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# Kano's model in Kansei Engineering to evaluate subjective real estate consumer preferences

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ABSTRACT

Kansei Engineering is a product development tool used to identify users' perceptions and find quantitative relationships between their subjective responses and design features. This paper proposes the use of Kano's model in this process to analyse the impact of different subjective attributes on consumers' purchase decisions. A practical example of real estate promotions design is presented. In the first stage, semantic differential is used to measure the subjective component of the emotional state. In the second stage, regression analysis and Kano's model are used to define the relative weight of each emotional attribute in the purchase decision. Besides linear attributes, Kano's model identified two other kinds of attributes that present a non-linear performance: basic attributes and exciting attributes. Therefore linear models could underestimate the effect of such kind of attributes.

*Relevance to industry:* This information is very relevant for architects and designers as it enables them to determine the extent to which they must direct their efforts at improving certain attributes with the object of improving the global evaluation.

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## 1. Introduction

The study of perception in the sphere of architecture is of great interest to architects and designers, especially at certain times where the inclusion of user needs and preferences in housing design can give a competitive advantage for a real estate company, as in the case in Spain. At the beginning of this decade Spain had the highest rate of construction in the Euro zone countries, and in 2004 was five percentage points above the European average. The strong real estate sector and in particular the residential market took the construction of new properties in Spain to record levels. While in 1997 over 250,000 properties were built, in 2005 this figure exceeded 650,000. The situation, however, changed radically in the second half of 2008. The world economic crisis and excess supply in the Spanish real estate market brought a slowdown in consumption and investment. In fact, new housing prices dropped in 2009. This scenario is causing real estate companies to consider the need for strategies which could give them a competitive advantage in the market. This is where the study of user needs, desires and preferences becomes particularly important.

Several techniques can be used to translate consumer or user needs and preferences into product design characteristics. These techniques include Quality Function Development (QFD), which can be used to identify relationships between customers' (functional) needs and engineering characteristics (Akao, 1990; Cohen, 1995), Conjoint analysis (Green and Srinivasan, 1978) which provides information on which product characteristics are most important to the customer, and Kansei Engineering. Nagamachi defines Kansei Engineering as "translating technology of a consumer's feeling and image for a product into design elements" (Nagamachi, 1995). Kansei Engineering is a methodology developed in the 1970s at the Kure Institute of Technology (Hiroshima, Japan). Kansei Engineering has some advantages over the other above-mentioned techniques. Firstly, Kansei Engineering establishes a suitable framework for working with symbolic attributes and user perceptions, expressed in their own words. Other techniques base product development on user preferences for functional aspects considered in terms defined by experts. It also establishes a framework for quantifying the relationships between design characteristics and emotional responses (Nagamachi, 1989, 1995; Demirtas et al., 2009). These contributions are very useful in areas such as real estate, where emotional impressions can explain a significant part of the variance associated with the purchase decision.

In the real estate sector, several studies have analysed the relationship between a building's physical characteristics and the

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global evaluation of the building (Fig. 1(c)). Thus, studies have been done on the observer's preferred architectural style (Fusch and Ford, 1986; Nasar, 1989), roof shape (Sanoff, 1991; Stamps, 1991; Stamps, 1993), facade design (Nasar, 1983; Stamps, 1999; Akalin et al., 2009), and even how the building's age affects observers' global evaluations (Herzog and Gale, 1996; Hull, 1992; Stamps, 1994). Fewer studies, however, have applied Kansei Engineering. Some studies have focused on building design, both in the perception of property on sale as a whole (Llinares and Page, 2007), and in specific aspects of the building such as door design (Matsubara and Nagamachi, 1997a), facade design (Nagasawa, 1997), or kitchen design (Matsubara and Nagamachi, 1997b). The difference between these studies and previous studies is that Kansei Engineering considers that the subject's judgment is not only influenced by the stimuli (a combination of objective and subjective parameters), but also by the scheme of concepts of a concrete group of users (semantic space). In other words, to evaluate a situation appropriately the assessment variables must be adapted to that mental scheme. This conceptual structure must be identified before any relationship can be established between each perceived attribute, be it symbolic or physical, and the global evaluation of the product.

The introduction of a Kansei Engineering system requires the following process (Schütte et al., 2004). In a first phase, user response is obtained and quantified in terms of evaluating the product's "sensorial attributes". The most commonly used technique for measuring user perception of a product in Kansei Engineering studies is semantic differential (Osgood et al., 1957). It can currently be considered the most powerful quantitative technique available for measuring the affective significance of concepts (Ishihara et al., 1997). This technique consists of following a given structure in a questionnaire design using Kansei words as scales for evaluating the sample stimuli. Principal component factor analysis is the most commonly used technique for reducing dimensionality (Hsiao and Chen, 2006; Hsu et al., 2000; Jindo and Hirasago, 1997; Nakada, 1997; Schütte and Eklund, 2005; Tanoue et al., 1997). In a second phase, after obtaining users' affective dimensions or semantic axes (Kansei words), attempts are made to obtain inference rules between the design elements and semantic axes or perception variables. The most commonly used statistical technique for obtaining this relationship is known as Hayashi's Type I Quantification Theory (Hayashi, 1976; Matsubara and Nagamachi, 1997a; Jindo and Hirasago, 1997; Kim et al., 2003), which is a linear regression statistical technique for quantitative variables. An alternative to the search for inference rules in which linear relations between variables are not assumed is the use of neural networks (Ishihara et al., 1997; Lai et al., 2006; Lin et al., 2007), fuzzy logic (Shimizu and Jindo, 1995) and the genetic algorithm (Hsiao and Tsai, 2005; Hsiao et al., 2010; Tsuchiya et al., 1996).

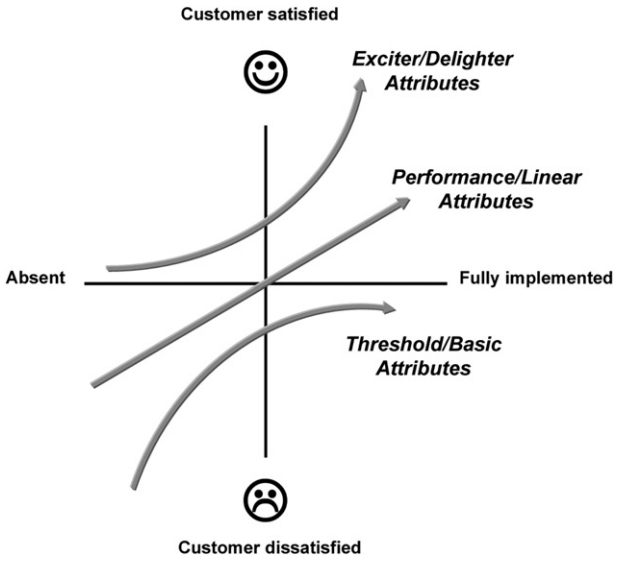


**Fig. 1.** Kano's model of customer satisfaction (adapted from Kano et al., 1984).

By applying Kansei methodology, we have identified design elements which provoke certain perceptions, but what emotional attributes or perceptions really influence the purchase decision and what is that impact like? This information is crucial for companies as otherwise they might direct their efforts towards improving attributes which do not improve consumer assessment. Furthermore, it would be relevant to analyse whether the relationship between consumer emotions and the purchase decision is linear. Presumed linearity involves considering that consumer assessments increase or decrease linearly as product attributes improve or get worse. However, in some cases these attributes can have a non-linear pattern, where the attributes which produce satisfaction are not the same as those which produce dissatisfaction. This non-linear behaviour requires special analytical techniques to identify the different effects which variations in product attributes may have on the consumer.

On these lines, there has been slightly more progress in the sphere of product development, where Kano's model (Cohen, 1995; Kano et al., 1984; Terninko, 1997), has provided a non-linear treatment of the contribution of different attributes to perceived quality. This model considers that the relationship between the fulfilment of a need and the satisfaction or dissatisfaction experienced is not necessarily linear.

Kano's model of Quality establishes three types of needs or requirements, differentiated by the type of response they induce in the user: basic attributes, exciter attributes and linear attributes. Basic factors are minimum requirements that cause dissatisfaction if not fulfilled, but do not lead to customer satisfaction if fulfilled or exceeded. Excitement factors are those that increase customer satisfaction if present, but do not cause dissatisfaction if they are not present. Linear factors lead to satisfaction if performance is high and to dissatisfaction if performance is low (see Fig. 1). Thus, Kano's model provides complementary information that is hidden in linear models.

By applying Kano's model several studies in different areas have demonstrated co-existing linear and non-linear attributes. Such studies have examined service quality in hypermarkets (Ting and Chen, 2002), the automotive industry (Matzler et al., 2004a), hospitals (Chen and Sun, 2006), logistics customer service (Huiskonen and Pirttïllä, 1998), web-community service (Kuo, 2004) and even, in a very different sphere, job dimensions which cause employee satisfaction (Martensen and Gronholdt, 2001; Matzler et al., 2004b). Until now, however, no studies have applied this technique to the building industry.

Along these lines, this present study proposes to include Kano's model in Kansei methodology to discover how emotional attributes (Kansei words) affect the property purchase decision (see Fig. 2). Kano's model will enable analysis of the particular features of this relationship, for example that acceptance or rejection of the property is only generated by one of the bipolar ends of the axes or sensations. It could be thought, for example, that the "quality housing" stimulation does not determine any reaction in the purchase decision whereas a negative stimulation might determine rejection. To achieve the study's objective following Kansei methodology, the set of adjectives, perception variables or conceptual structure used by the consumer to describe product-related sensations will firstly be determined by semantic differential.

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