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SURVEY ON KANSEI ENGINEERING METHODOLOGY IN E-COMMERCE DESIGN: PRINCIPLES, METHODS AND APPLICATIONS

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ABSTRACT

Current trends in product production indicate that customer associations are needed in terms of product design technology to determine their success in the market. Various E-Commerce websites are now widely available to the public, and the number continues to grow over time. Capturing users' needs is the fundamentals of a successful website design. However, website designers have focused more on the development of function and usability, and less focus is given to fulfill and address user-driven demands. The implicit needs in user experience are difficult to quantify. Kansei Engineering is a technology that can assimilate Kansei-based humans for the designation of product variables. This paper examines the principles, methods, and applications to understand the needs of users in E-Commerce and specifically explains the Kansei Engineering framework. This framework offers an understanding of the implementation of Kansei Engineering in finding implicit user needs and analyzing its relationship to E-Commerce design specifications. The proper use of Kansei Engineering implementation will benefit researchers and designers from the outline of the design to produce E-Commerce websites. It shall be useful to be used as guidance and improvements reference. This paper surveyed the Kansei Engineering methodology principle and then explores their prior application as part of the product design creative process with the perspective on the E-Commerce websites on the significance of the study in emotional appeal in website design. This paper will outline the Kansei Engineering methodology approach from various angles applied to E-Commerce contributing to conversion and retention. Suggestions and advice on the most suitable approaches that can be implemented to improve the E-Commerce quality are provided at the end of this survey.

Keywords: *Approach, Emotions, Cognitive, Usability, User Experience, Satisfaction*

1. INTRODUCTION

The digital age has produced a plethora of various websites for web users to connect and use. Although E-Commerce advancement has grown immensely and became a valuable channel for selling and purchasing activity between seller and customers (Song & Zahedi, 2005), E-Commerce companies are faced with a highly competitive environment today with the flooding emergence of business going digital. An effective website is a significant factor in attracting and retaining customers' absorption to promote purchasing behaviour. Literature reviews performed demonstrate very few empirical studies focusing on E-Commerce as a contextual periphery of user engagement optimization. Although user engagement has been widely highlighted in various fields for its significance, it is still a challenge for an E-Commerce business to optimize it due to the lack of reference effectively. Theoretically, a good design constitutes factors of users' satisfaction assimilation requirements and technical implementation (Bano et al., 2017). Therefore, to understand and satisfy people's demands is a fundamental design concept required to be implemented.

In the field of product development, Kansei Engineering is one of the methodologies that can connect user response to the nature of the product. It is a proactive framework of product production that assimilates the impressions, emotions and desires of consumers into design strategies with concrete design criteria. The Kansei Engineering methodology can uncover the Kansei values of a specimen based on subjective impressions through semantic tools (Schütte et al., 2013). It is a scientific discipline where the methodological approach is used to produce a commodity that fulfills customers through a technological approach (Nagamachi, 1999). At present, Kansei Engineering is implemented in various fields. Although it is initially established to be used on physical products, the method can be applied to the technology field. Given the concept of Kansei Engineering to elicit user-centric products and the significance of consumer experience and emotions in product development, it is essential to implement Kansei Engineering methodologies to the designation of business E-Commerce website to identify important parameters in creating a desirable interface design of an E-Commerce that induces positive emotion and optimize user engagement. The Kansei Engineering model can measure the intangible values of Kansei in a website and analyze the design scheme to formulate an optimized interface design of an E-Commerce. This initiative is essential to enhance the success and outreach potential of business in this modern technology era.

This paper reports the methodology of Kansei Engineering targeting to understand its implementation through the domain of E-Commerce. Several successful applications of technology have been introduced to provide insight into their use in the real world. This research intends to explore the prior application as part of the product creation process with the E-Commerce websites' perspective on the significance of the study in emotional appeal in website design. This paper will outline the Kansei Engineering methodology approach from various angles applied to E-Commerce contributing to conversion and retention. The survey framework is intended to be a useful guide for designers in the web design industry and researchers to apply this technology in various areas of user experience by applying emotional value.

2. E-COMMERCE

In 2020, global E-Commerce platforms saw a huge surge amidst the economic gloom due to the pandemic, Covid-19. Contactless and online shopping has become the new norm, and most businesses have transcended from the traditional method to the digital (Boey, 2020). E-Commerce refers to the paperless exchange of network-based technologies such as business knowledge in the electronic exchange of fund transfer. Additionally, E-Commerce technology advancement has led to the emergence of manual process automation, which has benefited organizations to operate in a fully electronic setting. The internet has grant E-Commerce a further boost as it is a low-cost alternative to proprietary networks (Bhaleka et al., 2014).

Another definition by Shahid et al. (2016) specified the use of E-Commerce to be the business transactions of electronic communications and digital information process technology to produce a value between organizations and consumers (Shahid et al., 2016). Turban et al. (2015) defined E-Commerce as the transactions of products and services among organizations and individuals facilitated through a comprehensive adoption of information and technology platforms and universal standardized network infrastructure. Throughout the overall business transaction process and above the barrier of cooperating organizations, these high-quality processes need to be operative effectively while sharing, exchanging, and processing data coherently. With personal data involved in the transmission, data security and data privacy become a concern. Business organizations need to guarantee that the data security complies with standard security laws and policies.

The choice of purchasing decisions does not necessarily emerge from logical mental mechanisms. However, they are also often motived by emotions. Steininger, Hölz and Veit (2012) stated that knowledge strategy constitutes the overall market strategy critical part in an E-Commerce context. It aims to discover fresh and beneficial insights to strengthen the relationship with the customer and improve customer satisfaction. The in-depth study of customers' expectations and actions is one of the main priorities of knowledge strategy. The strategy's effectiveness is focused on the detail and reliability of customer information accuracy and the convenience for online vendors to respond to these data to provide value proposals based on data-driven insights (Salonen & Karjaluoto, 2016). Although user emotions have been extensively recognized in numerous studies, the number of studies outlining the emotion significance in E-Commerce personalization content is comparably still limited (Bielozorov et al., 2019), which can be influenced by the absence of the generally agreed concept of emotion constitution. In the spectrum of emotions, researchers in E-Commerce have demonstrated and prioritized the following aspects: social/personality challenges, perceptual causes, and the association of emotions with other utilization factors (Gaur et al., 2014). A study by Lerner, Valdesolo, and Kassam (2015) confirmed that emotions often follow buying decisions. Thus, customer-centered businesses seek to discern current ties between the behaviour of customers and their emotions to obtain a deeper comprehension of the approach to improve customer engagement and boost loyalty and satisfaction rates by implementing improved customized support (Learner et al., 2015).

Through a profound understanding of the connection between consumer emotions and the construction of E-Commerce content, an E-Commerce platform's quality may be notably enhanced. Furthermore, understanding the influence of emotional variables on the customer decision-making process during online purchases will facilitate the analysis of design schemes for E-Commerce content. Hence, the business organization would gain significant benefits when an organization implements suitable tools when considering customers' emotions. Customers are emotional beings, and their emotions will ultimately affect their purchase decision towards conversion.

The main determinant of good business networking in E-Commerce business to consumers is satisfaction and confidence (Goh et al., 2013). In any aspect of business that involves the exchange of money, trust plays a crucial role. The customers' fulfillment has an explicit connection with the purchasing decision of customers and word of mouth marketing. Customer's contentment is a base indicator of quality levels of services and goods offered by a business based on the ability to fulfill customer's demands. A satisfied customer can expect stronger desired for purchase intention and repurchase and, in effect, market the business to other prospective consumers. The usability of a website is critical to fulfilling a company's success or failure (Tezza et al., 2011). However, many E-Commerce applications still do not satisfy the usability criteria of customers' (Li & Li, 2011). Commonly, usability evaluates websites' validity within the first 50 milliseconds of their experience. Hence, a website's design is required to consider in mind the customer's behaviour.

Given the value of E-Commerce website usability, several studies have been performed to understand the various aspects of an E-Commerce able to impact the actions of customers, such as Pelet, Katawetawaraks and Wang (2011), which investigated the logic of colour selection influence in the design of an E-Commerce can impact the mood and purchase decision of customers. Another study by Kamoun and Halaweh (2012) explored HCI variables that lead to the interpretation of E-Commerce security by customers'. Further, their research has re-addressed the value of a successful design of the user interface as an efficient approach to improve the customers' confidence and purchasing intention. In assuring, an E-Commerce website's success, customer's loyalty, trust, reliability, and reputation are key essential qualities. Nielson's heuristics are profitable for cognitive usefulness and accessibility. The significance of a website's influence and attractiveness is obvious as E-Commerce advances. Hence, understanding Kansei's potential influence on the people's impressions towards E-Commerce platforms is essential.

3. KANSEI ENGINEERING TECHNOLOGY

Kansei Engineering was founded in Japan to help market existing products to the public. It is now being adopted or adapted to gather the information that producers can use to create new products that can fit various lifestyles. Kansei Engineering methodology can be adapted to an extensive scope of product development. In a study by Jordan (2000), he mentioned Professor Nagamachi explanation on the two directions of Kansei "flow": "from design to diagnosis", which entails modifying specific aspects of a product's formal properties to evaluate the impact of the

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change of individual's overall interaction to a product; and "context to design", which requires analyzing situations and circumstances in which a product is used and then concluding results of the design implementation. The first direction technique has been used to promote the creation of numerous dimensions of products, while the second direction flow requires the gathering of qualitative data through field observations. The collected data helps establish a correlation between formal properties of a design and benefits related to the product.

Kansei uses the five senses, sight, voice, aroma, taste and skin, for the brain to infer one's feelings, emotions and institutions towards the product. When an individual's senses are stimulated, a person will become aware of the psychological perception that affects vision, decision, and memory. Asking people to articulate their Kansei in terms of the product they would like to experience in the future is one of the various approaches to determining a particular product's influence. Collected words from the procedure are known as Kansei Words. There are several entry points for an entity to encourage a person to express their Kansei Words and assess the expression. Figure 1 presents the gateway to reaching Kansei.

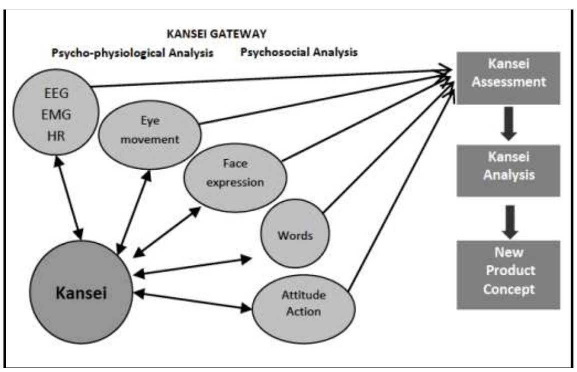

Figure 1: Kansei Gateways

Figure 1 illustrated the many psycho-physiological attributes that could extract the individual's Kansei expressions to assessment. Anitawati (2010) paper provided cases in which particular words are only used in a particular situation. For instance, the words "luxury" and "elegant" are ideal in-vehicle context rather than in an apparel context. Hence, context is a significant factor in understanding the necessary Kansei words. Studies conducted by Anitawati and Nagamachi (2009) have proven in the research results the validity of the implementation of Kansei Engineering into E-Commerce websites as a domain.

3.1. History of Kansei Engineering

The word 'Kansei' originates from Japanese, which denotes consumer's psychological feeling and image correlating to sensitivity, sensibility and feelings. It can be represented as the impression an individual experiences from a specific artifact, situation, or environment using human senses (Schütte et al., 2004). For example, when a person decides to buy a product, a pre-existing positive or negative image comes to mind, which coincides with the term Kansei which refers to the intuitive mental behavior of a person who feels the effects of external stimuli (Nagamachi & Lokman, 2016). Further, Nagamachi and Lokman (2016) pointed out the Kansei's psychological definition referring to the mental state in which knowledge, emotion, and passion are coordinated. Past research has outlined Kansei as implicit and cannot be measured directly (Nagasawa, 2004). Therefore, sensory activity, internal factors, psycho-physiological responses and research product behavior should be used as indirect measurements of Kansei measurements. A commonly used technique for the evaluation of Kansei is using Semantic Differential Technique, a method developed by Osgood (1957).

Kansei Engineering originated in Japan in the 1970s to convert feelings into visible design requirements to link the affective interaction of consumers to the development phase of products (Vieira et al., 2017). To incorporate Kansei human into product design to meet customer desires and satisfaction, Kansei Engineering integrates Kansei into engineering to assimilate Kansei human into product design to meet consumer demand and satisfaction (Lokman & Noor, 2006). The Kansei Engineering technology merges Kansei values into engineering domains to incorporate human Kansei values into design schemes to fulfill customer desire and fulfillment (Lokman & Noor, 2006). Besides, it is also a constructive approach to product creation that may be implemented in design solutions to current products or ideas (Schütte et al., 2004). Products that have been created with Kansei Engineering methodology are referred to as Kansei products. Nagamachi, a professor at Hiroshima University, developed Kansei Engineering's theory following the progression changes in the role and demand of customers in the industry. In the past times, when there was a limited selection of products sold in the market, the producer followed their intuition when creating products. At the time, customers were ignorant and made purchases of new products without further exploring the product descriptions. Consequently, the product development industry started to expand, and the market was overwhelmed with large quantities of goods. This has impacted the preferences of buyers by beginning to find consistency when purchasing a product. As producers recognized that buyers had reached the core of their business, producers struggle to enhance their quality and necessity of their product. The producers realized that high-quality products derive a prolonged lifetime, which will increase purchasing activity.

At the University of Hiroshima, Mitsuo Nagamachi founded Kansei Engineering in the 1970s. The technique has been used by various businesses and universities in Japan since the establishment. The methodology is used as a marketing or targeting tool to help bring future products or services to the appropriate market segment. Since then, it has been adapted to be used much earlier in the design process essentially to explore the consumer's impressions towards various goods and then convert the information into concrete outcomes to allow evidence to be used in the production and to produce a new product (Schütte et al., 2013; Mamaghani et al., 2014). Further, the need to analyze other facets of commodity valuation had prompted targeting to affect more individuals' purchasing activity. For this reason, improving the product development method is required to enable producers to develop new products. Businesses had then realized the necessity to produce goods, fulfilling consumers' satisfaction and desires, which has driven the entry of products to the field of consumer-oriented design. The concept Kansei implemented in Kansei Engineering specifies an ordered state of mind in which tangible objects such as products or surroundings, while conveyed using various mediums such as facial expression, sketches, words and others to bring understanding to the public. Consequently, the human brain is built of complex mind patterns, which contain all the impression experience that derives from human behaviour. In Dahlgaard and Schu (2008) studyied of Kansei Engineering, they mentioned that Kansei Engineering is a product development tool and the primary content is defined as recognizing and connecting the product properties and design elements.

The characteristics of psychological experiences, such as emotions and perceptions, are obtained using effective, appropriate techniques. The Semantic Differential Method (SDM) is a widely used tool of Kansei Engineering. Using mathematical techniques on the SDM application, the data obtained are used to construct a Kansei knowledge base, which forms the relation between emotions and product characteristics. This application enables the options of particular product properties to understand and influence the emotional experience of the entire product. Knowing consumers and the value of consumer engagement with the global process becomes an essential strategy in the business industry. Therefore, through user engagement, practitioners must gain expertise in those aspects and treat them as part of the system to optimize them.

3.2. Principles of Kansei Engineering

Kansei Engineering is a pioneer in product development approaches that translate customers' perceptions, emotions and needs into current products or perceptions into design strategies with specific design criteria to show how Kansei is transcribed into the design. Nagamachi (2001) showed three basic things of Kansei Engineering:

1. How to understand market Kansei correctly
2. How Kansei elements can be reflected and incorporated into product design
3. How to develop a design-oriented framework and system for Kansei

Although the Kansei Engineering technique is primarily a facility for the efficient creation of a current and creative product, it can also be used as an instrument to strengthen the principles of the product. The Kansei of a product is assessed, conditioned further analyzed by the Kansei Engineering system as input information. The acquired outcome presents the correlation of Kansei's psychological feeling to the considered product, which could be both material and immaterial. Anitawati (2010) demonstrated the Kansei Engineering framework in Figure 2.

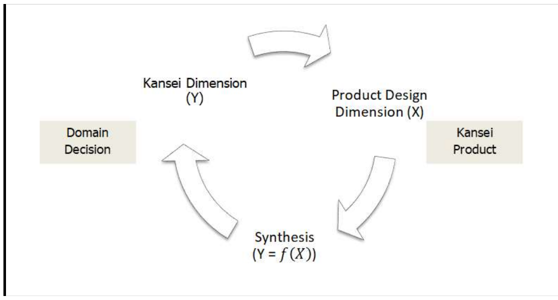

Figure 2: Kansei Engineering Principle

Kansei Engineering is performed to yield the Kansei Product. The general framework consists of four phases as presented in Figure 2, namely Domain Decision, Kansei Dimension, Product Design Dimension and Synthesis. Six types of Kansei Engineering are subjected to expansion at any point in time, as Nagamachi (2003); Ishihara et al. (2005). The classification of Kansei Engineering types is as described in Section 4.

The type of Kansei Engineering type to employ depends on the organization, designers, or objective in the assessment of Kansei. The implementation of each phase is as described in Section 3.2.1 to 3.2.6.

3.2.1. Domain Decision

Domain decision is the stage in which a particular domain is defined to be investigated using the methods of Kansei Engineering. Focusing on specific domains is important in Kansei Engineering studies because the Kansei experience is unique with different products (Nagamachi, 2003). Domain decisions can be made using the methodology of market analysis techniques or by segmentation of target customers. It is important to determine whether to implement Kansei Engineering based on existing products or to start developing a new product model from scratch. Different strategies can be implemented, and none can be classified as better than others. As a rule, domains can be resolved with the flexibility to improve the current situation.

3.2.2. Kansei Dimension

The phase consists of three stages:

a) Kansei Identification

Initially, Kansei Words is to be prepared. Kansei Words refer to the Kansei dimensions that can be conveyed in the form of an adjective or noun. Generally, the number of initiatives designed Kansei Words will be vast, and qualitative or quantitative methods can reduce this number.

b) Kansei Measurement

Kansei measurement is a method of collecting Kansei users. As Kansei expression is arbitrary, vague and unstructured, direct measurement of it is difficult. Therefore, the formulation of indirect measurement methods is required using alternative expression approaches (Ishihara et al., 2005). Kansei measurements are classified into physiological and psychological measures.

The purpose of physiological measurement is to capture the behavior, reactions and expressions of the user's body. Targets can be achieved through brain wave examination using electroencephalogram (EEG), assessment of muscle load using electromyography (EMG), eye movement, and other physiological ergonomic metrics used to assess Kansei when users use or view products. The effects of heat on the heartbeat (Nishikawa et al., 1997), refrigerator architecture (Nagamachi, 2007), and reactions to the movement of robots are some examples of studies conducted using this measurement method (Ishihara et al., 2007). Psychological measures relate to human emotional states, such as user behavior, expressions, actions, and effects. This can be measured using a Different Emotional Scale (DES) self-reporting system, Semantic Differentiation Scale (SD), or independent marking system. This form of measurement is common in the application of Kansei Engineering because of its simplicity. Some examples of successful implementation include women's suites (Ishihara et al., 1996), lift trucks (Schutte et al., 2005), wreaths (Ishihara et al., 2007), web design (Lokman et al., 2009).

c) Kansei Analysis

Kansei assessment allows a study to analyze Kansei concepts related to the context, form, and concept of Kansei users. The following shows common studies conducted to analyze user Kansei:

- **Investigate Equations Between Variables**

Kansei responses differ in different domains; therefore, understanding the correlation allows for further disclosure of the Kansei objectives that convey the domain. Correlation Coefficient

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Analysis is commonly used in Kansei Engineering to assess the frequency of the correlation between variables. It is broadly implemented to calculate the Kansei association in a domain that allows the exploration of the correlation between Kansei to enable highly correlated Kansei to be summarized. The results of the analysis can be used to measure Kansei more objectively. Alternatively, qualitative research methods can also be used to achieve relevant results.

- **Deriving Principal Components**

Although analysis is conducted using more objective Kansei, because of the subjective interpretation of consumers, the analysis outcome may still derive redundancy of variables. Redundancy in this context implies that any of the variables are associated with one another because they measure the same construct. In addition, because of its advantages, it is considered impossible to minimize the observed variables into smaller component parts which will explain most of the observed variables. Principle Component Analysis (PCA) is a method of data reduction performed to classify a small number of variables that comprise a large number of total variations from the original variables. Components can be determined from the correlation matrix (default) or the covariance matrix. The results consist of eigenvalues, parts and cumulative estimates of the total variance described by each principle component, and coefficients for each PCA principle component are widely used in Kansei Engineering to find Kansei semantic spaces and specimens, and PC Vector plots can determine Kansei strategies. The Kansei approach is essential because the organization could implement it to strategize a new concept of a product with hints about the product design of the competitors. PC loading plots can be used to visualize how many assessments of Kansei affect variables, and PC score plots will describe which Kansei has a strong relationship with a particular specimen.

- **Defining the Concept of Kansei**

Factor analysis (FA) is a statistical data reduction technique used to describe variables in several unobserved random variables called factors in observable random variables. FA believed it is possible to minimize all the ranking data on multiple attributes down to a smaller number of significant dimensions. This reduction can be done because the evaluation given to other attributes is partly the result of the effects of other attributes'. The FA is widely implemented to determine the psychological structure of Kansei which forms the basic concept of the domain investigated in Kansei. The results can be used to achieve Kansei products that represent the determinants of Kansei users within the domain.

3.2.3. Product Design Dimension

This phase determines important design elements such as color, size, and shape of product specimens. By using an analytical approach or qualitative technique, the process could be implemented. By empirical methods, the procedure begins with the selection of specimens with visible design differences from products available on the market in a particular domain. Empirical observations were then performed to analyze the structural elements from the user perspective in all specimens. The decision to restrict the number of design components depends on the details that must be included in a study. Arranging the number of elements allows for more objective measurement.

Additionally, a higher number of precise assessments may be facilitated by including all observable elements. Finally, by observing a series of guidelines in Kansei Engineering, valid specimens for Kansei Measurement procedures can be determined from all initial specimens. Subsequent specimens will evaluate the design dimensions of the intended product. In a qualitative approach, the dimensions of design can be measured by recruiting a number of experts. To achieve the design dimensions for a predefined new product concept, experts must rely on their expertise and capabilities. This can be done using the KJ method or also known as Affinity Diagram, which allows categorization of Kansei concepts into related Kansei dimensions to make it possible to determine design needs. Lee et al. (2020) defined the KJ method as an instrument for gathering vast quantities of language data and arranging them into segments according to their natural relationships. The method enables researchers to rapidly achieve consensus on subjective and contextual data goals. Figure 3 illustrates the adoption of the KJ method to group the affinity of KWs.

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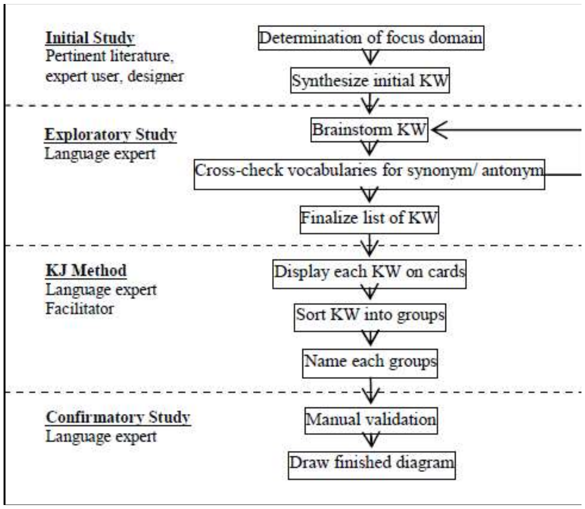

Figure 3: KJ Method Adoption

3.2.4. Kansei Product

Kansei products are products that arise from the results of a qualitative and quantitative approach to the application of Kansei Engineering. A combination of design specifications made with the introduction of Kansei Engineering and the expertise and capabilities of product designers can develop a good PSome Kansei Examples of famous Kansei products are Mazda Miata (Nagamachi, 1999), Wacoal Good-up bra (Nagamachi, 2003), Interior Design Boeing 7E7 (Guerin, 2004), and Sharp Refrigerators (Nagamachi, 2007).

There are many different types of Kansei Engineering products, such as vehicles, household appliances, kitchen cabinet design, virtual community design, aircraft interior design, and the list continues to grow (Nagamachi, 1999; Camurri et al., 1999; Yamada et al ., 1999; Ishihara et al., 2007). At various stages in the product development cycle, Kansei Engineering has been applied at different points of the product development cycle where practical flexibility stands in the decision-making action on several components of product design. The interest in the adoption of Kansei Engineering in academic science has been emerging with its outstanding performance in industrial applications. Among others are studies on RV cats (Ueda et al., 1996), landscape bridges (Ichitsubo et al., 1998), canned coffee (Ishihara et al., 1997), bathrooms (Nishikawa et al., 1998), bridges (Isitsuba et al., 1998), textile fabrics (Barker, 1999), dance/music interactive systems (Camurri et al., 1999), door handles (Higashitani et al., 1999), soft design (Yamada et al., 1999), smart shops (Higuchi et al., 2003), web branding (Yoon & Lee, 2003), online chat (Wang et al., 2004), pickup trucks (Schutte et al., 2005), robotics (Ishihara et al., 2007), posture seating (Barone et al., 2009), robotics (Papadopulos et al., 2010; Ford et al., 2010), original products (Shaari, 2010) and more. Such research focuses on analyzing the Kansei reactions experienced by consumers to extract their relationships with design elements when using products, situations and environments. A high-quality Kansei product can be produced by integrating the execution of Kansei Engineering design specifications and an expert designer's expertise and abilities (Anitawati, 2010). Consequently, using Kansei Engineering techniques does not guarantee the study Kansei somebody has about a certain product. It is practically the record of an interaction at a specific period under certain circumstances to map individual's Kansei impressions.

3.2.5. Synthesis

In this phase, analysis is done to investigate how product design affects consumer Kansei. Qualitative as well as quantitative methods, may be used in the analysis process. The aim of the process is to expose the relevant Kansei dimension to the product design dimension. The design requirements for building a product that integrates Kansei can be formulated. To perform the synthesis phase with qualitative methods, the KJ method can be used.

Several regression models are used in quantitative methods to accurately predict the influence of design elements, e.g., elements and variations, on Kansei users. This is achieved with the least squares method, which minimizes squared prediction errors (Ishihara, 2007). A large number of Kansei Engineering studies use Type I (QT1) Quantitative Theory to analyze Kansei and the relationship of product design elements. In the calculation, the value of the evaluation on the Kansei variable, y (dependent), the design element, the variable x (independent) of each element. For example, the color of the car corresponds to its elements and color variations. In QT 1, the weights for the categories will be calculated using a multiple regression model by solving (the number of all categories - 1) simultaneous equations (Hayashi, 1852). QT1 is deterministic in that it is a variation of the multiple regression model, and it uses the least squared method as the solution method (Ishihara et al., 2007). Alternatively, depending on the purposes, several other approaches can be implemented to analyze Kansei. Among others are Fuzzy Logics (Shimizu & Jindo, 1996), Neural Networks (Ishihara et al. 1996), Genetic Algorithms (Nishino et al. 1999), Rough-set Analysis (Nishino, 2005), and Partial Least Square Analysis (Ishihara et al., 2007).

4. CLASSIFICATION OF KANSEI ENGINEERING APPROACHES

A paper by Anitawati (2010) indicated that the emotional aspects of a product had been identified to be a key contribution to market success and consumer satisfaction. For ages, Japan's product development and innovation consistently surpass other countries. Their success heavily relied on their sensitiveness to develop products fulfilling consumer's demands and expectations. Fukuda (2013) presented and characterized six types of Kansei Engineering that have been established, proven and tested adapted from Schütte et al. (2013) and Marghani et al. (2013). Table 1 shows the six types of Kansei Engineering currently available in the order of their introduction with the previous application for the chosen approach.

Table 1 shows examples of organizational product development in industries involving Kansei Design methods in improving the quality of their products according to Kansei Engineering types. All of the products developed using Kansei Engineering presents the result of profitable business sales or have been a hit in the market.

This shows that as a consumer-oriented technology in modern times, Kansei Engineering is a tough ergonomics. In Kansei Engineering, surveys play an important role in understanding customer emotions at the beginning of product development. Thus, the scope of the Kansei word consisting of appropriate semantic differentiating adjectives can be completed prior to product development.

5. APPLICATION OF KANSEI ENGINEERING

The current exploration is based on selected Kansei Engineering model techniques extracted from 10 articles related to these methods from cited publications and resources, such as Elsevier, Science Direct, IEEE, and CiteSeer.

Researchers on Kansei Engineering applications have conducted several studies. The purpose of each study is to achieve various objectives, especially in analyzing Kansei words and measurement of a product in the context of design. To better understand the different approaches of Kansei Engineering towards fulfilling users' requirements and emotional needs, this paper characterized these techniques by empirically dividing them based on a study done by previous research. The studies are classified based on Topic, Domain, and Proposed Framework, as illustrated in Table 2.

6. PROPOSING A FRAMEWORK

Figure 4 illustrates the proposed framework for the Kansei Engineering methodology based on the previous section survey.

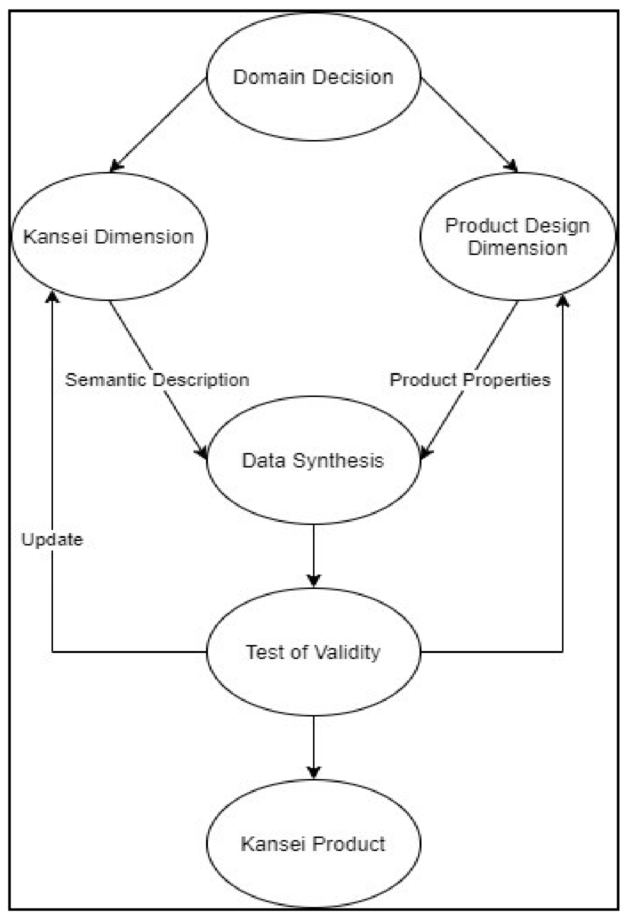

Figure 4: Kansei Engineering Proposed Framework

In the context of E-Commerce, domain decisions to act as a stimulus for the measurement of consumer emotions. The two yielded descriptions from the Kansei dimension and product design dimensions span a vector space each. Subsequently, in the data synthesis phases, the acquired spaces are integrated to present which of the substance's properties elicit a semantic effect. Only after the data synthesis has been carried out the Kansei Engineering implementation's validity test can be conducted. The two vector spaces (Kansei Dimension, Product Design Dimension) are updated based on the data obtained, and the synthesis step is re-run to ensure optimized results are acquired. When the outcomes from this iteration process are adequate, the Kansei product can be constructed to explain how the semantic and application space is associated. The synthesis process will extract the relation between Kansei and the E-Commerce design to construct a guideline to design optimized E-Commerce that satisfies emotional needs.

7. DISCUSSION

Kansei engineering has been developed in recent years as a design support technology to assimilate personal impressions, feeling, and imagery into a user-oriented design process. In this paper, the Kansei Engineering theory and methodology are explored and discussed to provide insights on the prior investigation in web interface design and E-Commerce correlation. The survey provides an in-depth understanding of systematically incorporating design theory and computer technology to optimize web interfaces to promote conversion and retention.

This paper elaborates on the existing types of Kansei Engineering and the Kansei Engineering approach application on product development. The technique and approach to be used depend on the domain and context, while several require combining more than one methodology. For example, Mazda Sports Car's product was enhanced using the Kansei Engineering Type I: Classification. With the advancement of mathematical analysis and web technologies, incorporating the Kansei Engineering technology appropriate technique will derive powerful results of a product.

This survey identified several approaches method of Kansei Engineering that can facilitate producers and designers to develop a Kansei product that presents implicit consumer needs that are difficult to quantify. The selected Kansei Engineering adoption study shows that the approach combines multiple instruments and media for Kansei extraction and measurement (questionnaire and EEG) and yielded more accurate consumer Kansei representation results.

This paper explains the advantages of Kansei Engineering, one of which is the fact that the methods and instruments used are obtained from various fields of research. This allows Kansei Engineering to solve problems using the most effective methods and flexible strategies to solve multiple domains. Kansei Engineering associates the research from different dimensions and incorporates the methods to construct a new whole. In addition, Kansei Engineering is often used as an independent methodology in practical implementation. However, in product development, Kansei Engineering is, at times, used as a tool to lead the whole process. As a result, Kansei Engineering is used as a complementary method in larger processes. In the literature review, Kansei Engineering is used in conjunction with other methods in product development such as QFD, Conjoint Analysis, or SMB.

The Kansei Engineering Framework has been proposed (Figure 4) based on an in-depth review of previous studies and literature from many previous studies. The Kansei Engineering from the framework indicates the concepts on which Kansei Engineering will enable the existing types of Kansei Engineering to be better understood and create areas for future expansion. The purpose of Kansei Engineering is to provide a model for the relationship between product properties and Kansei. The framework is built on almost all research. However, it is still difficult to state where this framework limit is valid. Such a limit could be the term of the selected Kansei, target group, product, or other.

8. CONCLUSION

The framework presented in this paper by Kansei Engineering presents a summary of the methods and tools used to analyze the relationship between an individual's psychological experience of a particular product and its design features. The paper defined the procedures of Kansei Engineering's, presenting the principle of Kansei Engineering that can be used as a reference for the application of Kansei Engineering in academics and industry. Unique emotional responses to specific product domains are also handled and carefully treated in Kansei Engineering studies. The proposed framework describes the various fields in Kansei Engineering and associates the available instruments from other fields to different steps. In some cases, it is difficult to use various tools for Kansei Engineering because many of the tools used in Kansei Engineering are borrowed from other scientific or technological fields. This results in the limited validity of the instruments used, and this should be considered when summarizing the Kansei Engineering study.

While the paper presents a standardized method for Kansei Engineering's introduction, the actual implementation action can be difficult in certain situations, as many of the Kansei Engineering instruments are borrowed from other scientific or technical fields that require some skills and experience.

A large number of these tools require a lot of resources and spend a lot of time, which affects the validity of the research and demands research at a high cost. Therefore, this paper proposes the entry of expertise from various fields into the research team to achieve optimal capabilities and success in its implementation. Future work is required to develop the understand and integrated instruments that can take advantage of the Kansei Engineering process's full potential to the derived optimum design specification of the product to promote retention and conversion.

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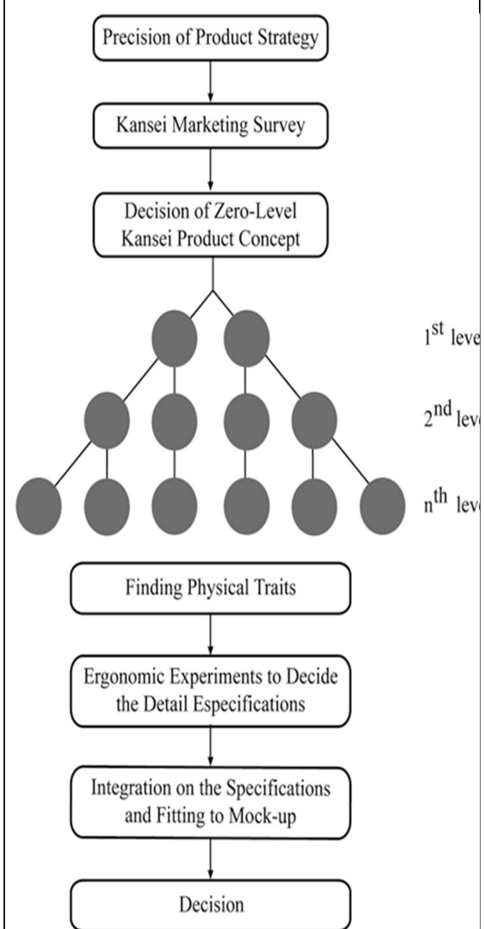
Table 1: List of Kansei Engineering Types

Type	Description	Method	Product Application	Structure
Kansei Engineering Type I: Category Classification	Category classification is a technique of breaking down the objective specification criteria from a targeted concept of a new product to the associated subjective Kansei.	Qualitative Research method	Mazada Sports Car (Nagamachi, 1999)	

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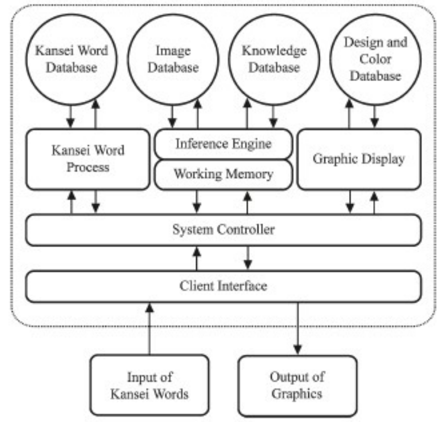
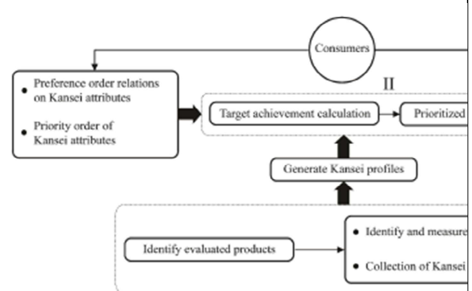
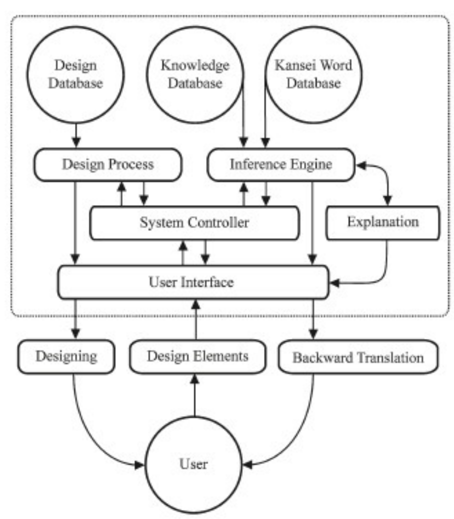
Kasei Engineering Type II: Kansei Engineering System (KES)	Computer Aided Kansei Engineering System, involves databases and inference engine to support a computerized system that handles the process of understanding the feelings and emotions of consumersto the aspect of perceptual design element.		• House Design Support System (Nagamachi & Nishino, 1999) • Flower Arrangement (Ishihari et al., 2007) • Fashion Image System (Nagamachi & Lokman, 2009)	
Kansei Engineering Type III: Modelling (Mathematical Framework)	Uses mathematical simulation in a computerized system as logic. Used to manage fuzzy logic to shape machine intelligence.		• Word Sound Diagnostic System (Nagamachi, 1993)	
Kansei Engineering Type IV: Hybrid	Kansei Engineering System by Forward KES and Backward KESform Hybrid KES. Enables iterative process form design elements to Kansei evaluation.		• High Heel Design (Chen et al., 2008)	

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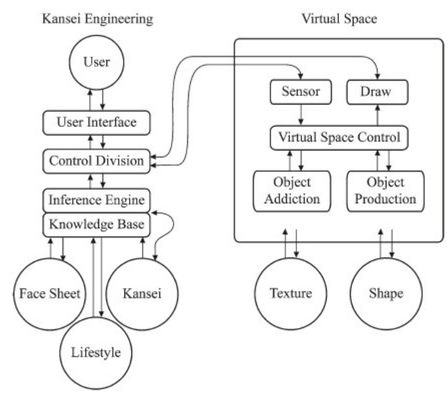
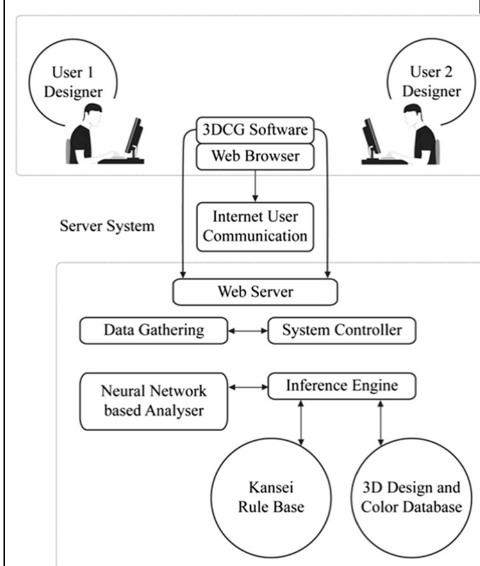
Kansei Engineering Type V: Virtual	Virtual Kansei Engineering incorporates Kansei Engineering techniques into virtual reality.to This allow consumer to analyse Kansei product in a simulated environment world		• Design of Kitchen Cabinet by Matshishia Electric Words (Enomoto et al., 1993)	
Kansei Engineering Type VI: Collaborativ e	A shared Kansei database is utulized by designers and consumers in different locations and collaborate through a network to construct a new design.		• Internet Collaborative Design System (Ishihara et al., 2005)	

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Table 2: List of Kansei Engineering Approaches

Source	Topic	Domain	Proposed Framework
Goh et al. (2015)	Application of Kansei Engineering Methodology in the Development of e-Government Job-seeking Websites	E-Government Job Seeking Website	1. Selection of domain 2. Span the semantic space 3. Span the space of properties 4. Synthesis • Factor Analysis 5. Test of validity 6. Model building
Hadiana & Lokman (2016)	Kansei Evaluation in Open Source E-Learning System	Open Source E-Learning System	1. Identification of specimens and Kansei Words 2. Kansei Evaluation 3. Synthesis • Principal Component Analysis • Factor Analysis 4. Recommendation
Lokman & Noor (2006)	Kansei Engineering Concept in E-Commerce Website	E-Commerce	1. Domain selection 2. Kansei measurement 3. Product attribute study 4. Synthesis 5. Kansei product
Ramachandiran (2013)	Kansei Engineering: Emotion Exploration in Blogs	Blogs	1. Student blogs 2. Blog visual information 3. Kansei evaluation • Self-reporting questionnaire • Data analysis
Anitawati & Nagamachi (2009)	Validation of Kansei Engineering Adoption in E-Commerce Web Design	E-Commerce	1. Synthesizing specimen 2. Establishment of Checklist 3. Determination of Kansei Concept and Requirement 4. Prototyping/Testing
Howard (2019)	Kansei Engineering and Web Site Design	Website Design	1. Synthesizing specimens 2. Establishment of Kansei checklist 3. Kansei measurement 4. Design scheme analysis 5. Prototyping and Testing
Khean et al. (2013)	Kansei Engineering for E-Commerce Sunglasses Selection	E-Commerce for Sunglasses	1. Collection of Kansei words 2. Structuring semantic differential (SD) scale for the Kansei words 3. Collection of specimens 4. Classification of item/category 5. Evaluation experiment 6. Statistical analysis 7. Interpretation of the analysed data 8. Identification of influential design elements

Hadiana (2018)	Study of Application Interface Based on User's Perception Using Kansei Approach	Application Interface	1. Collecting specimens 2. Collecting Kansei Words 3. Defining respondents 4. Gathering data questionnaires 5. Calculating questionnaire data and perform evaluation using multivariate analysis 6. proposing new design concept
Habyba et al. (2018)	An Affective E-Commerce Design for SMEs Product Marketing Based on Kansei Engineering	E-Commerce	1. Determining E-Commerce users 2. Collecting Kansei Words 3. Selecting Kansei words using TFIDF 4. Extracting Kansei words using PCA 5. New E-Commerce design concepts is generated 6. Collecting E-Commerce samples 7. Identify E-Commerce design elements 8. Generating the Relevant E-Commerce design elements 9. The relevant design elements is generated 10. Analysing their relationship using Q-TT1 11. Generating the highest value of partial correlation coefficient and category score 12. Design support information
Hadiana et al. (2016)	Kansei Engineering Implementation in Designing User Interface for Web Based Academic Information System	Academic Information Web System	1. Decision of strategy 2. Collection of Kansei Word 3. Setting of semantic differential scale of the Kansei word 4. Collection of product samples 5. A list of item/category 6. Evaluation of experiment 7. Multivariate statistical of analysis • Principal Component Analysis • Factor Analysis 8. Interpretation of the analysed data 9. Explanation of the data to designers