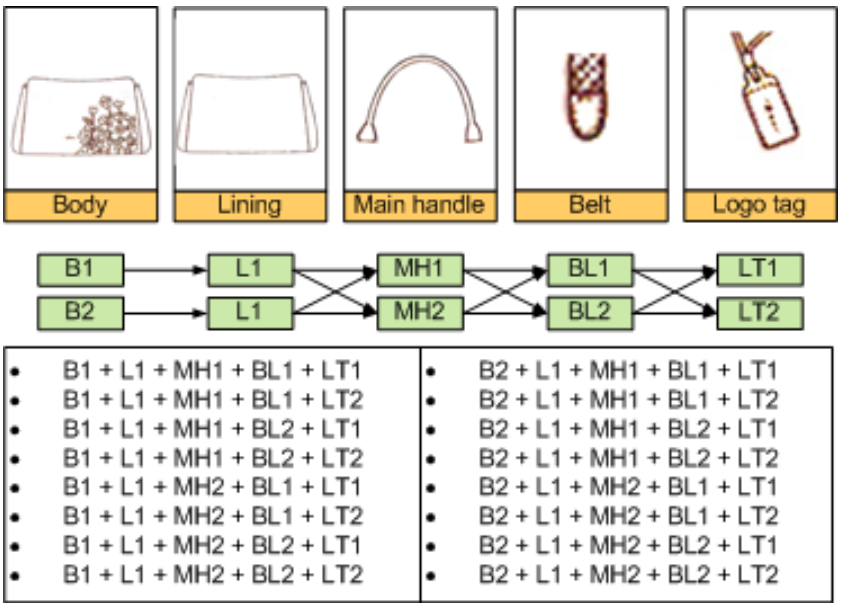

Figure 4.20: The sixteen initial solutions.

The set of solutions were reduced by using the technical conditions embedded in the manufacturing database. The technical conditions of folding and painting edge techniques are used to reduce the solutions. The folding edge technique is used with B1, L1, MH1, BL1 and LT1. The painting edge technique is used with B2, MH2, BL2 and LT2. Owing to the concept of "Relax" product line, the belt and logo tag are product element that are used to decorate the bag. They can be combined with the folding edge technique. The solutions were finally reduced from 16 to 3 solutions as shown in Figure 4.21.

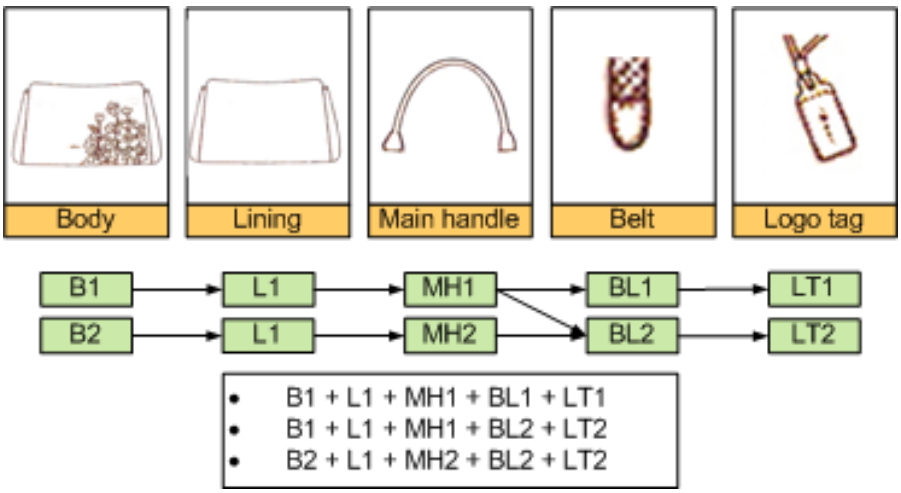

Figure 4.21: The three final solutions.

4.4.4 Evaluation of the three final candidate and selection of the solution

This step is to select the most suitable manufacturing process. The decision depends on the process parameters (quality, time, cost and environmental impact). The data from the manufacturing matrix are aggregated to summarize the values of each solution (Figure 4.22).

		Quality			Time (min)	Cost (Baht)		Environmental Impacts			
								Raw Mat.	Manufacturing		EOL
	Solution	Soft	Strong	Straight		Material	Labor	water consumption (litre)	Energy consumption (kWh)	Toxic emission (g)	Recyclability
1	B1 + L1 + MH1 + BL1 + LT1 + Body set 1 + Final 1	3.86	4.71	4.29	75	373	374	44.96	0.93	121.50	1.68
2	B1 + L1 + MH1 + BL2 + LT2 + Body set 1 + Final 1	4.00	4.29	4.29	74	363	384	44.07	0.88	290.53	1.64
3	B2 + L1 + MH2 + BL2 + LT2 + Body set 2 + Final 2	4.00	4.29	4.43	60	333	314	41.32	0.92	515.90	1.61

Figure 4.22: The summarized values of each solution.

Solution 3 was the most suitable solution when we focused on quality, time and cost. The values are lower than those of the other solutions. In the environmental impact point of view, the water consumption, energy consumption and recyclability of solution 3 are not different than other solutions except the toxic emission. This solution releases lot of toxic (515.9 g), which got harmful effects on workers. It was decided to reject solution 3 due to the bad environment impact. Thus, solution 1 was proposed to be the suitable solution, although the manufacturing time (75 min.) was more than solution 2 but the toxic criterion (health of workers) was the only acceptable.

4.5 Conclusion of Chapter

This case study was carried out to illustrate the integrated design system proposed. This study was specific and original in the sense that it was applied at the different steps of the product design process onto a specific product of the industrial partner. This section is to draw the conclusions of the experiment in a practical point of view.

When running phase 1 (explore the customer's perception and the brand identity), it was difficult to the target customers to understand semantic words and to valuate them. It was a very innovative method for Thailand in interviewing Thai customers. The interviewers had to

take more time to explain the meaning of each word and how to fill up the data in the customer's form. Furthermore, some words ("compact" and "oversize") were so difficult to the customers' decision because this interview was run on the paper without the real bag.

Fashion products have limited lifetime: six months generally. Designers have to launch new products every six months. After the initial study, designers had to start again six months later to re-interview the customers. This phase takes two to three weeks.

The power of PCA mapping was very appreciated by designers. They were able to easily determine the design strategy and the direction of the brand concept. However, it clearly appears that tools based on PCA techniques needs high level technical skills as the company experts had to analyze and interpret the results. It is a critical problem because most of the designers are not so clever with statistical tools.

When running phase 2 (create the new product), the semantic words were used to create the new product. It was so interesting for designers and also difficult to understand in the same time because the semantic words were used to be the connector to link the brand personality and the product attributes. Thus, designers have to know and participate with the experts to understand the meaning of each word and the relationship among them before using them.

Tool 2 was very useful in allowing designers to create and test different solutions. The main challenge here is to really create new products suited customers' expectations when the tool that supports the methodology is existing knowledge-based, what means that new products are reconfigurations of already existing elements. The solution comes from the integration of the fashion trends. As professionals were experts in their jobs and knew very well fashion trends, they could create new products. From the case study (similarity), the designers modified the concept of the flower from the flower piece to the printing technique to follow the fashion trend at that time. Therefore, fashion trend is the main driver of innovation in this phase that is very well supported by Tool 2.

In phase 3 (select the manufacturing process), it was necessary to provide a lot of manufacturing data to support the selection of the manufacturing process. Extracting all data was a huge work but finally not so difficult because production engineers used to formalize

their data. Finally, this phase that seemed to be very automatic was not so automated and designers had to participate with the production engineers, experts or workers, who well knew the manufacturing processes to acquire alternatives.

We conclude that the design methodology is able to create new products that meet the customer's requirements, express the brand identity and make friendly with the environment. But it must be manipulated by "hybrid" designers that must simultaneously have expertise in science (PCA mapping) and in fashion (fashion trends).

Chapter 5

Conclusion and Perspectives

Chapter 5

Conclusion and Perspectives

5.1 Conclusion

The objectives of this study were to develop a design methodology to respond to the continuous changes of customers. Enterprises should face an increasing challenge in designing to respond to individualized products and services. It leads to re-organize company processes, and mainly the design and development process, and the tools and methods that support it. Thus, it is important to work closely with customers to make sure that the products will fulfill their needs and requirements.

The research objective was to develop the design methodology to help designers design new products that meet the customer's requirements, express their company identity and make friendly with the environment.

Two research questions were formulated from the above objective:

- How to explore the correspondence and the gap between the customer's perception and designer's intention?
- How to use the brand identity through the design and the manufacture of the new products?

In this study, the design methodology was developed. It leans on an emotional design approach that leans on the analysis of product semantics used to describe the characteristics of products. It aims to create new products meeting customer's requirements. This approach is integrated with brand identity and environmental concerns to design new products.

The main contribution of the research reported in this thesis is to prove the feasibility of implementing a design and manufacturing strategy in a traditional company while keeping and developing the business performance of both the company and the designers. For that, we may ask for the following contributions:

(1) The design methodology was dedicated to support the Thai leather goods industry. It is integration of the emotional design, brand identity and environmental impacts assessment in a unique methodology. Consequently, designers can create the new products to respond to continuous and various changes of customers, sustain competitiveness and consider environmental concerns.

(2) The customer-oriented matrix is the tool that was developed to support the exploration of the customer's perception of product visuals. It leans on the emotion design approach. This tool was used to explore the correspondence and the gap between the customer's perception and designer's intention.

(3) The design support matrix was created to provide designers with an understanding of how to move the product attributes to meet the customer's perception. Designers used the design support matrix to create new products that are based on the brand personality. Similarity and combination design principles were developed to support the design support matrix and create the new design solutions.

(4) The manufacturing matrix was developed to help designers decide to select a suitable manufacturing process that ensured to meet the customer's perceptions and related to the brand personality.

(5) The tools and methods supported the integrated design system were implemented and tested on an original case in a Thai company.

5.2 Perspectives

Let us explain the main limitations of the work to draw fully the main perspectives:

(1) We were very lucky to be supported by an industrial company and their professional knowledge. It really helped to work on real knowledge and practices. The PhD candidate worked one year during his PhD in the company to design products. But despite all that, we may not conclude about the real utilization of the methodology by designers and engineers in company. The methodology and the tools developed are reliable because they were tested on the real situation. But if it is easily used by the developer of the method, which is a professional of the domain design task, it has not been used by other person in the company.

(2) This study did not focus on the deviation of the information that got from an interview of the customers. We interviewed the sample people who had the same profile as the target customers. We assumed that the information from the interview customers had more reliability. The tool developed should be made more robust with techniques based on the reliability of the information.

(3) Designers have to analyze the data from the design support matrix and the manufacturing matrix manually to create the new product and select the manufacturing process. It is difficult in the future if we have to analyze the huge of data. Thus, it should have tools or methods to help designers analyze them.

(4) Fashion trend is important for all fashion products. It is not included in this study because we do not have known exactly about how to extract the fashion trend. Thus, this study only follows the fashion trend from the fashion experts.

From this state, the research work should be further extended to:

(1) Improving the implementation. The reliability of the information received from the customers can directly affect the design of new products. We cannot design the new products without reliable information. Thus, the design process needs to base on the information that

has more reliability and precise. It should be coupled statistical techniques that could prove the reliability of the information.

(2) Improving the fundamental. The customer-oriented matrix, the design support matrix and the manufacturing matrix are a key element of the methodology. Today, they are generated, filled in and analyzed by designers manually. It is very complicated to be exhaustive, or at least not too incomplete. To be able to support huge data in the future, it should have tools or methods to help designers for generating, filling and analyzing the data.

(3) Improving the system itself. Fashion trend will come from the external side that will be introduced in the design system. In this case, it means the trend of color, material and style of each season from the fashion experts. It should be coupled by statistical techniques that could analyze trend, forecast it and formalize it in a useful format.

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Résumé

Résumé

1. L’Introduction: l’Etat de problème et la question de recherche

Dans le marché actuel, les entreprises et les concepteurs font face à des défis de répondre aux exigences croissantes de la variété des consommateurs, à l'environnement des affaires de la concurrence intensive et aux préoccupations environnementales, les nouveaux produits seront donc difficilement conçus et fabriqués: ils doivent répondre aux besoins et aux exigences des consommateurs, ils doivent être différents des concurrents et être amicaux avec l'environnement. Un bon concept de design et une bonne qualité ne sont pas suffisants pour survivre dans un marché concurrentiel. Il est important qu'ils soient prêts à adapter leur entreprise à toutes les situations. Notre point focal dans cette thèse est la nouvelle façon de designer pour surmonter tous ces défis. L'objectif principal est de soutenir les entreprises et les concepteurs en leur fournissant les nouvelles méthodes et les nouveaux outils pour développer les nouveaux produits.

La mode est le style et la coutume qui prévaut à un moment donné. Il sert d’un reflet du statut social et économique, c’est une fonction qui explique la popularité de bon nombre de styles tout au long de l'histoire de la couture. La mode est plutôt liée à des communautés culturelles et à la pluralité des modes de vie et des comportements. Les maroquiniers est l'un des produits de mode. Il est l’accessoire le plus porté dans la vie quotidienne. Cela comprend les sacs pour dames ou pour hommes, les articles de poche (les portefeuilles, les étuis à cartes, etc), les articles de sport et de voyage (les valises, les étuis, les sacs à dos, etc), ainsi que les ceintures.

En Thaïlande, les maroquiniers fabriquent des produits pour la vente à la fois sur les marchés local et mondial. Selon certains consommateurs thaïlandais facilement acceptant toutes les nouvelles tendances extérieures, les fabricants Thaïlandais suivent toujours les tendances de l’occident et ne mettent jamais l'accent sur le mouvement socio-culturel de la clientèle domestique. Les concepteurs désignent toujours, de leur expérience, les nouveaux produits

pour le marché intérieur en copiant les produits déjà réussis. En conséquence, ils confrontent à d'autres problèmes tels que la qualité qui est inférieure à celle de la France et de l'Italie et l'image des produits qui n'est pas reconnue par les consommateurs en l'absence d'identité. Contrairement, le mouvement socio-culturel a un effet sur les consommateurs occidentaux, ayant l'influence sur la perception du consommateur, son mode de vie et sa mode. Ainsi, il est tellement difficile pour l'industrie de des articles en cuir en Thaïlande à réussir dans le marché mondial avec leurs propres produits, comme ils n'ont pas encore d'identité et des études socio-culturelles.

L'emotional design, l'identité de la marque et les impacts environnementaux sont des défis importants pour les maroquiniers thaïlandais, on pourrait dire que les pratiques actuelles de fabrication sont à la fois inefficace et inefficiente, et par conséquent elles ne parviennent pas à offrir un résultat optimal dans de nombreux aspects. Nous trouvent, aussi bien dans la littérature et dans notre expérience d'entreprises, les principales questions sont les suivantes:

- Les concepteurs ne peuvent pas obtenir des informations ou des exigences directement des consommateurs parce que le service de marketing se trouve entre les concepteurs et les consommateurs pour le marché domestique et en Europe pour le marché mondial. On manque de culture sur la perception des consommateurs et on a un grand besoin de méthodes pour améliorer la situation.
- Il n'existe pas de procédures systématiques pour guider les concepteurs de développer les solutions afin de répondre aux trois perspectives nouvelles (l'émotion, l'identité de la marque et l'environnement).

Pour réussir dans les deux marchés et de prendre l'avantage sur les concurrents, un fabricant a besoin d'adopter le design et la stratégie de fabrication pour faire face à une qualité supérieure, à l'expression de l'identité, à la satisfaction des besoins et des exigences des consommateurs, et au respect de l'environnement, en intégrant un emotional design, une identité de la marque et une évaluation d'impacts environnementaux dans le processus de conception. Ainsi, il est nécessaire de développer une méthodologie de conception qui soutien l'activité de conception afin de répondre aux besoins ou aux exigences des consommateurs modernes. Notre travail dans cette thèse est de développer un système basé sur la connaissance de l'entreprise qui aidera les mains d'œuvres qualifiés à répondre aux

problèmes du monde moderne en intégrant l'emotional design, l'identité de la marque et les impacts environnementaux pour créer le nouveau produit. La thèse a été consacrée à un secteur spécifique de la mode : le sac en cuir chez un fabricant de la Thaïlande.

L'objectif de recherche est de développer la méthodologie de conception pour aider les concepteurs à concevoir de nouveaux produits qui répondent aux exigences des consommateurs, à exprimer leur identité et à respecter l'environnement.

Deux questions de recherche sont formulées à partir de l'objectif ci-dessus:

- Comment étudier la correspondance et l'écart entre la perception du consommateur et de l'intention du concepteur?
- Comment utiliser l'identité de la marque par la conception et la fabrication de nouveaux produits?

Le travail a été réduit au secteur des produits de mode et appliqué au désigne et à la fabrication de sac en cuir dans une entreprise Thaïlandaise. La thèse a été développée dans le programme doctoral conjoint entre Grenoble-INP et du King Mongkut's University of Technology Nord Bangkok. Il a également associé avec l'ENSAM Paris pour leurs compétences en «l'analyse du consommateur dans les méthodes d'ingénierie» et a été développé en basant sur une étude de cas d'un fabricant Thaïlandais.

2. La révision de la littérature et le domaine d'application

2.1 L'emotional design

Selon les théories de recherche concernant l'aspect de l'émotion et du design qui sont abordés par Desmet et Norman [Desmet 1999] [Norman 2004], la relation entre l'émotion et le design peut être classé en trois perspectives: l'emotionalize design, l'emotional design et l'émotion design [Ho Siu et 2009]. Il se compose de trois éléments clés: les concepteurs, les résultats de la conception et les utilisateurs, illustrés dans la Figure 1. Si nous regardons dans l'ensemble du processus de flux de l'émotion, c'est-à-dire des concepteurs qui s'injectent leur émotion (s) dans le résultat de la conception (Emotionalize Design) pour que les utilisateurs soient motivés pour certaines réponses émotionnelles dues à la consommation du produit de la

conception (Emotional Design). Il y a des interactions entre les concepteurs et les utilisateurs à travers le produit de la conception, établissant ainsi une relation forte entre les trois éléments. Cela devient également le motif pour l'emotion design.

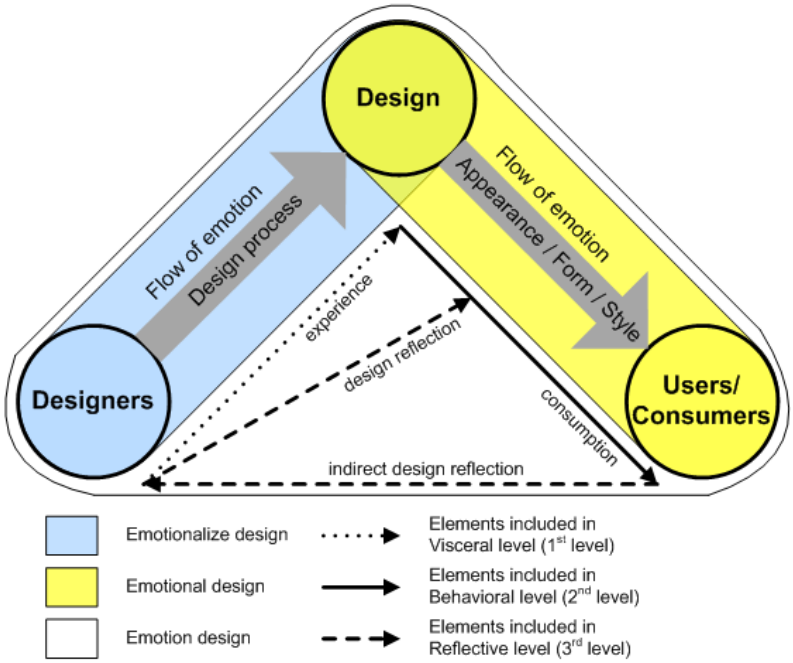

Figure 1: Le modèle d'émotion design (après Ho et Siu 2009).

Au premier niveau de l'emotion design, le cerveau des consommateurs a reçu les signaux de leur première impression sur les résultats de la conception (qui résultent d'une expérience de la conception des concepteurs) et de donner intuitivement des réponses émotionnelles.

Au deuxième niveau de l'emotion design, l'expérience de conception et les actions des consommateurs ont eu lieu à la fois chez les concepteurs et les utilisateurs. Les concepteurs injectent leurs émotions dans le processus de conception pour le résultat de la conception, tandis que les utilisateurs consomment la conception basée sur l'émotion soulevée par les résultats de la conception.

Au troisième niveau de l'emotion design, le niveau de réflexion, les gens réfléchissent sur leurs expériences ou essayent de préjuger au niveau de comportement. Ainsi, de l'application quotidienne, les concepteurs obtiennent des feedbacks et des réflexions indirectes par les

utilisateurs. Cela pourrait fournir des indications pour l'évolution future de leur conception. Les deux réflexions (directes et indirectes) pourraient également être trouvées à ce troisième niveau.

Ainsi, l'emotion design est la conception de produits qui vise pour répondre aux besoins ou des exigences des consommateurs. En contrôlant certains facteurs de conception, l'émotion du consommateur peut être évaluée, conçue, et satisfaites [Choi et juin 2007]. L'emotion design est un domaine de recherche commun impliquant à la fois aux concepteurs et aux facteurs humains. Il est axé sur l'évaluation et la phase de décision dans le processus de conception. En pratique, l'emotion design est réalisé par un questionnaire pour qu'un produit ou un concept nouveau soit évalué par les consommateurs.

2.2 L'identité de la marque

Une marque n'est pas le nom d'un produit. C'est la vision qui anime la création des produits et des services attachés à ce nom ; l'idée-clé des marques et ses valeurs fondamentales sont appelées «l'identité» [Warell et al 2006]. On transfère l'identité au domaine de la conception de produit. D'une part, ils définissent l'identité comme un attribut d'une chose, qui est partagé avec une autre chose (i.e., la «similitude»); d'autre part, l'identité est regardée comme un attribut unique d'une chose (i.e., la «dissimilitude»). L'identité s'exprime les caractéristiques tangibles et intangibles de la marque et s'appuie sur des racines et du patrimoine de la marque [Kapferer 2008]. L'identité de la marque implique des attributs clés d'identité de l'entreprise en forme «condensée». On exprime les valeurs de la marque avec leur forme. Le but de l'identité de la marque est de préciser le sens de la marque, le but et l'image et à favoriser sa reconnaissance [Karjalainen 2003]. Comme déjà dit, «l'identité» est le conducteur principal et unique pour une entreprise de se différencier des concurrents.

2.3 L'évaluation des impacts sur l'environnement

La conception de produits durables, également connu sous le nom de «design for sustainability» (D4S), est une des façons mondialement reconnue, selon laquelle les entreprises travaillent pour améliorer l'efficacité, la qualité des produits et les opportunités des marchés tout en améliorant la performance environnementale. A propos du conception

pour la durabilité, les critères environnementaux et sociaux sont également intégrés dans le processus de développement des produits, et ainsi, minimisant les impacts du produit tout au long de son cycle de vie [PNUE et TUDelf 2009].

La conception pour l'approche du développement durable est fondée sur le cycle de vie d'un produit. Le cycle de vie du produit commence par l'extraction, la transformation et la fourniture des matières premières et l'énergie nécessaire pour le produit. Il s'adresse ensuite à la fabrication du produit, sa distribution, son utilisation et son élimination finale.

Le défi environnemental pour la conception durable est de concevoir des produits qui minimisent les impacts sur l'environnement pendant toute la durée du cycle de vie du produit. Ensuite, la conception durable est un concept qui aide les entreprises à réviser la façon de concevoir et de fabriquer les produits afin d'améliorer les profits et la compétitivité et de réduire les impacts sur l'environnement en même temps. Il y a plusieurs approches dans la littérature. Nous avons retenu seulement deux d'entre eux qui ont contribué à la formulation de notre méthodologie: les impacts environnementaux et l'évaluation du cycle de vie (LCA).

Réduire les impacts du produit sur l'environnement au minimum est l'une des préoccupations principales des nouveaux processus de développement des produits. La totalité du cycle de vie du produit doit être adressée. Les catégories principales d'impact pertinentes doivent être identifiées pour la maroquinerie et doivent être sélectionnés. Pratiquement, seuls les LCA sont assez solides et complètes peuvent fournir des données quantitatives et exploitables. Malheureusement, l'exécution de l'LCA prend beaucoup de temps et il requit beaucoup de données. La méthode de l'LCA a été utilisée pour qualifier des technologies respectueuses de l'environnement (une seule fois), puis un calcul simplifié devrait être réactif lors de la conception.

3. La proposition du système de la conception intégrée

3.1 L'idée de base: le principe du système de conception

Il est clair que maintenant l'activité la conception du produit doit être centrée autour des consommateurs. La connaissance des consommateurs doivent orienter le travail des concepteurs. On suppose que la connaissance des consommateurs, donnée par les services de marketing, aux concepteurs faisant la liste des exigences est un bon point de départ, mais que ce n'est pas suffisant pour assurer la pleine satisfaction des consommateurs après les décisions de conception sur la création de produits. L'idée est de renforcer le lien entre les concepteurs et les consommateurs en introduisant l'identité de la marque (l'image de la marque) comme un second connecteur. L'identité de la marque est un outil de marketing qui est surtout utilisé pour la communication entre les concepteurs et les consommateurs. Il est utilisé pour obtenir directement l'information et les exigences des consommateurs comme le montre la Figure 2. Ce rôle d'interface entre les concepteurs et les consommateurs est partagé par le marketing et l'identité de la marque. Il a été analysé et optimisé pendant plusieurs années. De nombreux outils et méthodes sont maintenant disponibles pour supporter cette interface.

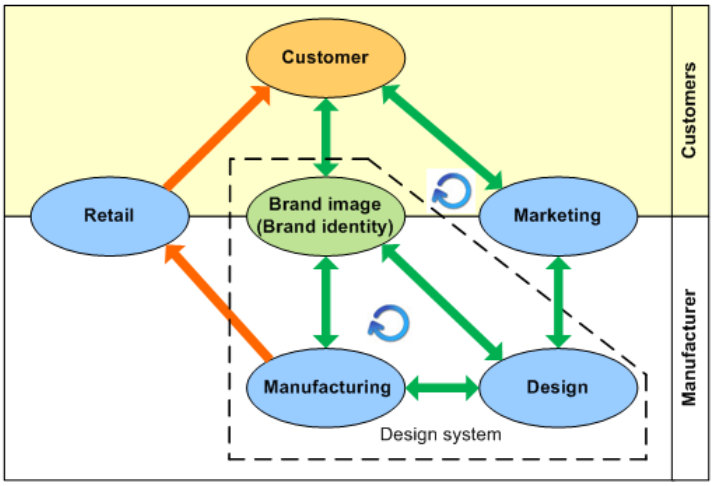

Figure 2: L'idée de base: le principe de système de conception.

L'introduction, l'identité de la marque matérialise 2 cycles importants: le cycle de satisfaction de la clientèle et le cycle d'ingénierie comme le monter la Figure 3.

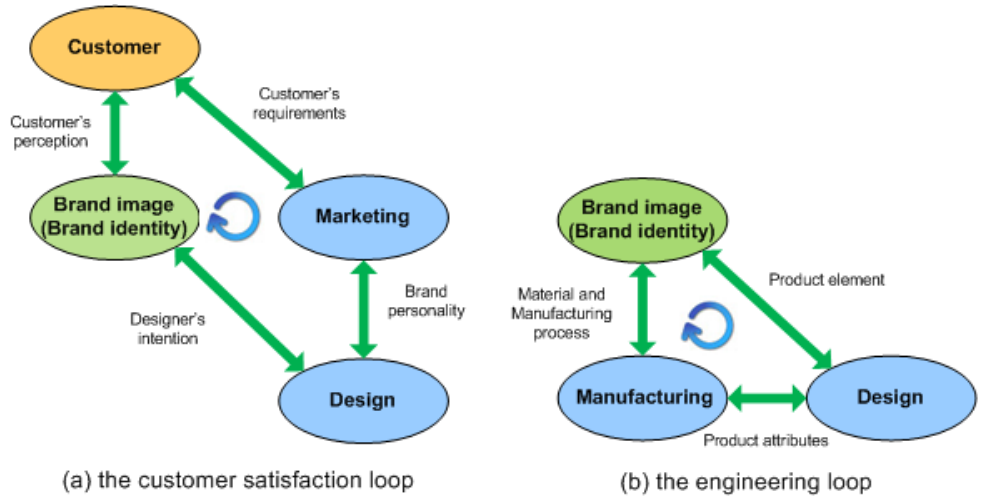

Figure 3: Les cycles du système de conception.

La Figure 3 (a) montre la relation des consommateurs, le marketing, le design et l'identité de la marque. Ce cycle vise optimiser le processus de satisfaction du consommateur. Les informations et les exigences des consommateurs, reçues de la recherche en matiere de marketing, sont transférées aux concepteurs pour créer de nouveaux produits. Les exigences du consommateur sont combinés avec la personnalité de la marque, les idées, les tendances de la mode et l'inspiration des concepteurs de créer de nouveaux produits. Lorsque de nouveaux produits (concept) sont conçus, ils sont évalués par les consommateurs afin d'explorer les perceptions du consommateur pour former un produit en forme visuelle. L'identité de la marque est utilisée pour explorer et vérifier les consommateurs. La perception des consommateurs sont comparés avec la personnalité de la marque afin d'explorer les correspondances et les écarts entre les intentions du concepteur et de la perception du consommateur. La perception du consommateur qui correspond à l'intention du concepteur est utilisée pour guider le concepteur dans le processus de conception. Après le concepteur a terminé la conception du nouveau produit, tous les coûts et les informations de l'impact sur l'environnemental sont transférées à la commercialisation pour prouver le nouveau produit. Le distributeur utilise les informations du nouveau produit pour la publicité. Il est clair que ce cycle de satisfaction du consommateur est bi-directionnelle et multi-directionnelle parce que le processus de conception est très lâche dans le cycle.

La Figure 3 (b) montre la relation de la conception, la fabrication et l'identité de la marque. Ce cycle est utilisé pour optimiser les processus d'ingénierie. Lorsque les concepteurs connaissent la correspondance entre l'intention du concepteur et la perception du consommateur, ils explorent les caractéristiques des produits qui expriment l'identité de la marque et qui sont liée à la personnalité de la marque. Ils peuvent être un élément de produit, un processus des matériaux ou de fabrication. Les attributs du produit seront guider la conception de nouveaux produits. Ainsi, l'identité de la marque est utilisée pour guider le concepteur pour optimiser le processus de conception et d'ingénierie.

3.2 La structure du système de conception

Le système de conception a été développé sur la base des principes de conception précités. Le système de conception est composé de trois éléments: la méthodologie de conception, la base de données et les outils d'aide à la méthodologie de conception comme le montre la Figure 4. La méthodologie de conception est l'essence même du système de conception. Il doit intégrer certains outils et base de données spécifiques pour soutenir la méthodologie de conception. Le système est conçu, initialisé et maintenu par l'ingénieur du système. Pendant le processus de conception, le système est utilisé par le concepteur pour créer le nouveau produit selon le besoin du consommateur. Ce principe nous conduit à définir la conception du système tel qu'elle sera présentée en détails dans les sections suivantes (la Figure 5).

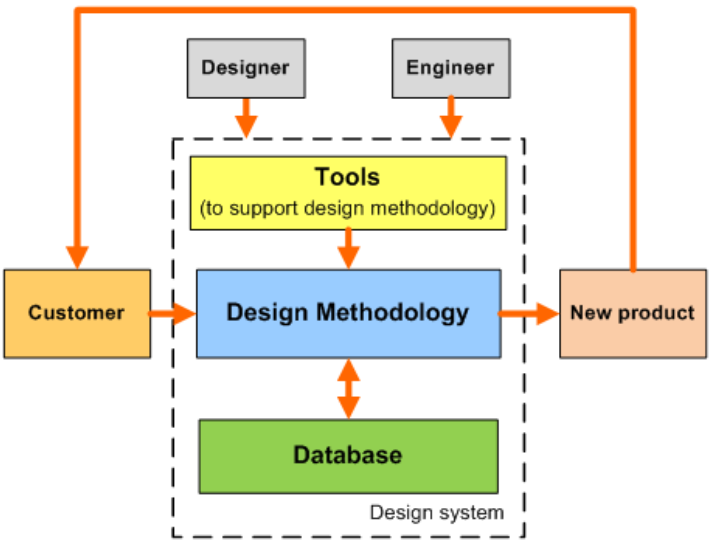

Figure 4: Le principe de système de conception.

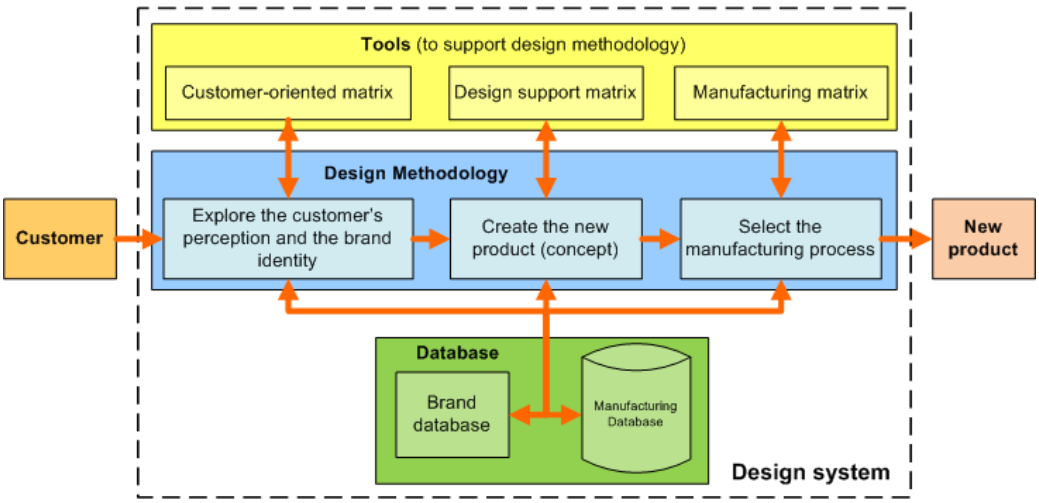

Figure 5: La structure du système de conception.

3.3 La Méthodologie de conception

La méthodologie de conception est l'essence même du système de conception. Il comporte 3 phases: explorer l'identité de la marque et la perception du consommateur, créer les nouveaux produits et sélectionner le processus de fabrication.

1. *Explorer la perception du consommateur et l'identité de la marque*: Cette phase est d'explorer la correspondance et l'écart entre l'intention du concepteur et de la perception du consommateur et d'explorer les éléments du produit qui expriment l'identité de la marque. La perception du consommateur qui correspond à l'intention du concepteur est analysée afin de découvrir l'identité de la marque comme le montre la Figure 6. L'identité de la marque vient des éléments de produit. Elle est utilisée pour concevoir un nouveau produit dans la phase suivante.

Le concepteur exprime la personnalité de la marque grâce à une apparence du produit. Ainsi, les produits sont utilisés comme une liaison entre les consommateurs et les concepteurs. Les consommateurs et les concepteurs utilisent la sémantique pour décrire les caractéristiques du produit. Les deux mots sémantiques peuvent être mis ensemble. La méthode et les outils qui ont été développés sont présentés dans la section «Outils». La perception du consommateur en forme de produits visuelle est comparée à la personnalité de la marque afin de déterminer la correspondance et l'écart. La correspondance est utilisée pour explorer les éléments du

produit qui expriment l'identité de la marque comme le montre la Figure 6, alors que l'écart est utilisé pour obtenir la modification de ce nouveau produit faisant face à la perception du consommateur.

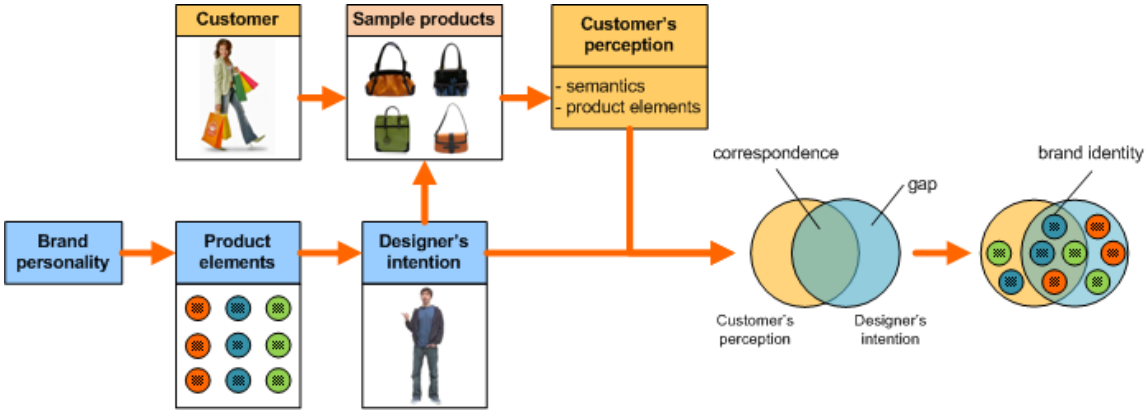

Figure 6: Explorer la perception du consommateur et l'identité de la marque.

2. *Créer un nouveau produit*: Cette phase est de créer un nouveau produit. Il vise à concevoir un nouveau produit (un nouveau concept) qui implique la personnalité de la marque et exprime l'identité de la marque. Les éléments du produit qui expriment l'identité de la marque sont utilisés pour concevoir un nouveau produit. Contrairement, les éléments du produit qui n'expriment pas l'identité de la marque et qui ne sont pas liés à la perception du consommateur sont supprimés ou modifiés afin de répondre aux attentes du consommateur. La matrice support de conception est créée pour guider le concepteur dans la création d'un nouveau produit. Cet outil est expliqué dans la section «Outils».

Dans cette phase se trouver deux principes directeurs: la similitude et la combinaison. Par similitude, nous disons que les produits existants, qui sont liés à l'identité de la marque, sont utilisés pour guider la création d'un nouveau produit. L'élément de produit, qui n'est pas lié à l'identité de la marque et qui a une valeur sémantique minimum, est enlevé pour être remplacé par un autre élément de produit dont les propriétés de l'«identité» sont meilleures. Cet élément du nouveau produit peut provenir d'autres produits ou être spécifiquement crées. Ce principe est appelé le "principe de similitude» comme le montre la Figure 7.

Le principe de combinaison est la conception des nouveaux produits à partir de la combinaison des éléments du produit. Les éléments de produits, qui définissent la personnalité de la marque et qui ont des valeurs maximales, sont combinés pour créer un nouveau produit. Ce principe est appelé le «principe de combinaison». comme le montre la Figure 7.

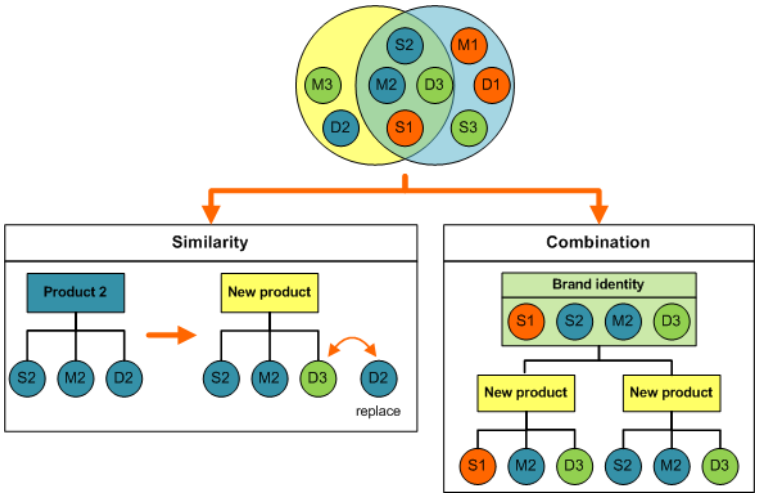

Figure 7: Principles de la similitude et de la combinaison.

3. *Sélectionnez le processus de fabrication*: Cette phase vise à explorer un processus de fabrication approprié qui se rapporte à la personnalité de la marque et qui exprime l'identité de la marque pour répondre aux exigences de conception. Le choix est guidé par les performances attendues sur la qualité, le temps, les coûts et les impacts sur l'environnement. Le principe de l'exploration du processus de fabrication est indique sur la Figure 8.

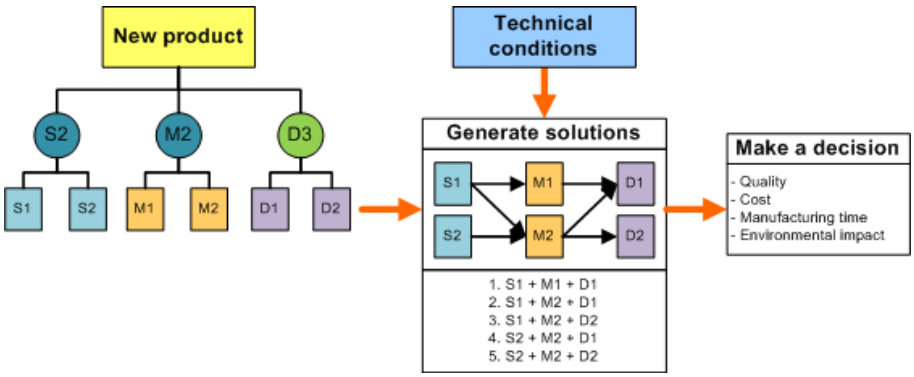

Figure 8: Le principe de l'exploration du processus de fabrication.

Du nouveau produit qui est créé dans la phase précédente de la méthodologie de conception, les éléments du produit sont extraits et chaque processus de fabrication sera étudié. Chaque élément de produit peut être fabriqué selon les différentes techniques. Les techniques sont variées et elles conduisent à des caractéristiques différentes qui répondent ou non à la personnalité de la marque. Les conditions techniques sont utilisées pour encadrer les limites de chaque technique et de réduire les conflits entre les techniques qui ont une conséquence sur les images et les valeurs des produits. Elles proviennent principalement de l'expérience des concepteurs experts et des ingénieurs et elle sont fondamentale pour le choix des processus de fabrication. Si les concepteurs et les ingénieurs choisissent les techniques inadaptées, les images et les valeurs du produit se varient. Comme dans tous les processus de conception, le choix du processus de fabrication et la conception du produit sont simultanés et il y a beaucoup de zigzags entre ces phases. Les étapes de fabrication sont matures et ont été étudiées afin d'officialiser à la fois le savoir-faire des travailleurs et les données scientifiques disponibles. Le processus de fabrication est une construction de la technique élémentaire et du processus de savoir-faire. Dans la plupart du temps, il conduit à sélectionner un processus connu et maîtrisé, mais il a parfois besoin de mettre au point une nouvelle technique ou une nouvelle organisation. Cette connaissance a été organisée pour rendre les informations utiles disponibles pour le concepteur. Le détail de cet outil «la matrice de fabrication» est expliqué dans la section «Outils». Le processus de sélection est un classique reposant sur trois étapes: l'identification du candidat technique, la génération de plusieurs processus de solutions, puis l'évaluation de chaque solution pour faire la sélection. A présent, nous avons défini quatre critères d'évaluation: la «qualité», le «temps», le «coût» et l'«impact sur l'environnement».

3.4 Base de données

La base de données peut être divisée en 2 sections: la base de données de la marque et la base de données de fabrication. La base de données de la marque soutient directement le processus de conception en raison des relations importantes entre la personnalité de la marque et les attributs du produit, et contribue à la création du produit. La base de données de fabrication est axée sur l'ingénierie et fournit l'information d'ingénierie utile dans le processus de conception. Toutes les deux bases de données sont reliées entre eux par les attributs du

produit. La sémantique est utilisée comme un connecteur pour relier la personnalité de la marque aux attributs du produit.

3.4.1 Marque base de données

La base de données de la marque est composée de deux éléments: la personnalité de la marque et la sémantique. La personnalité de la marque est créée à partir d'une caractéristique ou de la mode de vie des consommateurs. Elle est pour savoir quel type de personne le produit serait s'il était humain. Les valeurs instrumentales, qui ont été proposées par Rokeach en 1973 pour déterminer la personnalité de la marque, sont utilisées pour guider le concepteur de déterminer les caractéristiques du consommateur cible et la personnalité de la marque.

La sémantique est souvent utilisée dans le langage ordinaire pour signifier un problème de compréhension qui descend à la connotation du mot. Le mot sémantique a 2 rôles. Tout d'abord, il s'agit d'un connecteur pour relier la personnalité de la marque aux attributs de produit dans la méthodologie de conception. Deuxièmement, il s'agit d'un connecteur pour relier la personnalité de la marque aux attributs du produit. Les mots sémantiques qui sont utilisées dans cette étude ont été recueillis dans une enquête personnelle des magazines de mode et les sites de mode. Nous avons finalement proposé la liste des mots sémantiques, comme le montre la Figure 9.

List of the semantic words

Antique	Compact	Exotic	Modern	Simple
Authentic	Complicated	Fashionable	Musculine	Smart
Avant-garde	Contemporary	Feminine	Natural	Sportive
Basic	Delicated	Formal	Official	Stylish
Bright	Deluxe	Funtional	Original	Subtle
Casual	Dressed	Glamourous	Oversize	Traditinal
Chic	Dynamic	Grand	Precious	Trendy
Classic	Elegant	High-class	Luxurious	Unique
Comfortable	Elite	Innovative	Serene	Urban

Figure 9: La liste des mots sémantiques.

3.4.2 La base de données de la fabrication

Il se compose de trois éléments: les données sur les produits, les données matérielles et les données de processus de la fabrication. Les données sur les produits sont classées sur la base des éléments de la valise: la forme, la poignée, les accessoires et les détails, comme le montre la Figure 10.

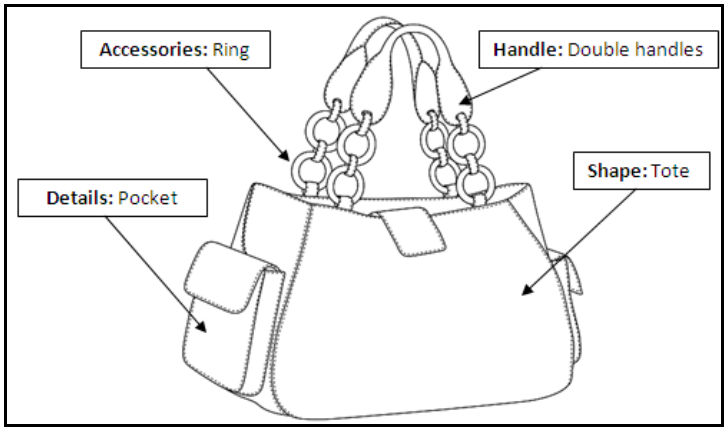

Figure 10: Les éléments de la sac.

Le matériel utilisé pour fabriquer un sac en cuir peut être classé en trois groupes: le matériel à l'extérieur, le matériel à l'intérieur et le matériel du support. Premièrement, le matériel à l'extérieur est un matériel principal de la sac qui contribue à son aspect visuel. Deuxièmement, le matériel à l'intérieur du sac, qui reste dans le sac, n'est pas en cuir. Il est appelé "doublure" (lining). Il est utilisé pour faire l'intérieur du sac et à cacher le matériel de support. Troisièmement, le matériel du support est significatif pour la sac, il ajoute des performances qui ne sont pas apportées par le matériel à l'extérieur et le matériel à l'intérieur. Ces propriétés sont mécaniques (la résistance, le poids et le droite) et comportementales (la douceur). Il est mis entre le matériel à l'extérieur et le matériel à l'intérieur.

Le processus de fabrication des sacs en cuir peuvent être classées en neuf étapes: le gabarit, la coupe, splitting, le pelage, le montage, le coloriage, la couture (machines à coudre), la

fixation d'accessoires et la finition. La séquence et le temps de fabrication de chaque élément de produit sont stockés dans la base de données de fabrication.

3.5 Le produit attribut

Les caractéristiques des produits sont les entités produit qui caractérise généralement le produit. Elles sont composées d'éléments de produits qui donnent le sens au produit et leurs associés, aux processus de fabrication et aux matériaux qui appartiennent à ces éléments. Ils sont le résultat du processus de conception. Les connexions des éléments du produit avec les processus de fabrication et de matériaux, et leurs conditions de fonctionnement sont également très spécialisées.

La question est de relier les propriétés d'ingénierie (les éléments de produits, les processus de fabrication et de matériaux) aux propriétés du consommateur et celles de la marque (les valeurs de la marque, les mots sémantiques), ce qui est, en fait, une vraie activité de conception qui assure la faisabilité. La Figure 11 est le mappage montrant la liaison entre la personnalité de la marque et les attributs de produit. Il relie les informations orientées vers le consommateur (la base de données de la marque) et les informations d'ingénierie (la base de données de fabrication). La personnalité de la marque est utilisée pour illustrer les caractéristiques de la clientèle ciblée. Elle est déterminée par les experts de la mode et les concepteurs de la mode. La personnalité de la marque peut être combinée de valeurs comportementales diverses. Chaque valeur est composée de plusieurs sémantiques. Chaque sémantique peut venir des éléments de produits différents. Chaque élément de produit peut être fabriqué à partir de différents matériaux ou processus de fabrication. Enfin, l'objectif de la conception est de créer le meilleur «arbre» de ces 4 éléments. En pratique, il est plutôt un réseau d'arbre qu'un arbre, parce que deux ces différents raisons peuvent conduire à la sélection d'un élément commun (il est vrai à chaque niveau: les 2 valeurs de la marque peuvent conduire au mot sémantique «confortable» commun; les deux mots sémantique peuvent conduire aux mêmes éléments de produit.

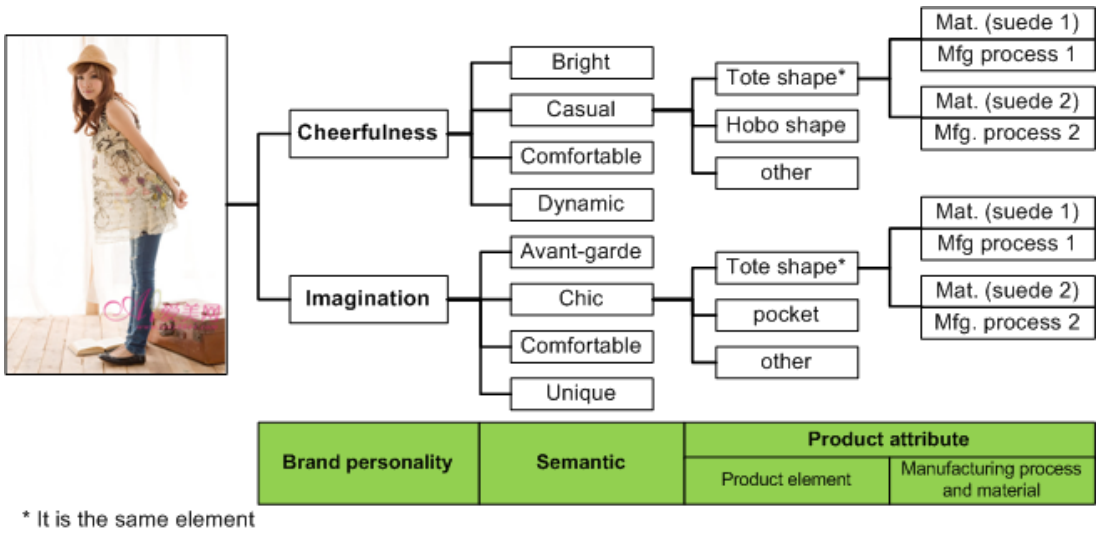

Figure 11: La relation entre la personnalité de la marque et les attributs du produit.

3.6 Les outils pour soutenir la méthodologie de conception

Outil 1: La matrice orientée client

L'objectif de l'outil 1 est de fournir aux concepteurs une compréhension fine des conceptions du consommateur. La matrice orientée client soutient l'exploration de la perception des produits visuels du consommateur. Elle a été créée pour aider les concepteurs à faire un entretien avec la clientèle ciblée. Elle est utilisée pour interpréter la perception de formes de produits visuels du consommateur. Elle mesure la sémantique et, à la fois, examine les liens entre la sémantique et les parts des attributs de produit. La structure de la matrice orientée client se compose de trois parties: la sémantique, les attributs de produit, et les relations entre la sémantique les attributs de produit, comme le montre la Figure 12.

La sémantique est utilisée pour décrire les caractéristiques du produit d'après le point de vue du consommateur. Dix paires des mots sémantiques opposés qui sont liés à la personnalité de la marque sont sélectionnés, par des experts de la mode et des concepteurs de la mode, de la liste des mots sémantique, comme le montre la Figure 9. L'utilisation de l'échelle d'évaluation est à 5 degrés de l'échelle de Likert (-2, -1, 0, 1, 2).

L'attribut du produit est l'élément de produits ; le matériel ou le processus de fabrication qui est lié à la personnalité de la marque et exprime l'identité du produit. Tous les attributs du produit de chaque sac en cuir sont extraits. Cette liste de cinq attributs de produits en cause est un dépendent du produit et est définie pour un sac de la marque. En conséquence, la liste des attributs de produit est différente pour chaque sac, même si certains attributs peuvent être communs.

La relation entre la sémantique et les attributs de produit sont des valeurs qui sont interprétées à partir de la perception de formes de produits visuels du consommateur. Elle sert à décrire les caractéristiques du produit. Les données qui sont remplis dans la matrice orientée client proviennent d'une interview de la clientèle ciblée. La méthode de remplissage des données dans la matrice est en 2 étapes. Tout d'abord, la clientèle ciblée sélectionne les mots sémantiques qui illustrent les caractéristiques de la valise en cuir et les score sur l'échelle de Likert. Puis, les consommateurs indiquent l'attribut principal de produit qui est relevant des mots sémantiques selon leur propre point de vue. Chaque mot sémantique doit correspondre à un seul attribut de produit.

Product	Semantic						Product attribute				
							tote shape	contrast color	patch piece	pocket	printing
		-2	-1	0	1	2	S17-1	D6-1	D10-1	D4-1	D7-1
	Basic		x				Luxurious	x				
	Chic		x				Comfortable					x
	Musculine					x	Feminine			x		
	Classic					x	Trendy			x		
	Elegant				x		Functional				x	
	Casual	x					Formal	x				
	Dynamic	x					Serene	x				
	Traditinal					x	Original					x
Bag No. 5	Compact				x		Oversize	x				
	Simple				x		Complicated					x

Figure 12: La matrice orientée client (le fiche du consommateur)

Pour soutenir la conception en connaissant bien la perception des consommateurs, toutes les formes sont regroupées pour donner un aperçu général pour les concepteurs. Cette agrégation est en 2 phases. Tout d'abord, les valeurs sémantiques moyennes d'un produit visuel, aux côtés de l'éventail des réponses, sont calculées. Elle donne une vue générale de la perception des consommateurs pour chaque mot sémantique. Deuxièmement, le lien général entre la

sémantique et les attributs de produit est donné par le pourcentage des consommateurs ayant choisi cet attribut spécifique pour correspondre à la sémantique donnée.

L'Outil 2: La matrice support de conception

L'objectif de l'outil 2 est de fournir aux concepteurs une compréhension comment faire pour que les attributs de produit répondaient aux perceptions du consommateur. La matrice support de conception est d'aider le concepteur de créer un nouveau produit. Il met au point les mots sémantiques de la perception du consommateur et les attributs de produit à fabriquer. Il faut évaluer la relation entre les mots sémantiques et les attributs de produit. La matrice de soutien à la conception est composée de la sémantique, les attributs de produit et la relation entre la sémantique et les attributs de produit, comme le montre la Figure 13.

La sémantique qui est utilisée dans la matrice support de conception est la même que la sémantique utilisée dans la matrice orientée vers le consommateur, elle est un dépendante de la marque.

Les attributs de produit sont des dépendants de produit et ils doivent être agrégés pour couvrir tous les visuels: ils ont été arrangés dans les trois groupes définis antérieurement: l'élément du produit, le matériel et le processus de fabrication.

La relation entre la sémantique et les attributs de produit est la valeur sémantique moyenne de chaque attribut de produit. Il peut être positif, négatif ou nul. Un chiffre négatif (-) signifie qu'il est lié au mot sémantique à gauche. Au contraire, une valeur sémantique positive (+) signifie qu'il est lié au mot sémantique à droite. Un zéro (0) signifie qu'il n'est pas lié à aucun mot sémantique.

Semantic							Product Attribute										
							Product element								Material		Mfg. proces
	Values						Shape				Main handle		Handle tab	Pocket	Leather		Printing
	-2	-1	0	1	2		Hobo (S11)		Satchel (S14)	TOTE (S17)	No tab (MH1)	with tab (MH2)	ring tab (HT1)	(D4)	Cow full grain (M1)		(D7)
							S11-1	S11-2	S14-1	S17-2	MH1-1	MH2-1	HT1-1	D4-1	M1-1	M1-2	D7-1
Basic			0.25			Luxurious	0.56	0.75	1.34	0.24	0.51	0.78	0.79	-0.14	0.67	1.05	0.78
Chic		-0.76				Comfortable	-1.21	-0.67	-1.34	-1.09	0.34	-1.67	-1.34	0.25	-0.9	1.31	-1.11
Musculine			1.21			Feminine	1.45	1.56	1.35	1.45	1.2	1.56	1.18	0.23	0.56	0.93	1.59
Classic			0.55			Trendy	0.71	0.64	0.98	1.34	0.34	1.03	0.89	1.07	0.02	0.97	1.68
Elegant			0.05			Functional	0.79	0.14	-0.67	1.26	-1.05	-0.23	-0.22	1.88	0.06	-0.6	-0.14
Casual		-0.61				Formal	-0.45	-0.78	0.06	-0.98	0.87	-0.56	0.11	-0.78	0.36	-0.7	-1.08
Dynamic		-0.65				Serene	-1.34	-1.32	-0.45	-1.21	-0.67	0.05	-0.67	-1.24	0.45	-1.1	-1.24
Traditinal			0.22			Original	0.29	-0.07	1.45	0.97	0.23	0.12	0.38	0.12	0.23	0.79	0.12
Compact		-0.33				Oversize	-0.45	-0.27	-0.24	0.65	0	0	0	0.28	0	0	0
Simple			0.11			Complicated	0.21	0.07	-1.13	-1.07	-0.79	0.21	0.19	-1.33	0.14	0	0.78
						Bag No.	6	7	4	5	4	1,2,3	1,2,3	4,5	1,2,3	6,7	4,5

Figure 13: La matrice support de conception.

L'Outil 3: La matrice de fabrication

Pour aider les concepteurs à choisir un processus de fabrication approprié qui répondent à la perception des consommateurs, la matrice de fabrication a été créée. Il a pour but de rendre une décision sur les paramètres de la performance du processus tels que la qualité, le délai, les coûts et l'impact environnemental. La matrice de fabrication met au point les éléments du produit et les paramètres du processus (la qualité, le temps, les coûts et l'impact environnemental). Il faut évaluer la relation entre les processus de fabrication de chaque élément de produit et les paramètres du processus. La matrice de fabrication est composée du processus de fabrication de chaque élément de produit, les paramètres du processus et la relation entre le processus de fabrication de chaque élément du produit et les paramètres du processus. La figure 14 illustre la relation entre les éléments du produit et les paramètres du processus. Les éléments du produit sont composés de la partie individuelle et la partie assemblée.

				Process parameters									
				Quality			Time	Cost (Baht)		Environmental Impacts			
										Raw Mat.	Manufacturing		EOL
				Soft	Strong	Straight	(min.)	Material	Labor	water consumption (litre)	Energy consumption (kWh)	Toxic emission (g)	Recyclability
Product elements	Individual part	Body	B1	5	3	2	32	252	160	19.53	0.2	26.66	0
			B2	3	3	4	25	280	125	16.926	0.1375	167.5	0
		Corner	C1	3	5	4	11	21	55	1.5345	0.1025	13.33	0
			C2	3	4	5	8	25	40	1.209	0.0975	154.2	0
		Main handle	MH1	3	4	3	46	100	230	6.51	0.325	26.66	0.65
			MH2	3	4	3	38	110	190	5.673	0.285	167.5	0.55
		Handle Tab	HT1	3	4	5	12.5	180	63	1.116	0.1063	13.33	0.6
			HT2	4	4	5	9.5	162	48	0.8184	0.0938	97.85	0.55
		Lining	L1	4	3	4	27	45	135	4.8825	0.0255	13.33	0
			L2	3	5	5	22	45	110	4.2315	0.0225	13.33	0
		Flower	F1	4	4	3	13.5	25	68	0.465	0.1875	97.86	0.25
	Assembly	Body set (body + corner)	BS1	3	4	3	24	20	120	0	0.45	26.66	0.35
			BS2	3	4	3	21	30	105	0	0.385	83.01	0.4
		Handle Set (main handle + handle tab)	HS1	4	4	4	18	35	90	0	0.1875	13.33	0.4
			HS2	4	5	5	13	15	65	0	.0.1255	41.5	0
		Last Assembly	LA1	4	5	5	20	10	100	0	0.5625	26.66	0.65

Figure 14: La matrice de fabrication.

4. L'Illustration du système de conception intégrée: Une étude de cas du l' entreprise Champ Ace et les objectifs de conception du sac

4.1 L'étude de cas de l' entreprise Champ Ace et les objectifs de conception du sac

Champ Ace Co., Ltd est l'un des fabricants des sacs en cuir en Thaïlande qui fait face à ces problèmes. Champ Ace fabrique les produits sous des marques autorisé (Lacoste, Lancel, Le Coq Sportif, Speedo, Gant et Mizuno) et aussi ses propres marques (BSC et Sarini). Cette étude porte sur la marque BSC qui est une propre marque du fabricant. Le concept de la marque BSC est un sac en cuir chic et élégant pour la femme thaïlandaise. Les consommateurs visés sont à l'age d'entre 20-32 ans, et elles sont les femmes salarières avec un salaire autour de 15,000-30,000 Baht par mois. Elles sont représentives de la femme moderne de nouvelle génération qui vit dans la capitale. Elles sont toujours à la mode et ont la confiance en soi. Elles aiment participer aux fêtes et à la communauté sociale.

Les sacs en cuir de BSC sont créés en réponse à toutes les activités du consommateur visée. Ils peuvent être classés en trois gammes de production: le travail, la détente et les vacances, comme le montre la Figure 15. Tout d'abord, le "travail" est conçu pour être adapté au temps

de travail. La couleur du sac est monotone. L'identité du produit provient de la forme, la poignée et l'onglet de la poignée qui illustrent le caractèristique d'«élégant». Deuxièmement, le "relax" est conçu pour les activités après le travail (telles que la fête). La couleur du sac est en deux tons. L'identité du produit provient de la forme, de la matériel, des pièces patch, de l'impression, de la poignée et de l'onglet de la poignée qui illustre «la mode» et l'«élégant». Troisièmement, "les vacances" est conçu pour être adapté pour les vacances. Le sac est aux couleurs vives. L'identité du produit provient des accessoires, du matériel, des pièces patch, de l'impression et d'autres détails qui illustrent les « couleurs vives » et la «mode».

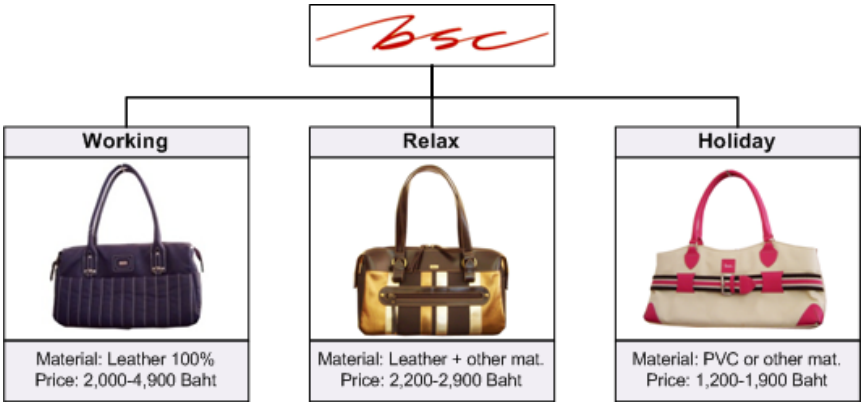

Figure 15: Les gammes de production de BSC.

4.2 L'Etape 1: Explorer la perception du consommateur et la 'identité de la marque

4.2.1 Les éléments de l'Etude de cas

Les sémantiques: les dix paires des mots sémantiques opposes sont choisis la liste de mots sémantiques par de experts de la mode et des concepteurs de mode. Elles sont liées à la personnalité de la marque. Elles sont «basique - de luxe», «chic - confort», «masculin – féminine», «classique – trendy», «élégant – fonctionnel», «informelle – formelle», «dynamique – sérène», «traditionnel – original», «compact – oversize», et «simple – compliqué».

Le consommateur visé: Cette étude porte sur les femmes thaïlandaises avec les objectifs définis dans la section 4.1.

L'exemple des sacs: Les sacs en cuir ont néanmoins une bonne réputation. Un ensemble de sacs a été choisi pour faire l'objet des interviews des consommateurs ciblés. Cet ensemble provient des collections et des gammes de production différentes, comme le montre la Figure 16.

Figure 16: L'échantillon des sacs en cuir de BSC.

Les attributs de produit: Tous les attributs de produit des sacs en cuir ont été extraits. Chaque sac de cuir a été défini par seulement cinq attributs de produit en cause qui illustrent l'identité du produit. La figure 17 montre la liste des attributs de produit utilisés dans cette étude de cas.

Figure 17: L'échantillon des attributs de produit.

4.2.2 Le Protocole d'interview

La matrice orientée client (la fiche consommateur), tel qu'illustré à la figure 18, a été créé pour s'entretenir avec le consommateur ciblé. Les cinquante-deux femmes interrogés ont des caractéristiques similaires aux consommateurs ciblés avec les objectifs définis dans la section 4.1.

Product	Semantic						Product attribute				
							Satchel shape	Main handle	Handle tab	Zip tab	Strap
		-2	-1	0	1	2	S14-1	MH2-3	HT1-2	D6-1	D12-1
	Basic										
	Chic										
	Musculine										
	Classic										
	Elegant										
	Casual										
	Dynamic										
	Traditinal										
Bag No. 9	Compact										
	Simple										
							Luxurious				
							Comfortable				
							Feminine				
							Trendy				
							Functional				
							Formal				
							Serene				
							Original				
							Oversize				
							Complicated				

Figure 18: La matrice orientée client (la fiche consommateur).

4.2.3 Les résultats: la stratégie de conception de produits

Les cinquante-deux formes conduisent à déterminer les valeurs sémantique moyennes de tous les 15 sacs (Figure 19). Le regroupement du produit a ensuite été effectué par une cartographie de PCA. Elle montre les produits qui agissent sur des mots sémantiques dans la même collection et des collections différentes (Figure 20).

Semantic			Product														
																
			No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	No.13	No.14	No.15
Basic	-	Luxurious	1.16	0.84	1.20	0.21	0.79	-0.52	-0.12	-0.28	0.32	0.16	0.07	0.43	1.36	-0.79	-0.50
Chic	-	Comfortable	-0.60	-0.44	-0.64	-0.86	-0.93	-0.16	-0.84	-0.52	-0.64	-0.32	-0.07	-0.14	-0.79	-0.50	0.29
Musculine	-	Feminine	1.80	1.80	1.88	1.71	1.29	1.76	1.84	1.56	1.64	1.72	1.79	1.71	1.36	1.00	1.14
Classic	-	Trendy	0.16	-0.16	0.28	-0.29	0.00	0.28	0.80	0.60	0.24	-0.08	-1.14	-0.79	-0.07	0.14	-0.21
Elegant	-	Functional	-0.48	-0.60	-0.57	-0.71	-0.86	0.80	0.08	-0.08	0.32	1.12	-0.76	-0.50	-0.05	1.00	1.21
Casual	-	Formal	0.96	0.80	0.92	0.14	0.86	-0.96	-1.00	-0.84	-0.36	-0.68	-0.14	-0.14	1.00	-0.50	-1.14
Dynamic	-	Serene	1.00	0.92	1.20	0.50	1.00	-0.64	-0.96	-0.60	-0.12	-0.56	-0.29	0.00	1.07	0.00	-0.57
Traditinal	-	Original	0.60	0.68	0.68	-0.43	-0.36	-0.20	0.00	-0.20	0.16	0.12	-0.07	-0.29	-0.86	-0.14	-0.07
Compact	-	Oversize	-0.32	-0.28	-0.48	-0.36	0.50	0.40	-0.68	-1.00	-0.04	0.36	-0.07	-0.93	0.07	0.36	-1.29
Simple	-	Complicated	-0.04	-0.04	0.00	0.07	0.07	-0.36	-0.48	-0.68	0.96	0.76	-1.21	-1.29	0.36	-1.21	-0.86

Figure 19: La matrice orientée client (les valeurs sémantiques pour tous les sacs).

La cartographie de PCA permet d'extraire les correspondances et les écarts entre les perceptions du consommateur et l'intention du concepteur. L'expert classe l'échantillon du sac en trois groupes.

«G1», ce premier groupe est lié à la personnalité de la marque: à la mode. Les mots sémantique qui sont près à la mode sont «trendy» et «chic». La forme de sacs illustre les caractères «occasionnel» et «dynamique». La couleur des sacs illustre la «trendy» et «chic».

«G2», ce deuxième groupe est lié à la personnalité de la marque: élégant. Il relève des caractères «élégant», «formelle» et «luxe» qui s'exprime par la forme des sacs.

«G3», ce groupe de sacs, accepté et acheté par les consommateurs, ne correspond pas à la personnalité de la marque. Il représente l'écart entre les perceptions du consommateurs et l'intention du concepteur. Il n'est pas lié à la personnalité de la marque parce que le style des

sacs illustre plutôt les caractères «classique» et «confortable» qui sont les mots sémantiques opposés de personnalité de la marque.

"G4", nous avons alors défini comme le groupe idéal de sacs BSC. Il s'agit d'une combinaison de «mode» et d'«élégant» que les concepteurs Champ Ace aurait obtenir. En fait, le sac n°13 est exclue dans le G4, car elle illustre la forte identité de style Hermès. Le sac de n°1, 2 et 3 sont exclus dans le G4, car ils illustrent plutôt le caractère «élégant». Le sac n°9 est, en revanche, inclus dans G4 parce que d'autres sacs dans le G1 ont plutôt le caractère "informelle" et "dynamique" qui sont exprimés de la ceinture et la forme du sac.

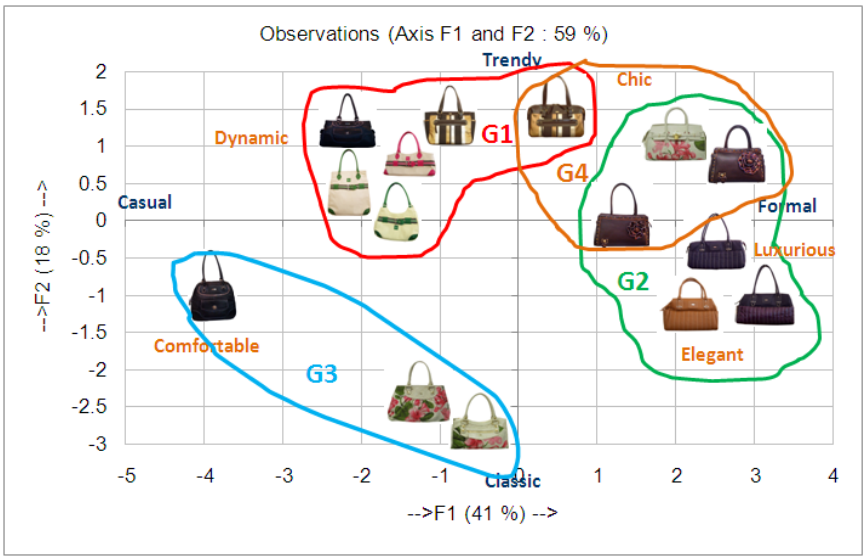

Figure 20: La matrice orientée client (La cartographie PCA des produits).

D'après la figure 20, qui illustre les correspondances entre les perceptions du consommateur et l'intention du concepteur, les experts de Champ Ace. En fait, seule la gamme de produits «Relax» s'adapte à la personnalité de la marque («élégante» et «à la mode»). Les deux autres gammes ne sont que partiellement adaptées: le «Travail» ne concerne que l'«élégant» et les «Vacances» ne concerne qu'«à la mode». Ainsi, la stratégie de conception doit être adaptée pour être pertinente à la personnalité de la marque. Les experts de Champ Ace ont décidé que la nouvelle stratégie de conception devaient être une combinaison entre l'«élégant» et «à la mode». Chaque gamme de production doit combiner l'«élégant» et «à la mode»: le niveau de chaque valeur (élégant, à la mode) dépend des caractéristiques de chaque gamme.

4.3 L'Étape 2: Créer le nouveau produit

4.3.1 Explorer l'identité de la marque

La matrice support de conception (Outil 2) a été créé pour la matrice orientée client de la Figure 19, comme le montre la Figure 21. Elle a été utilisée pour explorer l'identité de la marque et de créer le nouveau produit.

Semantic							Product Attribute																		
							Product element																		
							shape											Main handle				Handle tab		
							Double handle							Hobo	Satchel	Tote			no tab	with tab			ring tab		
	-2	-1	0	1	2		S6-1	S6-2	S6-3	S6-4	S6-5	S6-6	S6-7	S11-1	S14-1	S17-1	S17-2	S17-3	MH1-1	MH2-1	MH2-2	MH2-3	HT1-1	HT1-2	HT1-3
Basic		0.29				Luxurious	1.52	0.15	-0.06	0.2	1.56	-0.75	-0.44	-0.4	0.21	-0.13	-0.62	0.71	-0.5	0.78	-0.3	0	1.38	0	1
Chic		-0.48				Comfortable	0	-0.43	0	0.17	-0.67	0.5	1.33	0	0	0.5	0	0	0	-1.11	0	0	-0.33	-1.14	-1.5
Musculine					1.60	Feminine	1.88	2	1.91	2	1.13	1.67	1.57	1.69	1.81	1.4	1.9	1.87	1.5	0	1.43	1.62	0	0	2
Classic		-0.02				Trendy	0	-1.17	0	-0.67	0.25	0.5	-1	0	0	-1.67	0	0	0	0	0	0	0.31	-0.19	0
Elegant		-0.05				Functional	0.74	-0.14	0	-1	0	1.33	1	0.43	0.29	0	1.38	0	0	0	-0.8	0	-0.94	0	-0.75
Casual		-0.07				Formal	1.24	0.33	-1.43	-0.11	1.5	0.83	-1.11	0	-0.58	0.4	0	-0.67	0.38	0	0	-0.65	0	0	1
Dynamic		0.13				Serene	0	1.54	-0.93	0	2	0.33	-0.33	-1	-0.6	1.33	-1	-0.15	-0.43	1.2	-0.2	-0.77	0	-0.6	1
Traditinal		-0.02				Original	0	0.14	0	-1	-0.71	-0.11	0.57	0	0	-0.33	0.33	0	0	0	0	0	0.79	0.33	1.25
Compact		-0.25				Oversize	-0.39	-0.46	-0.67	-1.6	-0.25	0.86	-1.6	-1.2	-0.07	-0.13	0.53	0.29	0	0	0	-0.14	0	0	-1
Simple		-0.26				Complicated	0	-0.43	-0.29	-1	-0.33	-1.25	-1.25	-0.73	0.71	-1.7	-0.14	0	-1	0	0	0.85	0.13	1.14	0
						Bag No.	1,2,3	4,5	12	13	7	14	15	8	9	11	6	10	4,5	1,2,3	6,7	9,10	1,2,3	9,10	12

puis

Semantic							Product attribute																		
							Product element																Mat.	Mfg.	
							Detail															Accs.			
							Pocket		Zip tab		Corner part		Flower	Front part		Strap	Belt	logo tab	logo piece	Rivet		Printing	stitching	
	-2	-1	0	1	2		D5-1	D5-2	D6-1	D6-2	D8-1	D8-2	D10-1	D11-1	D11-2	D11-3	D12-1	D14-1	D15-1	D16-1	A18-1	D7-1	D13-1		
Basic		0.29				Luxurious	0.5	0	0	2	0	0	0.8	1	1.2	1	0.2	-0.67	0	1.5	-1	-0.2	0		
Chic		-0.48				Comfortable	0.82	-0.8	0	1	0.14	-2	-1	-1	-2	-0.5	-0.5	-0.61	0	-1.71	-0.5	-0.55	0		
Musculine					1.60	Feminine	-1	0	0	-1	0	0	2	1	2	0	0	0	0	0	0.43	1.68	0		
Classic		-0.02				Trendy	0.5	0	0	-2	0.43	1	-0.4	-0.5	1	-2	0.5	0.84	0	1	0.18	-0.94	0.48		
Elegant		-0.05				Functional	0.7	1.4	0.92	0	0.44	0	-0.8	-1.25	-0.83	1.33	0.86	0	0	-1.38	-0.6	-1.22	0		
Casual		-0.07				Formal	-1.38	-1	0	0.25	-0.88	0	0.67	0.17	0.8	-1.5	0	-1.58	1.1	0.83	0.86	0.3	0.83		
Dynamic		0.13				Serene	-0.13	-1	0	1	-0.85	0.75	0	-0.67	1.25	0.5	0	0	1.32	-1	0.17	-0.29	0		
Traditinal		-0.02				Original	0.5	0	0	-0.8	0	0.25	-0.67	-1	-0.71	-0.17	0	-0.12	1.1	-0.57	-0.33	0	0		
Compact		-0.25				Oversize	1	1	0	2	0	0.5	0.6	0	1.5	1	0	0	0	1	2	1	0		
Simple		-0.26				Complicated	0	-1.75	0	-1	-0.33	-1.67	0.77	2	1.5	-1	1.17	-0.81	0	0.45	0.83	-1	-0.32		
						Bag No.	14,15	14	9,10	12	6,7,8	14	4,5	11	13	14,15	9,10	6,7,8	1,2,3	4,5	4,5	11,12,13	1,2,3		

Figure 21: La matrice support de conception.

La Figure 22 montre la cartographie de PCA des attributs de produit. Elle exprime la variété des caractéristiques des produits. Les attributs de produit ont été regroupées en 6 groupes.

«F1», il est lié à «trendy» et «chic» qui se rapporte à la personnalité de la marque. Il vient de la poignée onglet, les rivets, la pièce patch et la pièce logo.

«F2», il est lié à «chic» et «élégant». L'attribut de produit qui illustre «élégant» est des accessoires en or. Il vient de les accessoires de la poignée onglet, les pièces logo, y compris les accessoires normaux (le rivet).

«F3», il est lié à «fonctionnel» qui vient de la poche, la forme et le zip.

«F4», il est lié à «dynamique» et «occasionnel» qui viennent de la forme et la ceinture du sac. Surtout, la ceinture exprime toujours "occasionnel".

«F5», il est lié à «classique» et «simple» qui viennent de la forme et la partie devant du sac.

«F6», ils sont attributs de produit qui illustrent la forte identité de style Hermès. Ils expriment «élégante» et «de luxe». Champ Ace ne veut pas utiliser le style Hermès pour sa prochaine collection.

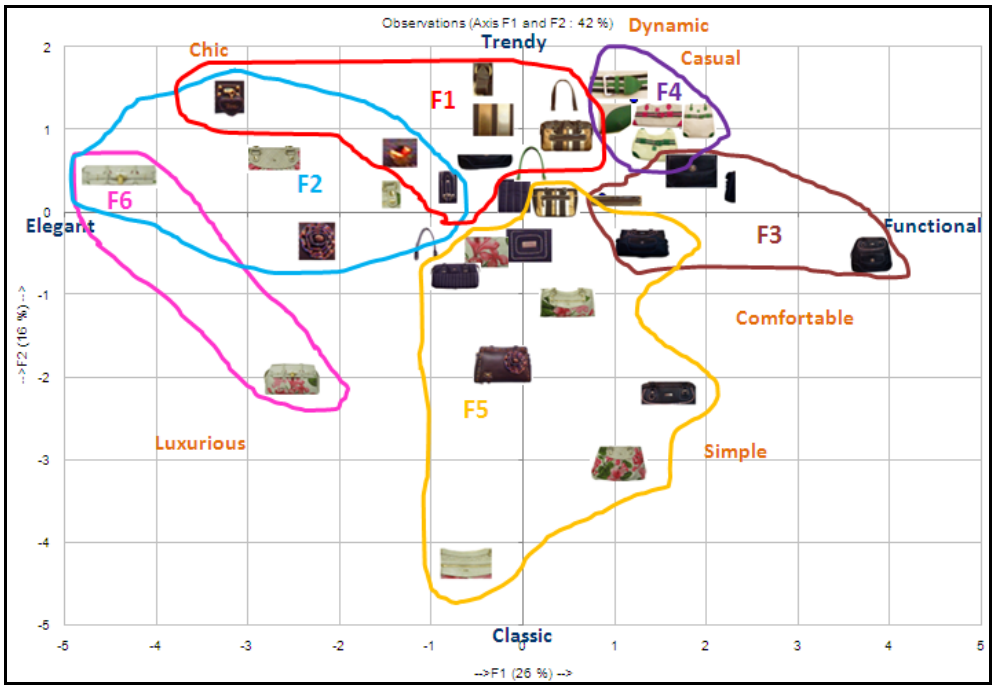

Figure 22: La matrice support de conception (la cartographie PCA des attributs de produit).

La Figure 22 souligne la diversité des attributs de produit. Les experts Champ Ace déduisent quatre lignes directrices pour la conception. Pour la première (F1), les concepteurs doivent choisir la forme de sacs plus liée «à la mode», que dans le passé. Pour la deuxième (F2), pour obtenir la valeur «élégante», les concepteurs devraient ajouter des accessoires en or. Pour la troisième (F3), «la mode», vient du détail de tous les attributs de produit qui sont différents des autres marques. Pour la quatrième (F4), les concepteurs doivent être prudents en utilisant les ceintures, car l'image et les valeurs du sac pourraient être affectés.

4.3.2 Concevoir le nouveau produit

Pour illustrer la méthodologie de la conception, nous présenterons deux conceptions différentes. La première est basée sur le principe de similarité, et la seconde sur le principe de combinaison.

La conception par similarité : A partir de la matrice orientée client (Figure 19), le produit qui est le plus lié à «élégant» et «à la mode» était le sac n°5. La valeur «élégant» est 0,86. La valeur «trendy» est 0. La valeur «chic» est 0,93. Ce sac était sélectionné pour guider la création d'un nouveau produit. Ce cas concerne la conception du sac «relax».

Les attributs du produit (S6-2, D10-1, D16-1 et A18-1) qui sont pertinents pour «élégant», «trendy» et «chic» ont été conservés (Figure 23). L'anse principale (MH1-1) n'a pas été liée à «élégant», «trendy» et «chic», elle a été retirée «trendy» et plus «chic».

Product	Semantic							Product attribute				
								Double handle shape	Main handle no tab	Flower	Logo piece	rivet
	-2	-1	0	1	2			S6-2	MH1-1	D10-1	D16-1	A18-1
	Basic			0.79			Luxurious	0.15	-0.5	0.8	1.5	-1
	Chic		-0.93				Comfortable	-0.43	0	-1	-1.71	-0.5
	Musculine				1.29		Feminine	2	1.5	2	0	0.43
	Classic			0			Trendy	-1.17	0	-0.4	1	0.18
	Elegant		-0.86				Functional	-0.14	0	-0.8	-1.38	-0.6
	Casual			0.86			Formal	0.33	0.38	0.67	0.83	0.86
	Dynamic			1			Serene	1.54	-0.43	0	-1	0.17
	Traditinal		-0.36				Original	0.14	0	-0.67	-0.57	-0.33
Bag No. 5	Compact			0.5			Oversize	-0.46	0	0.6	1	2
	Simple		-0.07				Complicated	-0.43	-1	0.77	0.45	0.83

Figure 23: La moyenne des valeurs sémantiques du sac n°5

La Figure 24 illustre les étapes de la conception utilisant le principe de similarité. Premièrement, la silhouette du sac (S6-2) est liée au caractère «chic» et «élégant» mais elle ne se rapporte pas au caractère «trendy». Initialement, nous nous focalisons uniquement sur la silhouette. Nous avons modifié la silhouette pour la rendre «trendy» en retirant le bout de la bordure du sac.

Deuxièmement, l'anse principale (MH1-1), qui n'était pas liée aux caractères «élégant», «trendy» et «chic», a été retirée and remplacée par une nouvelle. La nouvelle anse est liée aux caractères «trendy» et «chic». Elle a été créée pour constituer le nouveau style.

Troisièmement, conformément à la tendance de Printemps-été 2010 qui voyait l'arrivée d'accessoires supplémentaires, la plupart des concepteurs experts se sont portés sur la technique de d'impression [Style 2010]. La fleur (D10-1), le logo (D16-1) et le rivet (A18-1) ont été retirés et remplacés par la technique d'impression, même s'ils étaient de caractère «élégant», «trendy» et «chic». Le concept de la fleur a été transformé d'une pièce de la fleur aux fleurs imprimées comme présenté dans la Figure 26. Le logo de la marque a également utilisé la technique d'impression.

Quatrièmement, la ceinture, qui illustre les caractères «élégant» et «la mode» a été ajoutée au nouveau sac. La nouvelle ceinture a un nouveau style, qui a été créé par une technique de tissage avec les couleurs contrastées.

Cinquièmement, un nouveau matériel qui satisfait les caractères «élégant» et «la mode» a été ajouté. Le nouveau matériel fait référence au couleur de printemps-été 2010 [Trendselection 2009].

Figure 24: Les étapes de la conception utilisant le principe de similarité

La conception par combinaison : La matrice support de conception (Figure 21) a été utilisée pour explorer les attributs de produit qui avaient la valeur sémantique maximale et qui paraissaient pertinents pour représenter la personnalité de la marque. Les attributs sélectionnés étaient combinés pour concevoir le nouveau produit. La collection d'attributs présentés dans la Figure 25 permet d'illustrer le processus de combinaison.

Semantic	Product attribues											
	Shape		Main handle		Handle tab			Corner part (D8)	Flower (D10)	Front part (D11)	logo piece (D16)	Rivet (A18)
	Double handle shape (S6)		with tab (MH2)		Ring tab (HT1)							
												
	S6-2	S6-5	MH2-1	MH2-2	HT1-1	HT1-2	HT1-3	D8-2	D10-1	D11-1	D16-2	A18-2
Chic - Comfortable	-0.43	-0.67	-1.11	0	-0.33	-1.14	-1.5	-2	-1	-1	-1.71	-0.5
Classic - Trendy	-1.17	0.25	0	0	0.31	-0.19	0	1	-0.4	-0.5	1	0.18
Elegant - Functional	-0.14	0	0	-0.8	-0.94	0	-0.75	0	-0.8	-1.25	-1.38	-0.6

Figure 25: La moyenne des valeurs sémantiques des attributs du produit liés à la personnalité de la marque

Le nouveau sac à concevoir fait partie de la gamme de produit «Relax». S6-2, S6-5 et D11-1 et a été sélectionné pour être combinés ensemble. Conformément à la valeur «trendy» de S6-2, il a été intégré avec S6-5 pour créer la nouvelle silhouette qui illustrerait les caractères «élégant», «trendy» et «chic», comme montré Figure 26. La partie de front (D-11) a été modifiée pour répondre à la nouvelle silhouette du sac. La nouvelle fermeture, l'anse principale et le patchwork ont alors été choisis pour accroître les valeurs «trendy» et «chic» (Figure 27).

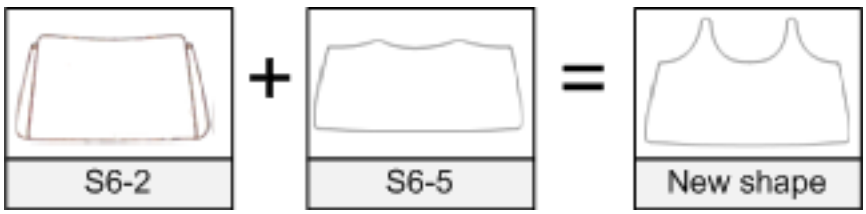

Figure 26: L'intégration des silhouettes S6-2 et S6-5.

Figure 27: Le nouveau sac conçu en utilisant le principe de combinaison.

4.4 L'Etape 3: Choisir le processus de fabrication

4.4.1 Extraire les éléments du produit

Le sac conçu par similarité (Figure 24) est utilisé dans cette étude de cas. Les éléments de produits du sac dans la Figure 24 ont été extraits (Figure 28), puis ils ont été classés en 2 groupes : la partie individuelle et la collection assemblée. Conformément à ce sac dans la gamme de produit «Relax», les techniques de pliage et de colorisation de la bordure ont été utilisées. Ainsi, chaque élément de produit peut être fait par les deux techniques.

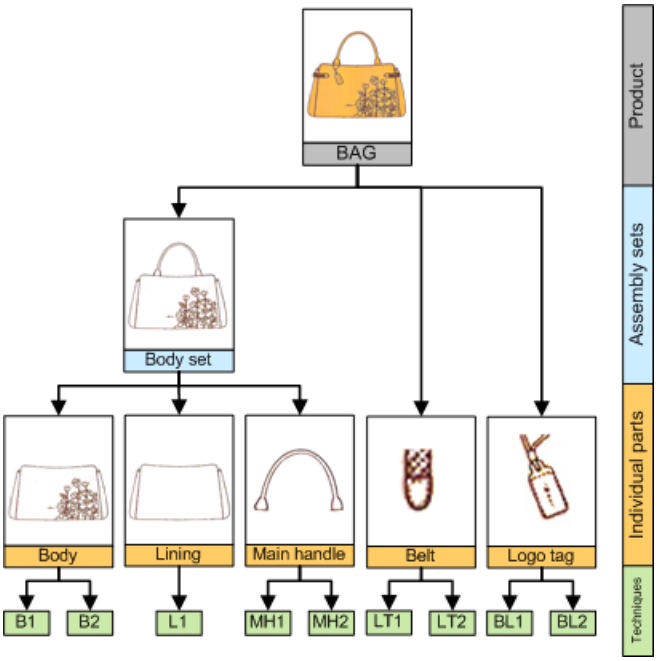

Figure 28: Les éléments du nouveau sac

4.4.2 Créer la matrice de fabrication

La matrice de fabrication est créée pour aider le concepteur à sélectionner le processus de fabrication approprié pour satisfaire la perception du consommateur. Il a ainsi tenté de prendre des décisions sur la performance des paramètres de performance du processus tels que la qualité, le temps, le coût et l'impact environnemental. La relation entre le processus de fabrication de chaque élément de produit et les paramètres du processus ont été résumés et structurés dans la Figure 29.

				Process parameters									
				Quality			Time (min)	Cost (Baht)		Environmental Impacts			
										Raw Mat.	Manufacturing		EOL
				Soft	Strong	Straight		Material	Labor	Water consumption (liter)	Energy Consumption (kWh)	Toxic emission (g)	Recyclability
Product elements	Individual part	Body	B1	4	5	4	30	270	150	25.11	0.4000	54.84	1.75
			B2	4	5	5	19	250	95	23.29	0.4625	139.35	1.5
		Lining	L1	4	5	4	6.3	47.5	31.5	14.73	0.0775	13.33	1.5
		Main handle	MH1	4	4	5	13	35	65	3.26	0.1250	13.33	1.5
			MH2	4	4	5	9	25	45	2.33	0.1000	97.85	1.5
		Belt	BL1	3	4	4	7	13	35	1.21	0.1000	13.33	1.75
			BL2	4	3	4	7	7.5	50	0.70	0.0750	97.85	1.75
		Logo tag	LT1	4	5	4	10	7	50	0.65	0.1542	13.33	1.75
			LT2	4	3	4	9	3	45	0.28	0.1292	97.85	1.5
	Assembly set	Body set 1	B1+L1+MH1	4	5	5	7		35		0.0625	13.33	1.5
		Body set 2	B2+L2+MH2	4	5	5	8		40		0.0625	69.68	1.5
		Final 1	Body set 2+BL1+LT1	4	5	4	1.5		7.5		0.0125		2
		Final 2	Body set 1+BL2+LT2	4	5	4	1.5		7.5		0.0125		2

Figure 29: La matrice de fabrication

4.3.2 Générer les solutions

Les éléments de produit (Figure 28), ont été combinés pour générer des solutions du processus de fabrication. Les parties individuelles ont été sélectionnées pour générer des solutions. Pour cette étude de cas, les parties individuelles génèrent 16 solutions initiales.

L'ensemble des solutions a été réduit en utilisant la technique des conditions encastrées dans la base de données de fabrication. Les conditions techniques de pliage et de peinture de la bordure sont utilisées pour réduire les solutions. La technique de pliage de la bordure consomme plus de temps lors de la fabrication parce qu'elle nécessite de plier la bordure avant la couture. Cette technique exprime les valeurs «officielle» et «formelle». La technique de peinture de la bordure est la technique la plus facile qui mène à des coûts plus bas. Cette

technique représente les valeurs «informelle» et «confortable». Ainsi, les deux techniques ne sont pas utilisées pour le même sac. La technique du pliage de bordure est utilisée avec B1, L1, MH1, BL1 et LT1, alors que la technique de peinture de la bordure est utilisée avec B2, MH2, BL2 and LT2. Conformément au concept relatif à la gamme de produit «Relax», la ceinture et l'étiquette de logo sont des éléments de décoration du sac. Ils peuvent être combinés avec la technique de pliage de la bordure. Les solutions sont finalement réduites de 16 à 3, comme indiqué dans la Figure 30.

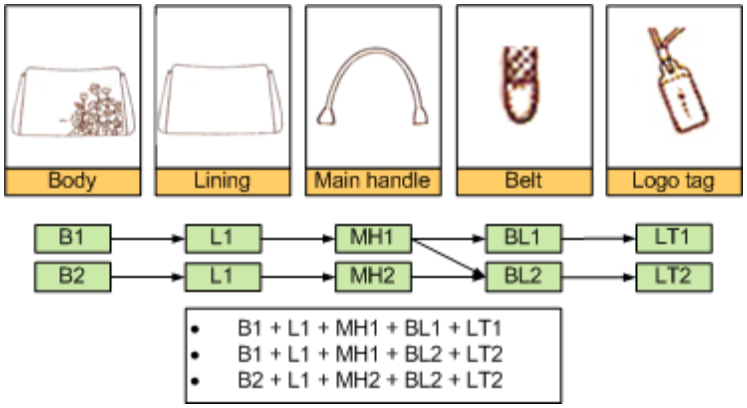

Figure 30: Les trois solutions finales

4.4.4 L'Evaluation des trios candidates et la sélection d'une solution finale.

Cette étape permet de sélectionner le processus de fabrication le plus adéquat. La décision dépend des paramètres du processus (la qualité, le temps, le coût et l'impact environnemental). Les données de la matrice de fabrication sont agrégées pour résumer les valeurs de chaque solution (Figure 31).

		Quality			Time (min)	Cost (Baht)		Environmental Impacts			
								Raw Mat.	Manufacturing		EOL
	Solution	Soft	Strong	Straight		Material	Labor	water consumption (litre)	Energy consumption (kWh)	Toxic emission (g)	Recyclability
1	B1 + L1 + MH1 + BL1 + LT1 + Body set 1 + Final 1	3.86	4.71	4.29	75	373	374	44.96	0.93	121.50	1.68
2	B1 + L1 + MH1 + BL2 + LT2 + Body set 1 + Final 1	4.00	4.29	4.29	74	363	384	44.07	0.88	290.53	1.64
3	B2 + L1 + MH2 + BL2 + LT2 + Body set 2 + Final 2	4.00	4.29	4.43	60	333	314	41.32	0.92	515.90	1.61

Figure 31: Les valeurs résumées de chaque solution

La solution 3 était la plus appropriée lorsqu'on se focalise sur la qualité, le temps et le coût. Les valeurs sont inférieures de celles des autres solutions. A propos de l'impact environnemental, la consommation d'eau, d'énergie et la recyclabilité de la solution 3 ne sont pas différents des autres solutions, à l'exception des émissions toxiques. La solution émet beaucoup de toxicité (519,9 g), ce qui engendre des effets nocifs sur les ouvriers. La solution 3 a ainsi été rejetée, en raison de son mauvais impact environnemental. C'est la solution 1 qui apparaît alors comme étant la plus appropriée, bien que le temps de fabrication (75 min) et le coût (747 Bahts) soient plus importants que la solution 2 ; mais c'est le critère de toxicité (la santé des ouvriers) qui est déterminant.

5. La Conclusion

Dans cette étude, la méthodologie de conception a été développée. Elle s'appuie sur une approche d' «emotional design» selon laquelle l'analyse de la sémantique de produit est utilisée pour décrire les caractéristiques des produits. Elle vise à répondre de nouvelles exigences des consommateurs. Cette approche est intégrée à l'identité de la marque et aux préoccupations environnementales pour la conception de nouveaux produits.

La contribution principale de la recherche présentée dans cette thèse est de démontrer la faisabilité de la mise en œuvre d'une stratégie de conception et de fabrication dans une entreprise traditionnelle tout en conservant et en développant la performance commerciale de l'entreprise et des concepteurs. Pour cela, nous pouvons nous demander les contributions suivantes:

- La méthodologie de conception a été consacrée à soutenir l'industrie des articles en cuir en Thaïlande. Elle est l'intégration de l'emotional design, de l'identité de la marque et de l'évaluation d'impacts environnementaux dans une méthodologie unique. Par conséquent, les concepteurs peuvent créer les nouveaux produits pour répondre aux changements continus et divers du consommateurs, pour soutenir la compétitivité et tenir compte des préoccupations environnementales.
- La matrice orientée client est l'outil qui a été développée pour soutenir l'exploration de la perception visuelle du produit du consommateur. Elle s'appuie sur l'approche de

l’«emotional design». Cet outil a été utilisé pour étudier la correspondance et l'écart entre la perception du consommateur et de l'intention du concepteur.

- La matrice support de conception a été créée pour fournir aux concepteurs une compréhension de la façon de déplacer les attributs du produit pour répondre à la perception du consommateur. Les concepteurs ont utilisé la matrice support de conception pour créer les nouveaux produits qui sont basés sur la personnalité de la marque. Les principes de conception de combinaison et de similarité ont été développés pour soutenir la matrice support de conception et de créer les solutions de conception nouvelles.
- La matrice de fabrication a été élaborée pour aider les concepteurs de décider à choisir un processus de fabrication approprié qui assurait la réponse aux perceptions du consommateur et liée à la personnalité de la marque.
- Les outils et les méthodes soutenant le système de conception intégré ont été mis en œuvre et testes sur un cas original d'une entreprise thaïlandaise.

A Methodology for the Integrated Design of Customer Goods

Résumé

Les nouveaux produits doivent relever le défi de répondre aux attentes changeantes des consommateurs, d'être différents pour chaque concurrent et aussi respecter l'environnement tout en générant du profit pour l'entreprise. Il conduit à réorganiser les processus de l'entreprise, surtout les processus de conception, de développement et les outils et méthodes pour répondre à cette demande. Ce projet de doctorat s'occupe d'élaborer une nouvelle méthodologie de conception intégrée à appliquer à un haut niveau stratégique à l'ensemble des industries de biens de consommation. Elle a été développée et appliquée à l'industrie d'articles de cuir en Thaïlande. La méthodologie de conception proposée s'appuie sur une approche de emotional design visant d'une part à mieux prendre en compte les attentes des clients et à les rendre actifs dans le processus de conception et d'autre part à représenter l'identité de la marque, ce qui est capital dans le processus de conception technique. Par conséquent, cette méthodologie englobe la satisfaction des clients, les bénéfices de la marque et l'optimisation des supports techniques. A la fin de cette étude, trois outils ont été mis au point : la matrice orientée client afin de prendre en compte les attentes des clients ; la matrice support de conception pour guider les concepteurs dans la création de nouveaux produits affichant l'identité de la marque ; la matrice de fabrication qui permet d'incorporer la fiabilité et les coûts de production. Les outils et les méthodes élaborés ont été mis en œuvre et testés sur un cas original d'un fabricant de produits en cuir Thaïlandais.

Mots-clés**:** méthodologie de conception, emotional design, l'identité de la marque

Abstract

Future products face dramatically challenges to meet continuously moving customers' requirements, differ from competitors and be friendly with the environment in a global sustainability where company profits are there as well. It leads to re-organize company processes, mainly the design and development process, and the tools and methods to respond to this demand. This PhD project deals with developing a new integrated design methodology to be applied on a high level and globalized consumer goods industry. It has been developed for and applied on the leather goods industry in Thailand. The proposed design methodology leans on an emotional design approach to understand customers and make them active in the design process on one hand and on the other hand on expressing the company identity as a main driver of the engineering design process. Consequently, the methodology integers customers' satisfaction, brand benefits and the optimized engineering supports. As a result of the study, three tools to support the methodology were developed: the customer-oriented matrix to be in phase with customers; the design support matrix to guide designers in creating brand identity oriented new products; the manufacturing matrix to embed reliability and costs. The tools and methods developed were implemented and tested on an original case in a Thai leather goods manufacturer.

Keywords: design methodology, emotional design, brand identity