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Strategy of textile design: Use of design methodology tools in the creative process

Sandra Helena da Silva de Santis
s.h.santis@hotmail.com
Universidade de Campinas. Rua Mendeleyev, 200, 13083-860, Cidade Universitária, Campinas, SP, Brasil
Universidade de São Paulo. Rua Arlindo Bettio, 1000, 03828-000, São Paulo, SP, Brasil

Franco Giuseppe Dedini
dedini@fem.unicamp.br
Universidade de Campinas. Rua Mendeleyev, 200, 13083-860, Cidade Universitária, Campinas, SP, Brasil

João Paulo Pereira Marcicano, Regina Aparecida Sanches, Maria Sílvia Barros de Held
marcican@usp.br, regina.sanches@usp.br, silviaheld@usp.br
Universidade de São Paulo. Rua Arlindo Bettio, 1000, 03828-000, São Paulo, SP, Brasil

Leandro Barros Fornazzari
leandrofornazzari@gmail.com
Universidade de Campinas. Rua Mendeleyev, 200, 13083-860, Cidade Universitária, Campinas, SP, Brasil

Victor Carlos de Santis
victorcarlosdesantis@gmail.com
Universidade Nove de Julho. Rua Guarnésia, 425, 02112-000, São Paulo, SP, Brasil

Abstract
This paper is based on the study of the application of the tools of design methodology in technological textile products also called smart fabrics. The application of the design methodology in the creative process took place in a textile factory by checking the contributions to the creativity, innovation, and quality. The purpose of studying the design practices in the use of resources and methods of the textile contributes to the development of the product and also meets the needs of customers. In this context, modifications were necessary to the development tools in the creative process that may cause the best use, reduction and cost containment improving the overall quality and meeting customers' needs. There is much talk about making products, refining and improving, but there is hardly any detailed application on how to carry it out, what parameters are used to such an achievement and what solutions are applied to the design process. The application in creative processes and product design follows parameters that are often provided by customers. The concepts that are linked to these product development processes, and the understanding of their purpose helps reveal the customers' needs.

Keywords: design methodology, creative process, textile design.

Introduction

The external business environment has a great influence on growth, profitability and performance, many important events such as wars, economic cycles and to the emergence of new technologies has caused differences in the expansion or even the closure of the enterprises (Hoskisson, 2009). It is also important to mention that the competitive advantages of the twenty-first century no longer follow the same parameters of the past where large-scale production and the use of large advertising dollars it generated a differential.

The business environment is dynamic, competitive strategies analyze the information of both influences and internal and external pressures. Thus, factors that could help get the innovation process over time can be a way to meet environmental needs. In this sense, the creative process gives answers the need for competitive advantage market appeal.

Several social, environmental and technological changes experienced in the last decade led demonstrations in the market. Concern about the environmental impacts caused by man is seen by the world. In this respect, companies are also concerned about possible environmental damage, search for to contribute to reducing this impact with proposals to improve the production processes.

In this context, it appears that the methodological issues that formed the basis for the search can be elucidated that the companies know promote properly use the concepts to enhance the process of creating.

However, it is worth researching the creative process that gives rise to the whole discussion. Based on market reality and aesthetic aspects, the present research is dedicated to examining the creative design process in the textile industry and its relations with the selection of colors in this creation.

The methodology used to unravel this question is in the literature through books, articles, and websites.

As the focus of analysis is elected the issues surrounding the use of design methodology in practice.

The objective of this study is present the application of the creative process based on the design methodology tools applied to the development of technological fabrics, considering the technical aspects, production tools to improve performance, dynamic, parameters and methods used to create the product.

Creative processes

The spread of human capital has led companies to encourage knowledge sharing, learning and planning strategies for organizational knowledge management. According to Kalkan *et al.* (2014), human capital appears the first time mentioned in 1969 by John Kenneth Galbraith, but the concept as we understand it today was reported by Tom Stewart, in 1991, when published in *Fortune* magazine article "The intellectual power: As the intellectual capital is becoming much more valuable Americas". The human creation is an attribute of intangible resources within the globalized economy Corporation's success depends on this type of resources than their physical assets.

However, in order to Increase the competitiveness of countries and companies, it is important to create conditions for people not to leave with their human capital and potential abroad, but they are motivated to remain in their country. Increasing performance and approaching to economic growth it is also important to draw attention to the effective use of macroeconomic and company production inputs, hence human capital. The human capital includes the natural ability, innate and acquired skills, knowledge, experience, talent, inventiveness. These characteristics are all components of the human capital. The essence of creation, Increasing the value and effectiveness of human capital, is spending money now but expected benefits will flow in future (Kucharþíkováa et al., 2014, p. 49).

Organizations use the human potential as an increase in productivity, competitiveness, and creativity.

The human knowledge, according to Hitt (2008), is a difficult intangible asset to be understood, measured, bought and imitated, for this reason, the company creates a dependent relationship and this, in turn, begin to understand that the more intangible is the resource more sustainable is your competitive advantage.

In this context, the human creative process has been one of the factors driving the growth and development of mankind (Figure 1).

The process of creating part of a series sponsored by thoughts, aspirations, and information problems through reasoning results in actions, reactions and decisions.

The history of human evolution has shown the various stages of the development process in line with human creativity, man evolves through various discoveries and inventions.

The man has his creative expressions through individual, social and psychological needs. The need consists of a motivating factor that drives to the pursuit of knowledge, problem-solving and satisfaction.

For Lobach (2001, p. 26), "the conduct of the human being is also driven by multiple and varied needs. The appearance of needs is not always logical, especially when other activities or processes have an occasional preference".

The need to satisfy demand, since the aspiration is the spontaneous desire to get something that comes from the idea or view. Aspiration is the desire to get something

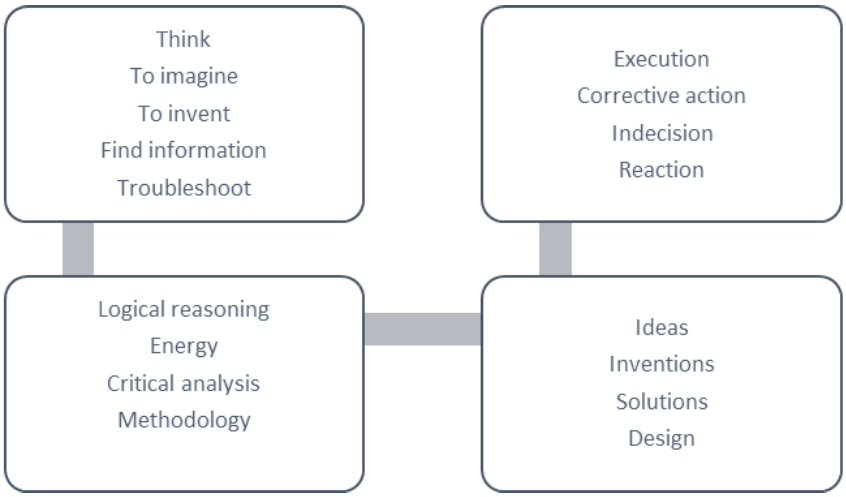

Figure 1. Structure of the creative process.
Source: Adapted from Dedini (2015).

that can be achieved or not. The needs and aspiration monitor the evolution of technology, information tools, and economic development.

Over the centuries, the needs in their evolution have been accompanied by the development of tools, methods, and systems. The constant evolution through research and events show that innovative creativity has played a key role.

In this sense, the methodology of the studies for the development of the creative process inserted a logical and rational thinking in human evolution.

The development of human creative process has also been marked by several frustrations, problems in the development of creativity and innovation, is a constant.

Several scholars and researchers have been affected by creative inertia, inability to expose the ideas, fears, lack of innovation or even problems that seemed insoluble.

Currently, it has been no different, diverse reasons hinder creativity, this has been discussed in various areas of study.

Due to technological advances and globalization, the market is increasingly demanding, encouraging the search for methods and techniques for the creative incentive, innovative and inventive. To meet this demand, arise methodologies, techniques, and tools that help to systematize the creative process of logical form.

According to Lobach (2001), the creative process begins with the research of customer needs and aspiration that turned into ideas turn into products or services.

Mete (2006, p. 281) discussed the ways to develop the creative process:

> *Although designers choose a marvelous source of inspiration, it gets nowhere if the designer cannot bring it to reality or interpret it appropriately. However, finding the right source of inspiration is not enough to be creative or not so often a matter of inventing something totally new. In order to increase designer's originality and creativity, designers can seek new ways of seeing old and familiar things, new ways of using old, familiar media to increase their pool of ideas.*

There are several kinds of creative processes in general, creative processes are developed for the generating idea. The goal is to increase the ideas and thoughts in order to get an answer.

Many problems can be solved using methodologies and techniques that stimulate the creative process.

Several studies have been conducted to define a better way to create a product, the ways and methods differ, but in general, all looking for a way to contribute to the improvement of the product.

According to Roy (2012), different methods of product concept testing aim to identify optimum product designs. Conjoint analysis, which was introduced later in comparison to other traditional concept testing methods, has outperformed other methods of product concept testing. This is because conjoint analysis not only chooses optimum designs but also determines utilities of the levels of the product attributes that form the product design.

The systematic construction of a creative process through techniques aims to solve or even stimulate creativity. Creativity consists of a result of thoughts, stimuli, problems, and information. This makes creativity result of a systematic process of thoughts, techniques, and tools. The systematic process by a technique can a set of actions directed to obtain a product or a design.

According to Mete (2006, p. 280, our translation), the design is divided into:

> *Project carried out by the man in goods and services is divided into two main categories: sensory and behavioral. The sensory project is perceived through the senses and is classified as visual, auditory, olfactory, tactile and gustatory. The behavioral project is planned action. Many products, however, include aspects of both, because the design can be perceived by the senses, and then interpreted behaviorally. A fashion show, for example, includes many sensory and behavioral projects.*

The creative process has to observe the customer need working both the sensory desires as the behavioral. According to Back (1983), the barriers of creativity occur in habits, reactions, prejudices, locks that reduce the creative potential, suffocating or reducing the ability of the individual to create. These barriers of creativity must be overcome to get the creative process, in this sense several techniques that stimulate can be used to eliminate the problem.

The process consists of a rational structure defined for analysis and creative problem solution, allowing you to explore ideas and increase in a number of ways the process. To encourage creativity, propose the use of research methodologies and techniques, consisting of the area strategies design used the methodology for product development, methods such as: Axiomatic Design, TRIZ, value Analysis, morphological and another framework, to the creative process.

The development of these methods is based on a common factor analysis of customer needs. The process for the development of these methodologies is intended to analyze the functions required to meet customer needs.

In this context, it appears that the methodological issues that underpin the creative process can be clarified if there are tools to promote the adequate use of concepts, that within their expectations, conflicts, and interests.

Textile products have evolved a lot with the new technologies, the research on the use of new materials and treatments. This requires new dimensions in creativity and product innovation. The techniques employed for innovation and creativity in the textile industry has modified the methodology and created new tools for troubleshooting. Several concepts, techniques, and methodologies have been applied in product development.

Although, innovation and creativity are present in products, processes that are developed yet they have many activities that are manual.

Design methodology

The last decades were scenarios of various global changes: globalization, technology, information were introductory channels for changes in the market and in organizations. In this context emerged methodologies, techniques, and tools that have transformed businesses in a complex and competitive space.

According to Cross (2006, p. 19, our translation), states that the design methods arise:

> *The movement emerged from a series of conferences: 1962 1965 design methods Conference the design method and 1968 Methods Design in architecture. These were seminal events for design research. The project was understood as a process and a systematic view of the project resulted from these discussions. The notion of design research emerged at that time. The collection of Bruce Archer tests emphasized design as an activity that is common to many disciplines. Systematic approaches to problem solving were developed, informed by computing technologies and management theory.*

The development of project management from the 60s has been marked by many changes, technological advances and management, with this change, which is the increasingly intense use of the techniques of management processes, features, design and features in organizations.

The design applied to industry and experimentation (prototype) appears as a practice related to design and architecture.

The design methodologies in the industrial area started to be seen as part of the process. For this reason, a study in a textile company contributes to suit the standards, practices, and tools which are used to maintain the quality of products and services.

Bouer and Carvalho (2005) state design methodologies have become important tools that add competitive advantage.

The design means a plan that uses a set of steps developed to developing creative solutions, each step provides the necessary information for the development of the design, along with techniques and tools.

Companies seek to expand its production following current concepts to become more competitive in the market. Necessarily, the techniques of production of goods and services prioritize ways to make the increasingly agile process and contributes to the use of limited resources, quality and performance of the company.

According to Back (1983), the term design consists of a plan, a scheme, a first idea, structured writing and graphics, to present a budget for something to run. Design in this sense is a creation that meets a need with a formalized structure to present a budget.

The design quickly developed without the enterprise market, most companies working with this methodology, which absorbs time and multivariate knowledge.

The design methodologies, according to Back (1983), seek to provide support for the development of the design.

The design unfolds in a sequence of stages, each uses up resources, tasks, and creative processes and are called: feasibility study, preliminary design, detailed design, review, testing, production design, market, consumption, maintenance and disposal (Figure 2).

According to Okabe (2003, p. 1):

> *Fundamentally the design of a new product follows a logic of events or stages, customarily Feasibility Study calls, Preliminary Design and Detailed Design, Production before the project itself. In these stages, a series of operations are performed to minimize redundant, repetitive or incomplete processes.*

The design methodology proposed by Back(1983), Ertas and Jones (1996), Pahl and Beitz (1996), Okabe (2003) and others claim that it is systematic applied comprising in tools, techniques, and models in the design of the exercise.

The design requires the integration of knowledge and process to develop properly a series of events triggered with a critical analysis of the needs and motivations.

Tools and design methodology techniques for creative processes

Machado and Heineck (2001) state that the administration assisted the development of production processes with new production philosophies. Several theories, tools, and techniques have been developed related to the management of production systems. But this development is more related to the industries of the automotive field and quality in the production system that has developed several tools.

The textile industry has a deficiency in studies in the process area, and it draws attention because it is considered an important area (Santis, 2013).

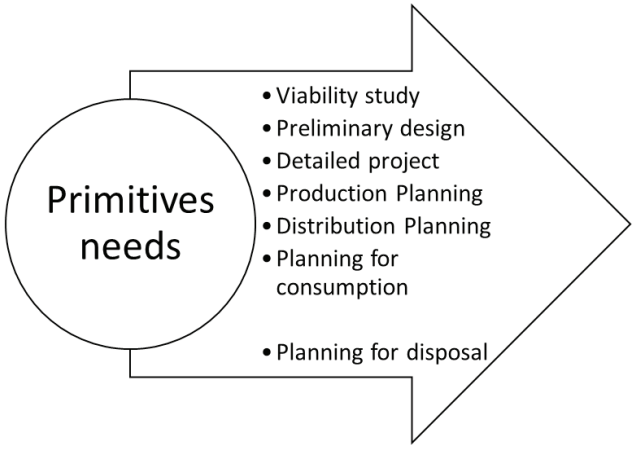

Figure 2. Design methodology.
Source: Adapted from Back (1983).

Vicentini says:

> *More and more industrial products have a higher complexity and sophistication, seeking to meet an extremely competitive market, which thus require companies a creative capacity increasing. Because of the need to address this increasing competitiveness and complexity comes the need for methodologies that help to systematize the product development process (Vicentini, 2010, p. 3).*

The industrial textile production which has a booming market and very competitive (market of fashion), this production needs of methods, tools and products compatible with the quality assured by the design, processes, internal and external organizational controls to affirm the continuity of production.

Competitiveness today takes new directions, to the company being investing in strategies that stimulate creativity. Creativity means creating a differential attraction for the consumer market. In this context, the design methodology applied in the creative process in product development brings an alternative to a new strategy.

The idea is to create a model able to encourage, stimulate and guide the creative process in product design. In order to make this process model or a support to increase creativity in the product design cycle. This model met methodological practices of design, creativity, and innovation resulting parameterization in product development.

Product design

The design or design in the current context is used in different ways in culture, ethnic, products, sustainability and others. The word design brings several possibilities, which recompenses its very broad sense.

According to Lobach (2001, p. 12):

> *The design is the economic use of aesthetic means in product development so that they attract the attention of potential buyers at the same time that optimizes the use of values of marketed products.*

According to Menezes and Paschoarelli (2009), knowledge understood in the design acquire new approaches that should cover the demand of contemporaneity.

The design involves communication, technology, materials, processes, and people. Paschoarelli and Menezes (2009) concentrate the term design as the corresponding action to seek, to search for something in its historical and etymological design.

The action consists of in the act of performing a procedure, a decision but is also a risk, uncertainty. Strategic thinking is a way to structure and define paths to follow, a way to organize an action. In strategic thinking analyzes the internal environment and the external environment (economic, governmental actions, etc.), it defined the objectives we want to achieve and elaborate the strategy, which shows a clear and objective view of where we are and where will we go.

Objective consists of an expected effect to be achieved within a given period of time. Strategic thinking is related to the changes, which usually involve large uncertainties, it happens when there is a need.

The decision means the choice of a stock, option among the available alternatives of action, depends on numerous factors and analysis and strategy established to limit the uncertainties.

> *Strategic thinking is an art of creating strategies effectively. Think strategically and act operationally mean dominate the present and win the future. Visa overcome opponents, knowing that they are trying to do the same thing that the organization or its managers proposed (Rezende, 2008, p. 2).*

The design in this view is the research for a new conception of creation is the action to seek an interface between the object and the subject identity through its fulfillment of the need or purpose.

According to Paschoarelli and Menezes (2009), the law of gestalt is an important factor in the design of the creative process to the end product.

The law of Gestalt applied to the design facilitates the understanding of customer needs turning it into the final product to your satisfaction. Gestalt enhances perception by understanding the object of the message meant.

This perception makes up the development of objects and their forms, style and cultural patterns that adequately remedy the existing customer need.

> *According to Gestalt, art merges the principle of pregnant fashion. That is, in forming images, equilibrium factors, clarity and visual harmony are for humans a necessity and therefore considered essential, it is a work of art, an industrial product, a printing part, a building, a carving or any other type of visual event [...] (Gomes, 2004, p. 17).*

The textile industry has a market with high competitiveness and a lot of pressure on product design area and creativity.

Textile-making companies seek to adapt to the international market and become more competitive presenting products that represent the expected performance. The need for international certification in order to provide quality assurance for products. Therefore, it is necessary to adapt the company to the international certifications that are important in the market.

The product design promotes the personification of ideas through the construction of the design which is manifested in a product for the industry, the creative process consists of a system to gather a set of ideas and information that results in a creation.

Material and methods

This research focuses on the study of design methodology in use in creative processes for product design, design methodology tools in functional management and the creation of a model application of the items mentioned in the design of a technological fabric.

In the study, the design methodology tools are used in product design to production in a textile industry, parameters, management and difficulties in developing the product.

This methodology should lead the work and development, the increase their knowledge of the subject and the development of research.

The work is characterized as an exploratory research through application of tools producing quantitative and qualitative research study which used method is modeling (study on site), interviews and tests. In addition, the use of data collected by secondary (books, articles, and manuals) that provided the theoretical and practical basis.

Results and discussion

The results presented were obtained in the feasibility study on the design. At this stage, it was used the creative model that idealizes the functions required by the clients to be provided by technological knitted fabric (Figure 3).

Technological mesh fabric needs features, functionality, and properties that satisfy customer needs. For this to happen, it is important to critically evaluate each feature. The criteria were organized by assigning note and each corresponding to a color:

- Note 5 - red corresponds to high priority;
- Note 3 - yellow to medium priority;
- Note 1 - green for low priority.

From the ideas and information contained in the mental model, we chose to analyze the correlation of the properties required for the sake of evaluating the criteria that should be prioritized in the creative process of the production of smart fabrics (Figure 4).

The group examined the properties of the fabric and the principles of TRIZ noted that some points should be prioritized for creating the design of a technological fabric, especially the need for alignment of the value of property's needs.

In Figure 5, we can see that only 10% of the correlations should be prioritized, the other correlations were considered a medium priority and low priority are practically representing only a difference of 6%, the average priority appears with 48% and low priority 42%.

Features ergonomics, physical properties, and mechanical properties are more important than the aesthetic aspects and trend because it is woven, as these features are important to made objects.

According to Dedini (2007), this method was developed by Fritz Zwicky consisting in decomposing the global problem into partial problems (or system parameters). Table 1 assists in creative development analyzing the problem through the deconstruction of the object and thus encouraged to creative thinking.

Another type of tool used for the creative process is the Fast diagram, which is used in the analysis value.

First is the identification of the components of technological fabric:

(i) Elastane yarn 50%,
(ii) Polyester yarn 50%,
(iii) Treatment for emitting infrared radiation.

The polyester mesh value is between R$ 19.00 to R$ 25.00 per kilo, but with the treatment increased the amount can range from R$ 68.24 to R$ 95.00. It was identified tissue functions and its composition, the price varies according to the chosen treatment.

Baxter says:

> *At a minimum, should establish a balance between the factors that add value to the product and those which cause increased costs. In the first group are, for example, the increase in function and quality improvement. Then, the choice of the most expensive components of the product and dilation design time. This commitment will be well set to result in a feasible product to compete in the market in constant change. Otherwise, the product may fail, and the resources invested in their development will be lost (Baxter, 2005, p. 3).*

The identify functions as desirable in a fabric technology have provided a review of the features to be obtained by this object. In detail, this function is used the Fast dia-

Figure 3. Mental model of knitted fabric.
Source: Santis (2016).

TRIZ principles / inventive factors	Ergonomics	Physical properties	Mechanical properties	Aesthetic and symbolic aspects	Tendencies	
3 Quality Location	5	5	5	3	1	19
5 Streamlining properties	5	5	5	3	1	19
27 Use and Disposal	5	5	3	3	1	17
4 Asymmetry	5	5	3	3	1	17
40 Use of composite materials	5	5	3	3	1	17
33 Thermal Stress	5	5	3	3	1	17
35 Chance physical or chemical state	5	5	3	3	1	17
1 Segmentation and fragmentation	5	3	3	3	1	15
9 Prior compensation	5	3	3	3	1	15
10 Prior Action	5	3	3	3	1	15
11 Prior Damping	3	3	3	3	1	13
12 Equipotentiality	3	3	3	3	1	13
13 Inversion	3	3	3	3	1	13
14 Esferoidicidade	3	3	3	3	1	13
15 Consolidation	3	3	3	3	1	13
16 partial or excessive action	3	3	3	3	1	13
17 Moving to a new dimension	3	3	3	3	1	13
18 Mechanical vibration	3	3	3	3	1	13
19 Periodic Action	3	3	3	3	1	13
20 Continuity of useful action	3	3	3	1	1	11
21 Acceleration	3	3	3	1	1	11
22 Loss transformation into profit	3	3	3	1	1	11
23 Feedback	3	3	3	1	1	11
24 Mediation	3	3	3	1	1	11
25 Self-service	3	3	3	1	1	11
26 Copy	3	3	3	1	1	11
37Thermal Expansion	3	3	1	1	1	9
28 Substitution mechanical means	3	3	1	1	1	9
29 Pneumatic or hydraulic construction	3	1	1	1	1	7
30 Use of thin films and flexible membranes	3	1	1	1	1	7
31 Use of porous materials	3	1	1	1	1	7
32 Color change	3	1	1	1	1	7
8 Balance	3	1	1	1	1	7
34 Disposal and regeneration	3	1	1	1	1	7
7 Nesting	3	1	1	1	1	7
36 Phase Change	3	1	1	1	1	7
6 Universal	3	1	1	1	1	7
38 Use strong oxidizers	3	1	1	1	1	7
39 Use of inert atmospheres	3	1	1	1	1	7
2 Extraction	3	1	1	1	1	7
	140	110	96	78	40	

Figure 4. Matrix priority.
Source: Santis (2016).

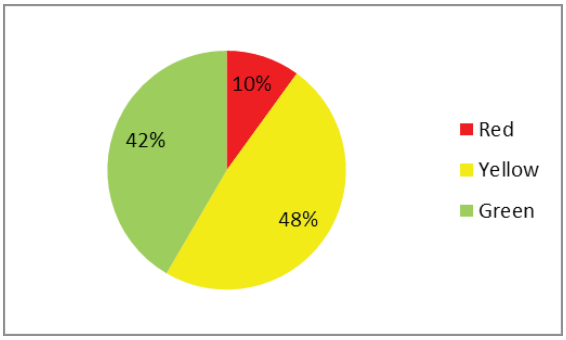

Figure 5. Priorities in percentage.
Source: Santis (2016).

Table 1. Identification of Functions.

Item	Material	Identified functions
Knit with elastane	Polyester and elastane	Coat To cover To model Control temperature Driving stimuli Aesthetics

gram, a figure that seeks to demonstrate the desired configuration on the object.

Figure 6 shows the Fast diagram and the technology fabric functionality.

The approach developed by Miles for determining the purpose of considering the action developed by the object. The analysis of the physical form and features fabric technology to encourage the creative thinking, the process of the definition of basic and secondary functions of the product to generate new applications and cost reduction possibilities. The analysis deals with the definition of the functions that are classified using methodologies and tools.

The implementation of the functions of the morphological requirements are made above and the following results were obtained.

Final considerations

The study was developed based on the concepts of the theory TRIZ (Theory of Inventive Resolution). It was verified that the proposed methodology was capable to incentive the creative process, and permitted the evaluation of the use of the design methodology and tools for the design of the technological fabric. In the study was obtained various alternatives working with the functions and requirements of the fabric, it was analyzed the functions through an array. It was possible to realize that was created options for the development of technological fabrics.

This strategy when used with the application of the correct tool facilitates the recognition of parameters related to technological fabrics.

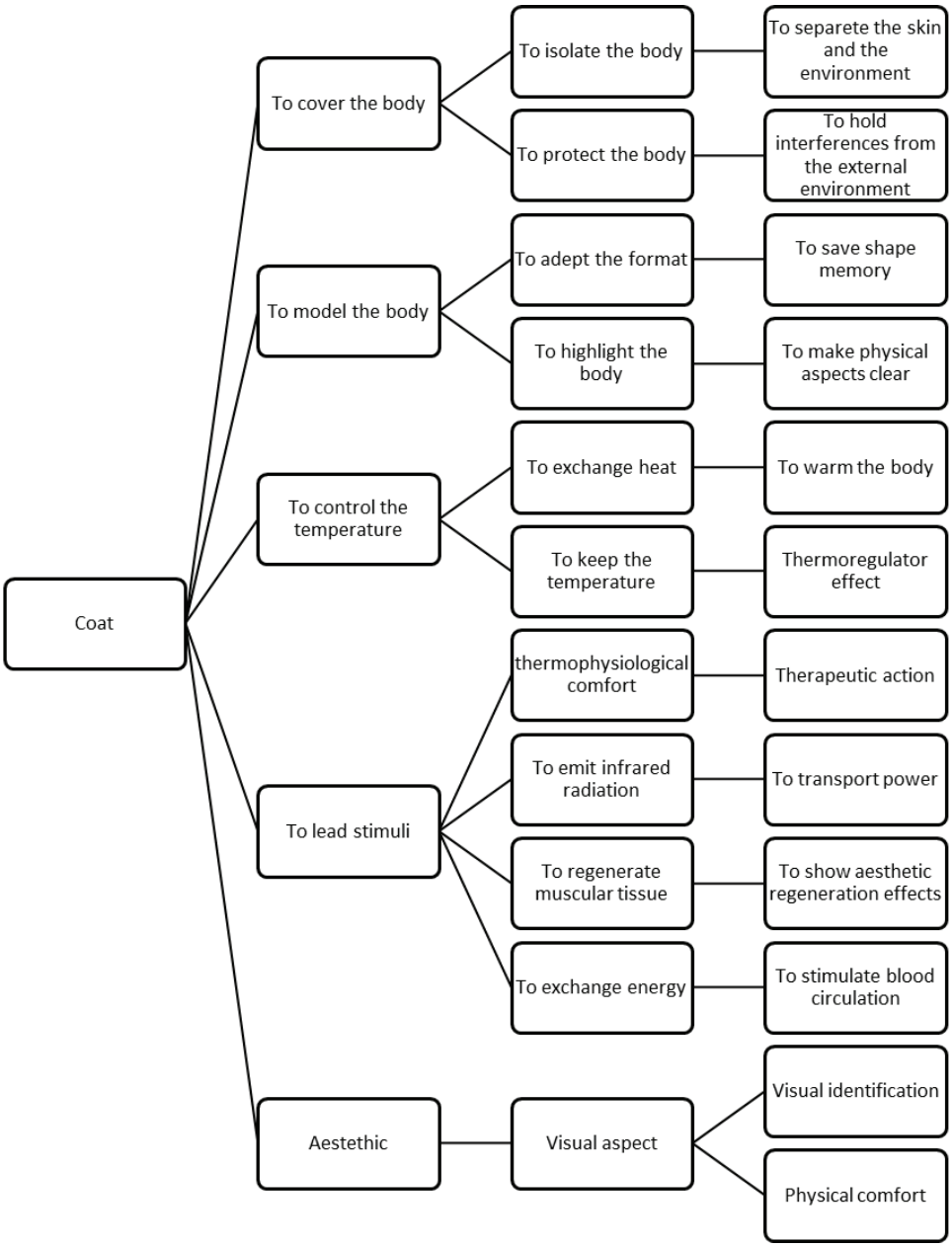

Figure 6. Fast diagram.
Source: Santis (2016).

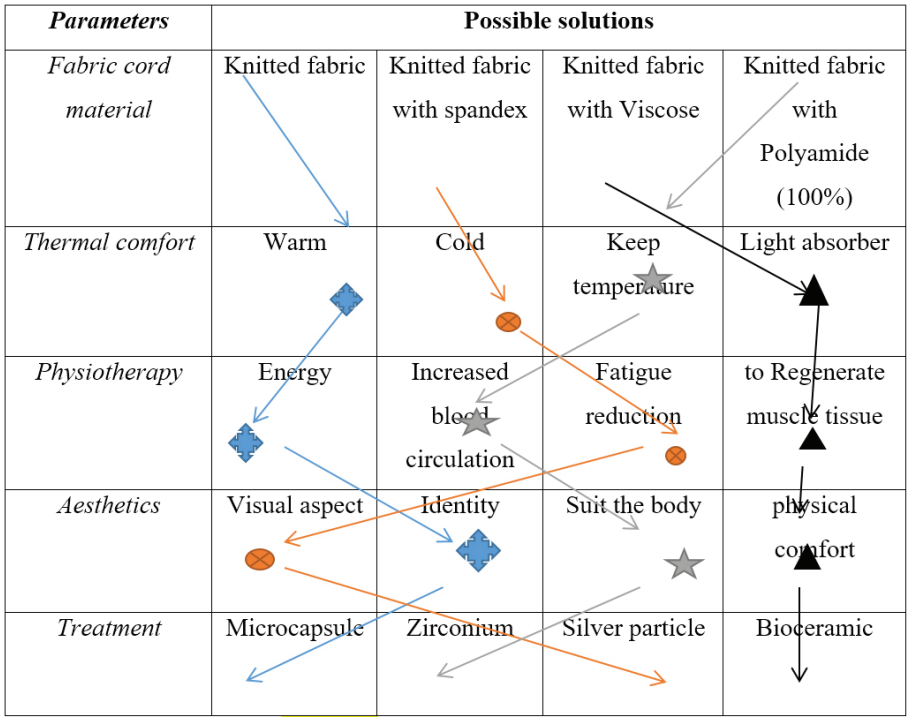

Figure 7. Morphological Framework.
Source: Santis (2016).

This practice promotes an assessment of the needs and aspirations of customers, including the product creation process, evaluation of resources, evaluation functionality, cost management, control and management of the operation. The application of the tools gives the necessary support to the construction of the product development process.

This work contributes to providing the solution for innovation and creativity, and also to problems of conflict between necessity and usability. The tools applied to the creation process must use the skills, research, and exploration of ideas by means of the methodology, thereby offering new alternatives to the process. Therefore, the use of these tools expands and diagrammatic the creative process working with creativity and innovation.

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