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ORIGINAL ARTICLE

Kansei Engineering and Ergonomic Design of Products

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ABSTRACT

The main purpose of this article was to describe the concept of Kansei and its status in ergonomics, to specialists of disciplines such as safety, industrial engineering, and specifically the associates of ergonomic design of products and industrial designers. During last decades the dominate approaches of ergonomics were mainly focused on physical aspects of human body, but along with the development of sciences, it has had a dramatic growth in human mental characteristics and has expanded from physical to cognitive, aesthetic, and recently affective domains. This study includes two parts of descriptive and review study. In the descriptive phase the scopes of ergonomics and its new approaches were focused, while in the review part by choosing the appropriate keywords, the published articles in three scientific databases were searched in the context of subject. In addition, in the basis of obtained data with an emphasis on the relevancy of ergonomics and Kansei Engineering, the position of Kansei Engineering in the growing discipline of ergonomics has been analyzed due to the authors' perspective. In this study, recent trends in ergonomics approaches and some concepts of cognitive ergonomics and its relationship to Kansei were considered.

Keywords: *Ergonomics, Kansei Engineering, Industrial Design, Product Design*

INTRODUCTION

Rapid growth of technology has affected the structure of human life in numerous ways ranging from proper to harmful effects. In this regard, various sciences have been developed for the comfort and health of human beings, each is concerned with a part of human work-life issues. One of these applied sciences is ergonomics. "Ergonomics (or human factors) is concerned with the understanding of interactions among humans and other elements of a system, in order to optimize human well-being and overall system performance. The definition implies that ergonomics has both a social goal (well-being) and an economic goal (total system performance); i.e. ergonomics considers both physical and psychological human aspects" [1].

This field of science is among interdisciplinary sciences, associated with other disciplines, and possessing a considerable domain. In the beginning the human physical issues were more remarkable, but with the development of sciences, specifically in the past two decades it has had a dramatic growth in human mental characteristics and has expanded from physical to cognitive, aesthetic, and recently affective domains. This evolution in ergonomics has various reasons such as economic issues, productive and satisfaction of product users and service consumers. Certainly, responding trends to customer needs approaches to make an appropriated connection between emotional

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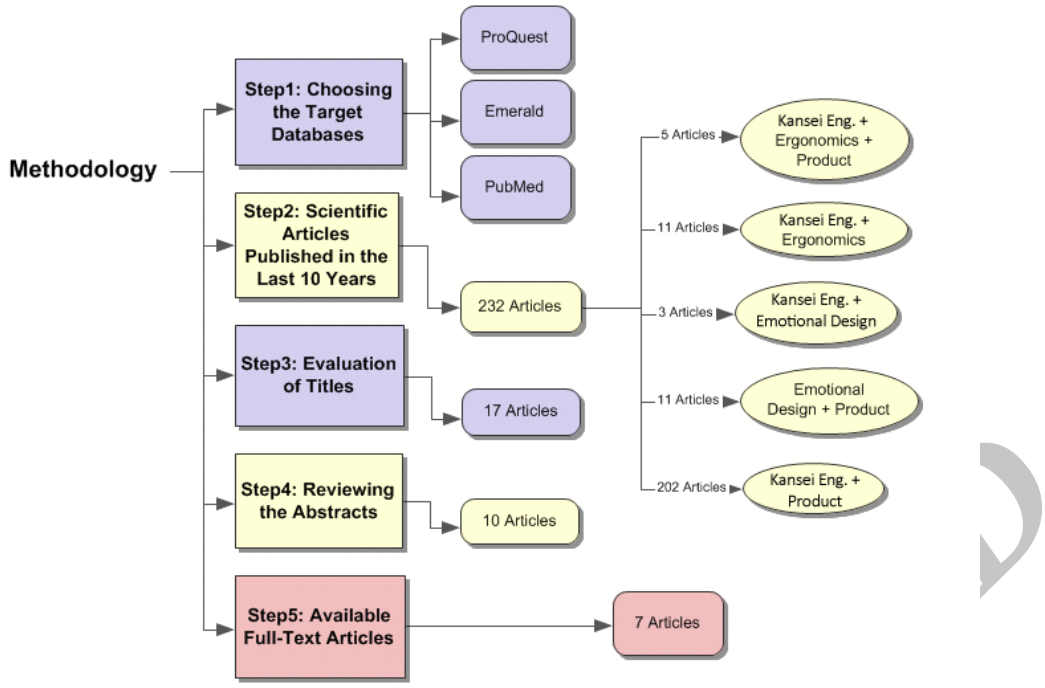

Fig 1. Articles gathering and research methodology process

aspects of design and products. In fact, specific orientation toward considering emotional and cognitive aspects of human has been remarked beside the fulfillment of safety requirements and micro-ergonomics.

One of the methods in identifying the emotional needs and demands of consumers in recent trends is "Kansei Engineering". In this the relation between ergonomics and Kansei Engineering was considered.

Ergonomics

Ergonomics or human factors engineering is an interdisciplinary science; the study of human activities in workplace and life environment. More specifically ergonomics is the science of modifying environment, jobs and equipment to be fitted with limitations and capabilities of human being, in order to fulfill two main goals: health and productivity.

Ergonomics and its modifying solutions are not limited to controlling work-related musculoskeletal injuries but considering further domains including human-machine interactive design, environment and product design based on physical and emotional needs, perceptual-cognitive issues and other similar cases.

Kansei Engineering

Kansei Engineering is a multidisciplinary methodology that embodies product design and is appropriate with the principles of ergonomics. The wide realm of this methodology is extended from humanities and social sciences to natural sciences and similar cases.

This method is a tool for identifying emotional needs and translating them into tangible product features. It also can determine the most important product factors for the costumer. The recent case proves the overlapping edge of ergonomics and human factors with Kansei Engineering. In fact, a Kansei product which converts the user needs into tangible features can be an ergonomic product; on the other hand, it is perceived that for having more efficient designs from an ergonomic point of view, it is better to follow Kansei Engineering in design process.

MATERIALS AND METHODS

In this study, all published English papers within the past 10 years were reviewed using the databases PubMed, ProQuest and Emerald. Titles and abstracts were searched on December 2010 covering the keywords, using "Kansei Engineering", "Ergonomics", "Emotional Design" and "Product".

No article was found embodying all four keywords, so the search terms converted to the combination of two and three keywords which resulted in 232 articles. Moreover it was decided to exclude the articles with keywords featuring product and ergonomics due to the overwhelming volume of results.

By evaluating the title of mentioned articles, 17 items related to the context of subject were included. Afterwards the abstracts were reviewed, which resulted in 10 pure articles. Due to the availability of the items, 7 full-text articles were selected: 2 in Emarald, 3 in ProQuest, and 2 in both mentioned resources. The process is illustrated above in Fig 1.

RESULTS

In 2009, Kosaka and Shiizuka published an article in which they proposed a Kansei value creation methodology. This study with demonstrating case studies has clearly stated that Kansei information is a

Table 1. Gathered articles for review

No	Author/Year	Location	Methods	Key findings	Conclusions
1	Kosaka, Y., Shiizuka, H., 2009	a. A dry-cleaning shop, in the Tokyo City of Akiruno b. ZERIA Pharmaceutical Co. c. Kyowado, a newsagent in Nagano	a. The sale of a waterproofing spray. b. Expanding the sales of laxatives with no change in features of the product. c. Establishing a relationship with customers based on self-disclosure information by contact frequency.	a. POP ad based on Kansei information motivates buying behavior. b. The annual sales increases from ¥300 million to ¥1.5 billion. c. Relationship building facilitates the motivation of consumers.	The key factor in value creation is closely related to the design of Kansei information.
2	Barnes, C., Lillford, S. P., 2009	A Drinks Company in UK market	For introducing a new product for a well-developed brand, a group of young males were asked to describe their favorite drink. 37 users rate 15 bottles about semantic evaluation.	The optimal design solution was revealed: the wide clear bottle is the most suitable.	A framework based on Kansei Engineering, for considering the emotional aspects of products in design process.
3	Nanda, P., et al., 2008	A leading smartphone manufacturing company	Data-collection instruments are direct observations, rating scales, and interviews. 50 male participants were shown 10 different visually smartphone images. They were asked to assign a value for their emotional reaction to the visual aesthetics of the device. The users were also interviewed at the end of the session.	Piano Black, red and dark blue patterns are preferred to all other patterns.	Varying the aesthetic design of the BlackBerry Pearl has an impact on emotional reaction of males.
4	Nagamachi, M., et al., 2000	Kimita Village with a population of 2.000 people	Evaluation the easiness of 6different types of computers using 39 subjects, 20-40 subjects and old subjects over 50.	At present, computer operations are accepted as the part of the community & sending E-mails is new enjoyable connecting tool.	Successful community redesigning based on Kansei & participatory.
5	Dahlgaard, J. J., et al., 2008	A company producing chocolate products in Sweden	A combination of literature analysis, data collection, data analysis, reflections and model building	A delicious chocolate bar should have smooth edges, be light brown in color, be large & carry the brand of the manufacturer.	"Profound affection" is a result of a combination of sensing, cognitive, emotional, social, behavioural & spiritual experiences.
6	Nordvik, E., et al., 2009	Commercial floors products available on the European market through the internet & retailers	200 potential customers were asked to rate 8 digital pictures of wood flooring in 6 aspects using visual analogue scales.	The combination traits for a good looking floor should be calm, yellow, dark and three strip.	Kansei Engineering as an evaluating tool determining which wood properties are obtained from pictures.
7	Nagamachi, M., 2008	a. The redesigning of a refrigerator b. Designing a new toilet based on the philosophy of a universal design	a. Curious user observations reveal that they are bending their backs when taking out vegetables from the bottom room of the refrigerator. b. The data of peoples' feelings of sitting comfort of 8 different toilets, collected from different makers, showed the best comfortable curve of a toilet surface.	a. Changing the vegetable position to the top of the refrigerator for having a more comfortable posture while interacting with the stuff. b. Kansei Engineering as a successful methodology in product design, can be even more fulfilling if it's supported by the ergonomic philosophy.	Each user has a hierarchy of values in his/her life. Excellent product quality is fit with customers Kansei values.

crucial factor in value creation, and successful companies should design upon the information gained from the analysis of human behavior [2].

In 2009, Barnes and Lillford reported a new framework for considering the emotional aspects of products in design process. By using Kansei engineering as the basis for this framework, it is about utilizing the potential of users in identifying new opportunities in product design and evaluating the proposed concepts [3].

In 2008, Nanda et al. demonstrated the impression of aesthetic design on users' emotional reactions. This

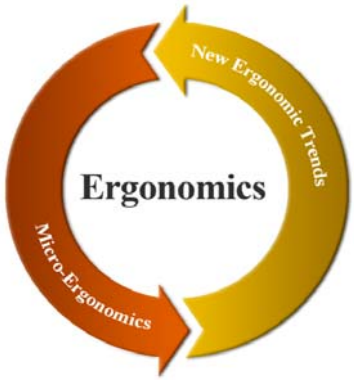

Fig 2. Recommended conceptual model

article embodies a case-study that approves the variation of aesthetic design of a leading smartphone has an impact on emotional reaction of males [4].

In 2000, Nagamachi et al. reported the redesigning of a community based on Kansei ergonomics and participatory ergonomics. The study is about implementation of information technology, with the aim of the enhancement of people's quality of life within an aged village. At present, computer operations are accepted as a part of the mentioned community and sending E-mails to friends and grand children is their new enjoyable connecting tool [5].

In 2008, Dahlgaard et al. published an article which suggested the structural model of Profound Affection as a framework for future studies of Kansei/affective engineering. In this article Profound Affection was defined as the result of the combination of sensing, intellectual/ cognitive, emotional, social, behavioural and spiritual experiences [6].

In another article by Norvik et al. (2009) the effect of various visualizations on people was examined. The study indicates the relationship between visual properties and its effect on users based on Kansei Engineering [7].

In 2008, Nagamachi demonstrates the potentials of users Kansei in order to be directly used in ergonomics. One of the case studies indicates the redesigning of a refrigerator. Among the collected Kansei words, "hard work" for taking out vegetables indicates the work load from the ergonomic point of view. Nagamachi suggested changing the vegetable position to the top of the refrigerator for having a more comfortable posture while interacting with the stuff.

In another case, designing a new toilet based on the philosophy of a universal design, the Kansei words of users evaluation from the current toilet surfaces, lead to choosing the most comfortable curve of a toilet surface. Further examinations from ergonomic point of view prove that the Kansei toilet receives less pressure on users.

This research suggests achieving more valuable outcomes if Kansei Engineering be supported by the ergonomic philosophy [8]. In Table 1 the summary of the reviewed articles are arranged.

CONCLUSION

Recent trends in ergonomics, mainly Kansei Engineering, have focused on emotional and cognitive values instead of micro-ergonomics and physical human body aspects. The concept of Kansei is the mental ability for experiencing emotional values, which is originated from right brain process. Nagamura approves that “Kansei is processed by the right half of the brain, processing analogue and fuzzy data whereas the understanding possessing logical speculative nature is (reason) treated by the left brain side, whose specialization is digital data processing” [9]. In Japanese philosophy the counterpart of the concept of Kansei is Chisei, which is concerned with knowledge and logical facts (left brain characteristics).

By adopting the neurological consideration of Kansei with the definition of ergonomics emphasizing in health and productivity (physical and psychological human aspects), the model below is prepared (Fig 2). In this view, ergonomics is a whole concept, embodying two main components answering Body and Mind demands.

This concept is also proposed as a revision of Maslow hierarchy of needs, since in Maslow view answering basic human needs in the pyramid are disadvantaged to achieve higher levels, while in the proposed model needs are not in hierarchical position, but are in conjunction, means that the evolution is the comprehensive growth in answering all aspects of human needs.

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The authors declare that there is no conflict of interests.

REFERENCES

1. Dul J, Neumann WP. Ergonomics Contributions to Company Strategies. Applied Ergonomics 2009; 40: pp 745–752.
2. Kosaka Y, Shiizuka H. A Method for Creating Buying Behavior of Customer by Kansei Information Design. *J Model Management* 2009; 4(1): pp 19-27.
3. Barnes C, Lillford SP. Decision Support for the Design of Affective Products. Journal of Engineering Design 2009; 20(5): pp 477–492.
4. Nanda P, Bos J, Bos KL, Hay C, Ignacz J. Effect of Smartphone Aesthetic Design on Users' Emotional Reaction: An Empirical Study. *The TQM Journal* 2008; 20(4): pp 348-355.
5. Nagamachi M, Komatsu K, Ichitsubo M, Nishino T, Ishihara S. Kansei of the Elderly and Community Ergonomics. 44th Annual Meeting of International Ergonomics Association and Human Factors and Ergonomics Society, July 30 - August 4, 2000; San Diego, California, USA.
6. Dahlgaard JJ, Schutte S, Ayas E. Kansei/Affective Engineering Design. *The TQM Journal* 2008; 20(4): pp 299-311.
7. Nordvik E, Schutte S, Broman NO. People's Perceptions of the Visual Appearance of Wood Flooring: A Kansei Engineering Approach. *Forest Products Journal* 2009; 59(11-12): pp 67-74.
8. Nagamachi M. Perspectives and the New Trend of Kansei-Affective Engineering. *The TQM Journal* 2008; 20(4): pp 290-298.
9. Schutte S. Engineering Emotional Values in Product Design: Kansei Engineering in Development. PhD Thesis, Linkoping University, Sweden, 2005.