Identifying customer behavioral factors and price premiums of green building purchasing

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ABSTRACT

In recent years, global urbanization and overdevelopment have resulted in environmental degradation and an energy crisis. Promoting green buildings is among the most effective methods for achieving environmental sustainability. Although the initial costs of green buildings are higher than those of ordinary buildings, people perceive that the environmental benefits of green buildings justify their higher price premiums. From a developer's perspective, devising optimal pricing strategies according to customer-perceived prices and developers' expected profit is complex and difficult. Hence, in this study, we developed a framework based on the Howard–Sheth model of consumer behavior to identify behavioral factors that may affect consumer purchases of green buildings. An artificial neural network (ANN) was then used to develop a pricing model for predicting the price premiums of green buildings. The results revealed that the ANN model's overall prediction capability was 94%; the model's robustness was demonstrated by comparing the results produced using the model with those produced using a multiple regression analysis. In addition, the characteristics of consumers who were willing to accept higher price premiums for green buildings were identified and discussed. The proposed model can be applied as an effective decision-support tool for green building pricing and formulating marketing strategies.

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1. Introduction

The construction industry is one of the largest emitters of greenhouse gases, and the energy consumed by this industry accounts for 40% of the global energy consumption (Tsai, Yang, Chang, & Lee, 2014). Increased awareness about the environmental sustainability of built environments is substantially changing the construction industry. Promoting green buildings has become crucial to sustainable development (Tatari & Kucukvar, 2011). The concept of green building focuses on improving the efficiency of resource use, including the use of energy, water, and various types of materials, as well as reducing the environmental damage caused by buildings during the building's life cycle (Tam, Hao, & Zeng, 2012). To mitigate and measure the environmental impact of buildings, many green building rating systems, such as Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Methodology (BREEAM), and GBTools, have been developed (Building Research Establishment Global, 2008; Council, U. G. B, 1999; Green Building Council Green Building Tool, 2005).

Because of increased environmental awareness, the focus on green consumption has increased and the market value of green products has grown substantially. For instance, the estimated value of the global green building market was US$195 billion in 2010 and was estimated to reach US$600 billion by 2015 (GBI-Research, 2010). Some studies have indicated that people were willing to pay more to purchase green products, and this behavior was implicitly affected by consumers' personal traits and characteristics (Sheehan & Atkinson, 2012; Stern, 2000). From a developer's perspective, devising optimal pricing strategies according to the factors influencing customer-perceived prices and developers' expected profit was complex and difficult (Hostetler & Noiseux, 2010).

Several studies on green buildings have emphasized environmental assessment tools and methods (Ali & Al Nsairat, 2009; Schlueter & Thesseling, 2009), technology and energy simulation (Sailor, 2008; Scheuer, Keoleian, & Reppe, 2003), optimization design (Wang, Zmeureanu, & Rivard, 2005), industry analysis and developmental policies (Chan, Qian, & Lam, 2009; Eichholtz & Quigley, 2012), and local case studies (Cheng, 2003). Moreover, researchers have attempted to determine and predict the construction costs of green buildings, reporting that an average cost premium for green buildings ranges from 1% to 6%, according to different certification levels (Mapp, Nobe, & Dunbar, 2011; Tatari & Kucukvar, 2011). However, few researchers

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have investigated pricing strategies and factors that may influence green building prices from the perspective of consumer behavior.

The objective of the present study is to identify behavioral factors that may affect customer purchases of green buildings and develop a pricing model for predicting the price premiums of green buildings. We first investigate customer behavioral factors according to the Howard–Sheth model of the theory of consumer behavior and acceptable customer price premiums. Subsequently, the relationship between behavioral factors and the price premiums of green buildings will be examined using various statistical approaches. Furthermore, to develop an artificial neural network (ANN)-based model, we use the refined behavioral factors as inputs and price premiums as outputs to predict the price premiums of green buildings. Multiple regression analysis will be then performed to validate the model's overall prediction capability. The limitations and challenges in implementing the model are also discussed in this paper.

2. Green consumer behavior

2.1. Green consumerism

According to Pieters (1991), green consumerism is a consumption activity that satisfies human needs or wants with a minimal detrimental impact on the natural environment. In 1991, the International Organization of Consumer Unions (IOCU) adopted a resolution on green consumerism in the IOCU World Congress to introduce ecological awareness and green consumption concepts into product and service evaluation (Ko, Hwang, & Kim, 2013). Recently, green consumerism has received increasing attention in the domains of marketing and environmental policy (Nyborg, Howarth, & Brekke, 2006). The emergence of green consumerism has also stimulated the awakening of "green consumers," who accept individual responsibility for the provision of green products and services.

Research regarding the purchase of green products and services has increased over the past few years (Young, Hwang, McDonald, & Oates, 2010). Some studies have revealed that these green consumer purchases were affected by consumer personal traits and behavior (Stern, 2000). For example, Farhar (1999) indicated that 52%–95% of private households in the United States were willing to pay a price premium to buy electricity that was produced using renewable energy technology and that this propensity may depend on beliefs regarding the behavior of others and internalized moral norms. Laroche, Bergeron, and Barbaro-Forleo (2001) explained why consumers were willing to pay high prices for ecological products, according to five factors: consumer demographic characteristics, knowledge or ecoliteracy, values, behavior, and attitudes. Furthermore, Gao and Mattila (2014) reported that consumers were more satisfied when they stayed in green hotels than they were when they stayed in nongreen hotels. Chau, Tse, and Chung (2010) also reported that green housing residents were willing to pay more to enjoy green landscapes and facilities. These studies have shown that consumers were willing to pay more for green products and services, and these behaviors are implicitly affected by consumers' personal traits, characteristics, and behavior (Sheehan & Atkinson, 2012).

2.2. Theory of consumer behavior: Howard–Sheth model

Several scholars have explained consumer behaviors and their influence on marketing strategies (Rahbar & Abdul Wahid, 2011; Valette-Florence, Guizani, & Merunka, 2011), policy development (Hanimann, Vinterbäck, & Mark-Herbert, 2015; Lee & Kim, 2013), and service design (Theotokis & Manganari, 2014). Theories and models, such as the Nicosia, Howard–Sheth, and Eagle, Kollat, and Blackwell models, have been proposed. Among the various research models, the Howard–Sheth model was the most widely used. Howard and Sheth presented the theory of buyer behavior in 1969 and claimed that input and external factors can be crucial in stimulating purchases. Through the generation of motives in consumers, stimuli can provide various selection messages that affect buyers' psychological activity (an internal factor). The Howard–Sheth model examined buyer behavior through learning and classified consumer purchase decisions into three categories: extensive problem solving, limited problem solving, and routine problem solving. As shown in Fig. 1, this model comprised four components of consumer behavior: *input variables*, *hypothetical constructs*, *output variables*, and *exogenous variables*. The *input variables* consisted of stimuli, which served as customer information; *hypothetical constructs* were the intervening variables that influenced customer output decisions; *output variables* were the customer responses; and *exogenous variables* were the external factors that influenced customer decision-making (Howard & Sheth, 1969; Sheth, 2011; Sheth & Parvatlyar, 1995).

2.3. Price premium

A price premium refers to a product's or service's price that exceeds a market price under normal competitive conditions (Fuerst & McAllister, 2011). In other words, on the basis of green consumerism, the price premiums of green products and services are higher than those of nongreen products and services under the same market conditions. Many studies have investigated the range of price premiums in green building markets. For example, Fuerst and McAllister (2009a,b, 2011) have indicated that the rent of office buildings with green building certifications was 8% higher than that of ordinary buildings. Yoshida and Sugiura (2013) also examined residential apartments in Tokyo and reported that the price premiums of green buildings were 10.3%. Moreover, Fowler, Rauch, Henderson, and Kora (2011) assessed LEED-certified buildings and concluded that their price premiums ranged from 1% to 8%, according to the different LEED certification levels.

In construction markets, price premiums incentivize developers to employ green building technology or materials to differentiate themselves from other developers and increase competiveness. Consumers are also willing to pay more to live in green buildings and built environments. To achieve this win–win goal, optimal pricing strategies must be developed and appropriate price premiums must be determined according to consumer-perceived prices and developers' expected profit.
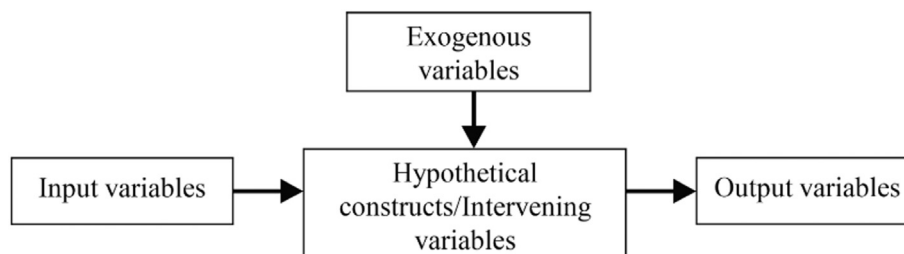

Fig. 1. Major components of the Howard-Sheth model.