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AN IMPROVED CONSTRUCTIVIST KANSEI ENGINEERING METHODOLOGY

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ABSTRACT

This paper is excerpted from a project titled, "Designing and Implementing an Artificial Design Tool Based on Improved Kansei Engineering" which was prepared by the authors. The project ultimately led to a developed model for Kansei Engineering (KE). This paper explains the weak points of the conventional KE methodology encountering culturally unfamiliar complex objects and products; it also presents the improvements implemented on the method in order to overcome these notable insufficiencies. A set of various techniques, methods and tools reported to exemplify the objectives include: Genetic Algorithm, Analytic Hierarchy Process, Mood Boards, and Product Personality Profiling.

The developed model was later called, "The Constructivist Kansei Engineering," which proposes some modifications on a model based on Dahlgaard's work. It helps to intensify the expert designer's role (by applying AHP), meanwhile supports the importance of the inter-segmental familiarity, integrity, unity and structural aspects of the design as an object and a product. For the latter goal, a new term has been added to the KE terminology designated as the, "Theme of Design" (TD).This TD is defined by designers based upon their feedback and perceptions during the procedure of design. By extracting a TD through communicating with the target group and also respecting the main objectives of the project, not even the designers will be able to converge the whole groups' preconceptions, but also they will be able to go beyond the conventional KE functions and set up a desired context (the missing part in KE) for the near future.

Keywords: *Intelligent Design Tool, Constructivist Kansei Engineering Model, Theme of Design in Kansei Engineering, Culture-Center Design, and Improved Kansei Engineering.*

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1. INTRODUCTION:

It is an accepted truth that there has been an increasing rate in appearance of various novel technologies in the field of goods production. Due to the abundance of the products in the same category, their capability to compete with other products has become a more meaningful concern for several giant corporations. A product's impression is quite an important factor which helps its competence ability. Therefore, Emotionalism and paying attention to the customers' perceptions and aspirations has become the crucial factor that any design procedure has to deal with.

Accordingly, in recent years, mass-production is no longer the ultimate goal of manufacturing for huge companies. This change is the consequence of the more significant role customers play in the production chain. A desire for individuality, distinctiveness, privacy, personality and identity are some of the main reasons for the advent of a new customizable mass-production approach [1]. This approach deals with producing more adorable products in vast quantity, and meanwhile supporting uniqueness.

At this juncture of mass production vs. creating distinctiveness, the role of designers become more impressive. Designers are in close contact with the customers' needs and they are in charge of perception and conversion of these desires, while keeping in touch with the manufacturers' orders. Therefore, their chosen methodologies are of great importance, because methodologies will conduct the designers through every phase of the products' conceptualization, creation, and design.

At the same time, Kansei Engineering is an emotional methodology which has taken the customers' emotions and desires into consideration. Additionally, this method has been proven to serve the production purposes of famous companies. Its procedure starts from a holistic look over a product digging into the details. Afterwards by sorting the analyzed details, KE procedure once again obtains the holistic formation of the new concepts, and in turn, it comes up with the final concept. As with other methods there are some insufficiencies within KE's system.

In other words, although, the designers choose their own methods, each method might, to some extent, restrict the designers to a firm framework. These shortcomings and a solution for them are going to be specifically discussed in the KE methodology domain in latter sections.

1.1. Frame work of the paper:

In the next chapter of this paper, the evolution of KE since 1970s is reviewed. Some important shortcomings of KE are discussed, and the authors' suggested solutions and its application through the KE series of steps are proposed.

A synopsis will be offered describing contributions of the recommended solution to an Improved Constructivist Kansei Engineering structure.

2. EVOLUTION OF KANSEI ENGINEERING:

Kansei Engineering originated from the work of Mitsuo Nagamachi in 1970s at the University of Hiroshima. Since then, it has been widely applied by various companies and researchers in several academic and industrial projects. It was used as an auxiliary marketing tool in order to predict the type of consumer who might wish to buy a specific product and to ensure future

product success. Since then, it has been adopted and used in the design process helping to translate the customer's feelings into design elements [2].

In the context of product development, Kansei can be referred to as the impression somebody gets from a certain artifact, environment or situation using all their senses of sight, hearing, feeling, smell, and taste as well as their recognition [3]. Nagamachi has developed seven methods for Kansei Engineering/Ergonomic so far, namely, Category Classification, Kansei Engineering System KES, Hybrid Kansei Engineering System, Kansei Engineering Mathematical Model, Virtual Kansei Engineering, Collaborative Kansei Engineering Designing, and Combination of Kansei Engineering and Concurrent Engineering [4]. Then, Schutte examined all these types of Kansei Engineering and developed a model covering the contents of Kansei Engineering [5]. The model is presented in Figure1.

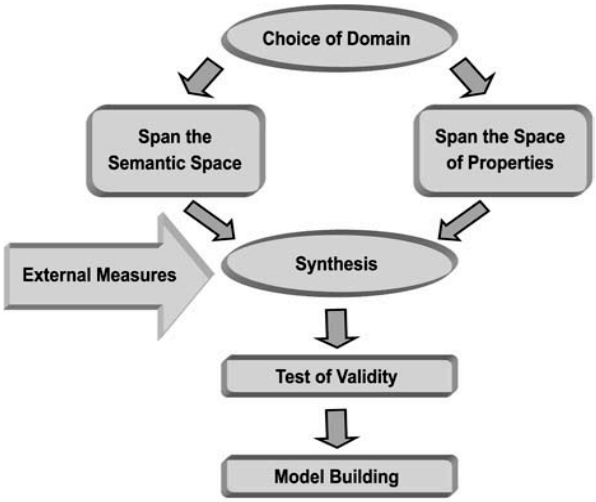

Figure 1: KE model proposed by Schutte

Later, Dahlgaard discusses that people today care more and more about whether products and services match and appeal to their feelings, emotions, personal life styles, identities, and even moral/ethical preferences. He believes that the most attractive products/services of the future will be designed to satisfy all dimensions of human needs – manifest as well as latent needs [6]. Furthermore, he put forward a terminology "profound affection" and articulates that it is a very comprehensive state, which is a result of a combination of sensing, intellectual/cognitive, emotional, social, behavioral and spiritual experiences that can have one or multi-functional interaction with one another. In other words, "Profound Affection" is not only a result of sensing or emotional experiences.

In order to broaden the traditional scope of Kansei Engineering to the new scope of "Profound Affection", he suggests that Kansei Engineering researchers in the future should not be too narrow in their research. Also, he recommends the designers to think about the "New Kansei Engineering" which he calls "affective engineering design". Go back to the basics, understand human needs, and then try to understand the enablers for moving people's hearts and touching their souls. And finally, he includes that in this process there is a need for effective and efficient statistical tools for identifying and understanding the following important detailed relationships between the mentioned six factors.

3. RECOGNIZED WEAKPOINTS ON KANSEI ENGINEERING PROCEDURE:

There are some shortcomings within the current methodology of Kansei Engineering which we might categorize in three main groups:

3.1. Product's complexity-related problems:

These problems occur when the objective of the design is a complex and multi-segmental product. Because, the KE firstly deals with separate segments of the product and then look for various arrays, the outcome concept is ambiguous to some extent. Therefore, the designer will get confused in selecting a way to track, especially during the limited deadlines of educational projects.

As for the mentioned case study about designing an urban green vehicle, in which the subject of the design is a product with complex segments, several approaches can be taken in defining space of properties. For instance, one may concentrate more on the characteristic lines; the other may pay attention more to the different assortments of segments which impress distinct impacts. And finally, one may try an amalgam of approaches. Therefore, as the subject of design gets more complicated, the number of possible combinations raises, and consequently designers will get confused in the phase of idea generation and also defining the space of properties (as the number of traits raise radically). Table 1 shows some of the optimized traits obtained in the corresponding project. Here again, designers might come up with various possibilities in generating concepts as there exist several automobile concepts which might share all of the optimized traits and yet remain at variance in style and this is the point of confusion.

Table 1: Samples of optimized traits

Property name	Optimized trait
Assortment of windshield, lamps, and bonnet	
Side view of windshield and bonnet	
Side view of windshield and trunk	
Front view of borderline	
Ratio of windshield to the bonnet	**1.5:1**

3.2. Product's cultural-oddity-related problems:

These problems occur when the objective of the design is a product which is not globally unknown, but regarding the specific target group, it is culturally odd. Therefore it will bring on a design challenge to parallel the target group's mental image with the main objectives of the project. In the case like green urban vehicle, the term urban vehicle and its usage is not fathomable for Iranian people. Also, green vehicles or products are almost unheard of in the cultural context of Iran. So, if a design team decides to initiate designing such a vehicle based on Iranians' taste, it

would be confusing to determine an appropriate semantic context. In situations like this, a new role will be added to designers' responsibilities which is creating an imaginary context.

3.3. Product's novelty-related problems:

These problems occur when the objective of the design is a new creative product. Conventionally, KE deals with sample products to build the two semantic and property spaces. But, encountering a creative product that no previous sample of it is in hand, there will be no strong anchor for the designer to rely on, unless the imagination and visualization of the users which will bring about confusion.

On the other hand, there are quite a few creative mental images which the users might unconsciously think of, here, the designer is the only person who is able to extract these unknown inclinations and put them to good use. But, there are no reliable criteria upon which a designer would be authorized to interfere in directing the process of visualization.

On a larger scale we can describe these problems within two comprehensive concepts: an Epistemological Problem (EP) and a Methodological Problem (MP). What can be inferred from three previously mentioned problems is that all of these problems are due to some condoned EP or MP-related matters, namely, Lack of holistic insight and unique meaning within the current procedure of KE; incidental inconsistency among the design team and the target group about the important meanings; the declining emphasis on the role of the human intelligence; and a lack of applied tools for establishing a holistic and inter-segmental relationship between the final product's pieces.

4. ONE SUGGESTED SOLUTION: ROLE OF "TD" IN THE KE FRAMEWORK

According to the defined problems, this paper suggests the TD terminology to be taken for granted by the design team through the design procedure. We believe this concept will lead to more holistic and constructivist KE, and consequently will solve the problems mentioned above.

4.1. Definition of TD:

What is TD? It can be described as follows: *"TD can be a leitmotif in the procedure of KE which is the reflection of customers' aspirations translated by the designer's perception, respecting the basic objectives of the project".*

TD is not equal with leitmotif in the meaning, in other words TD's conception is different from leitmotif; the latter is defined conventionally by the designers respecting their objectives, but in the process of TD creation, a designer is an impartial medium who conveys the reflection of the customers' current and aspired needs.

TD can be extracted by interviewing target groups, trying to interpret their mental images and preconceptions about the project's goals, and helping them to express their real feelings and to visualize themselves within the desired context, which is the objective of the project, by applying several indirect techniques. In the second step, an integration of different tools and tasks should be implemented to define the project's TD.

It can be exemplified by explaining a corresponding project titled, "Designing and Implementing an Artificial Design Tool Based on Improved Kansei Engineering". The project's objective was to design an urban green car according to Iranian women's preferences. As this subject includes in some respects all of the problems mentioned in previous pages, the design team decided to work on a solution. It was important to direct the minds of focus group according to the real objectives of the project, help them assume something new, and make them feel as they were in the context. Also, in the creation of imaginary context, first, designers had to gain a perfect knowledge about the possible desires of society, and then try to be loyal to theses desires in creating an imaginary background.

The TD was extracted through prior interview with focus group, and then they were asked for participation in a Mood board session in order to release their unknown desires using abstract images. In addition, PPP questionnaires were submitted by the focus group. All the gathered data was then analyzed by a group of psychologists, and sociologists while the designers have had considered the six factors proposed by Dahlgaard in outlining the questionnaires.

In describing TD, the analyzers were of the opinion that in the cultural context of Iran, nature is the main source of inspiration which people refer to its attributes in describing their thoughts about Green products. These attributes include well-ordered, originality, vigor, naivety, and immaculacy were articulated in broader meaning as a product which is familiar, friendly, doesn't evoke a sense of isolation, can easily be predicted, and neither is too novel to look strange nor too outdated to look ordinary and owns a kind of completeness which contains in the same time power, speed, excitement, sense of childhood, balance, convenience and calmness. Then this report was confined through an abstract statement which in the related project was perceived as *something that is fathomable, friendly, and ultimately has a sense of completeness*. This result was absolutely different from the prior Kansei words obtained.

4.2. How the TD responds to the problems which may arise:

TD will be helpful epistemologically and methodologically while being implemented in several phases of KE methodology such as: choice of domain, semantic space, synthesis, concept generation and final evaluation. In this way, the KE will become a more dynamic method in which all phases are in deep interaction and will be governed under a specific goal and unity.

Once more, an example from the previous mentioned project may help in understanding the impression of TD on the KE procedure. First, TD was applied in the semantic phase. It was the referent meaning for the design team to direct the whole phases of design process. According to the TD of the research, abstract images were gathered for the Mood Board session. These images were then described by the participants to build the Kansei words. Also, the images were prioritized by the participants.

Additionally, as a result of using computational optimization program, Genetic Algorithm, and consequently the need for a unique fitness value, or at least it's clearly defined weights, the designers had to aggregate all the affective parameters of feeling into a unique value defined as Fitness Function which represents the overall "fitness" of the product for consumers. In the mentioned project the designers used these defined priorities, meanwhile respecting the TD, to set coefficients of the AHP's criteria which in turn was used to form the overall fitness function fed into synthesize phase based on GA and accordingly gaining the optimized traits.

Furthermore, TD was beneficial in outlining the predilections of the target group, and later in evaluating the degree of consistency between the pre-outlined concepts of participants comparing the final outcome concepts. This was a qualitative task which utilized the PPP questionnaires in the semantic and evaluation phases. [TD was included within the PPP task by using the sample products, which were scored higher regarding the TD paradigms in the latter semantic space]. A sample of the PPP questionnaire and Mood Board practice used in the semantic phase is illustrated in figures 2-3.

Imaginary product	Product C	Product B	Product A	participant	
					sex
					age
					occupation
					lifestyle
					car
					personality
					Family environment
					clothes
					newspaper
					pet
					Favorite TV program
					Music
					Food
					Name
					Role in the family
					Favorite Cartoon Character
					Perfume
					Do you like to buy this product?
					Color

Figure 2: A sample of PPP questionnaire

Figure 3: A sample of Mood Board practice

5. AN IMPROVED CONSTRUCTIVIST KE MODEL

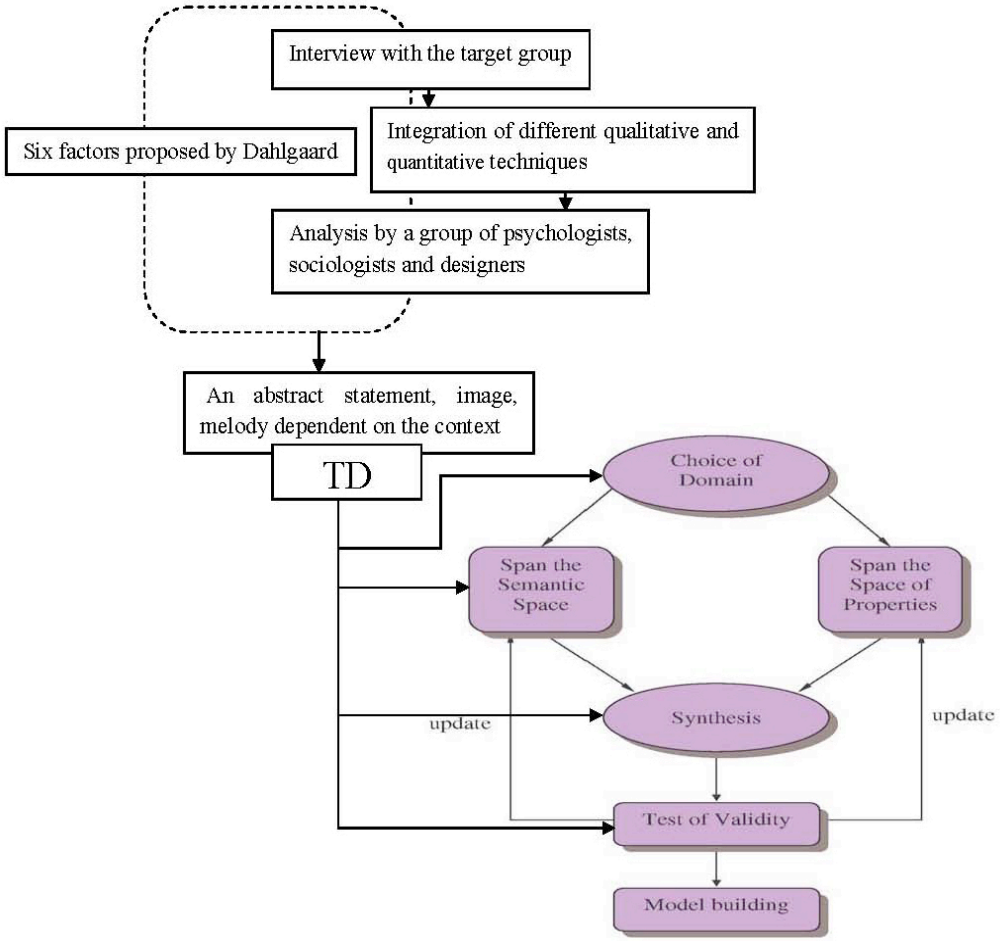

Figure 4: Improved Constructivist KE model

Our findings led to a developed model considering forming a constructivist approach, which will bolster the "Profound Affection" presented by Dahlgaard. This model is illustrated in figure4. This model suggests the TD as the controlling agent to be inferred from amalgamation of: interview with the target group, integration of different qualitative and quantitative techniques, and analysis by a group of psychologists, all respecting the six factors proposed by Dahlgaard, and accordingly to be implemented in the choice of domain, semantic space, synthesis, idea generation and evaluation phases. According to the above model, we can depict the inter-relationships among several agents of a TD- based KE design process in a graph presented in figure5.

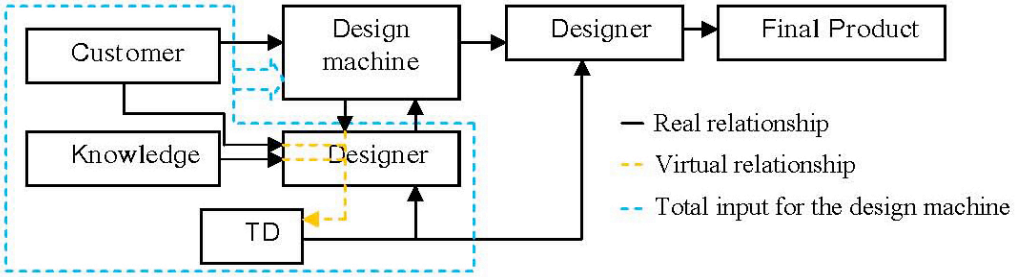

Figure 5: Agents of a TD-based KE

There are two basic relationships among these agents: real and virtual. It means, the agents can be whether directly related to each other or through a medium. For instance, knowledge affects the designer, and consequently can be impressive in TD creation. The graph perfectly explains that the process of design is involved in more iterated steps. In addition, it shows that within this procedure there are several inputs for the design machine, which in turn have inter-relationships.

6. CONCLUSION:

Kansei Engineering is considered as a method or a holistic concept of design, however due to its current nature, some important features may be lacked. According to our findings, it might have some severe shortcomings in its approach to the way that design should be: shortness in epistemology.

Through proposing a revised and improved Kansei Engineering method, we offer some changes to the method and also the epistemology which governs the whole method. As an improvement in the epistemology we have added the term TD to the semantic space of KE. The TD tries to compensate for the lack of a holistic insight which KE should have. The TD guarantees that the method preserves a unique and defined meaning all over the design process and the designed product. Furthermore, TD tries to converge the meaning and perception of the basic terms of KE similar among all involved people including the designer, the designing and surveying team and the focused and target groups.

On the other hand, to solve the methodological weak points of KE, which can be called the ignorance of a holistic and inter-segmental relationship between the product's pieces, we have added some modifications in the application and implementation of KE. Therefore, we have applied an artificial-intelligence design tool in our project. We have achieved this by adding some extra methods such as AHP and Moodboard in the process of design and tried to inject some adhesive parameters, for instance weights of importance, to make a unique figure representing the total goodness or fitness of the product, meanwhile considering all the design properties and their role in making the product joyful for the target consumer. It is what we call, the "Constructivist KE", which can maintain the inter-segmental and the Constructional consistency among all of the design processes, at the same time save the products unity and integrity.

Furthermore, as an important philosophical preconception of design, which was considered in our project, we made a dedicated effort to magnify and define the role of human intelligence. One result of this effort was permitting including of the radical decision making ability of a human in the final design procedure and product creation. The human intelligence source in our project is

included throughout the designers' decisions. For this purpose, we have added some sort of undetermined degrees in our Artificial Intelligence processes, which serve the designer with realm arbitrary of freedom. Also we have injected some parameters through defining some second and first priority sets of criteria to project the designers' points of view, intentions and perceptions.

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