



Green Building Perception Matrix, A Theoretical Framework

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Abstract

Research has consistently shown that architects differ from the public in what they prefer in buildings. Today, as building design and construction evolve to more sustainability, some recent studies show that the overall level of satisfaction of occupants of green buildings still does not exceed the level of satisfaction in conventional structures. Satisfaction is typically measured, with Post Occupancy Evaluation, which gathers feedback from building occupants about aspects such as comfort, indoor air quality, and aesthetics. This raises some questions: Do people perceive green building design as consistent with their desire for sustainability? Do ratings of green buildings by systems such as LEED or BREAM affect the level of satisfaction of laypeople? Can owners and occupants of green buildings be considered as green consumers, who are attracted to green products because of their willingness to mitigate the impact of human activities on the environment? This article examines Peattie's (2001) green purchase perception matrix as a means of understanding occupants' perceptions of green-labeled buildings. Additionally, two other concepts from consumer behavior studies: Schema Congruity and Stimulus Organism Model have been discussed. An analytical approach has been taken to identify the influential factors. As a result, the authors propose a green building perception Theoretical framework that addresses different situations which leads to a degree of compromise that occupants could accept in green buildings and level of confidence that building systems are indeed making a difference environmentally. Understanding and using this framework may help green building designers to improve the level of satisfaction of building's owners and occupants. The discussion is critical for future research on how green building design attributes can be used as a catalyst for green consumption behavior.

Introduction

Modern humans spend more than ninety percent of their lives indoors (Bruce, Perez-Padilla, & Albalak, 2000; Lee & Guerin, 2009; Spengler & Chen, 2000), hence buildings are a venue for consumption behavior and are intricately tied into our quality of life and well-being. Building design can directly affect the health, wellbeing of the occupants (Altomonte & Schiavon, 2013; M. Frontczak et al., 2012; Monika Frontczak & Wargocki, 2011). Numerous studies in psychology, marketing, and retailing, have noted that consumption behavior is

directly influenced by the design of the physical environment (Kotler, 1974). For example, the quality of a building's architecture, layout and the interior design of the facility, may strongly influence how long customers will stay in the store or restaurant and how often they will return to it. Likewise, the layout and design of a stadium or arena may partly determine whether sports fans will stay for the entire game or exit early to avoid congestion at crowded games (Wakefield & Blodgett, 1996). Building design also affects the health, wellbeing, and productivity of employees and hence organizational outcomes (Baird, 2011; Feige, Wallbaum, Janser, & Windlinger, 2013; Heerwagen, 2000; Huang, Zhu, Ouyang, & Cao, 2012; Wyon, 2004).

With increasing global concerns about environmental degradation and resource depletion, architects have been directing their attention toward building design and construction practices that are more resource efficient. The wide adoption of sustainable building design and construction is a manifestation of this concern and is anticipated to replace conventional methods and practices (Altomonte & Schiavon, 2013; Fillingham, 2004; Liang et al., 2014; Singh, Syal, Grady, & Korkmaz, 2010). The aim of sustainability in buildings is to satisfy present needs while at the same time preserving a healthy living environment for future generations. This means creating living conditions that are ecologically compatible, economically acceptable and which give users' needs top priority (Beatley, 1997).

While sustainable buildings can affect ecological, economic, and socio-cultural factors (Sobek, Sedlbauer, & Schuster, 2009), much of the current practice in sustainable design is driven by environmental factors. This focus on environmental factors may be partially driven by the common understanding of sustainable practices as encompassing primarily green practices (Simpson and Radford 2012). This positive, albeit limited attitude towards sustainability is exhibited in sustainable products (Peattie, 2001), sustainable practices (Aragon-Correa & A Rubio-López, 2007), and indeed sustainable buildings (Browne & Frame, 1999). However, by focusing primarily on the environmental dimensions of the built space, architects may be underestimating the importance of the ongoing economic costs to owners and social effects of green buildings on occupants. Even though many people support the idea of sustainability there is a surprising lack of knowledge and understanding of both sustainability and sustainable development (Kagawa et al, 2007). This may partially explain findings by Mansour (2014), which suggest that building users think that green buildings are cold and aesthetically unpleasant.

Because of the positive marketing, public communication, and potential benefits of green buildings, they are often perceived as a 'good thing' (Kagawa et al 2007) or even better than conventional buildings (Wiley, Benefield, & Johnson, 2010). However, this perception has not always been validated by occupants of these buildings, as they have a more intimate interaction with and knowledge of building elements such as aesthetics, lighting, ventilation, acoustics, and humidity. In fact there is little evidence to believe that green buildings are more comfortable than conventional ones (Paul & Taylor, 2008) moreover, ongoing interaction and activity in green buildings may even lead to some negative attitudes and perceptions (Mansour, 2014).

Although there are many studies that investigate the process of consumer perception and behavior while purchasing green products, little attention has been paid to laypeople's' perception and behavior while interacting with green buildings. The differences between green consumers and green building occupants might have hindered such reflection and establishing this connection. There is a clear difference between the decision makers in green buildings and green products. For example, for green products the customer is often both the decision maker and the consumer of a product. While with building design, the owner of the building is not always the occupant who will spend all of their time in this building. Therefore, the occupants of green building may not place a high value on green building design, and it may have been imposed upon them with little choice or input. However, the occupants of green buildings are integral to their success as a successful green building must demonstrate

ongoing energy conservation and minimize resource depletion, which will be directly tied to the actions of building occupants.

Building designers must consider three specific segments: 1) The decision makers or *building owner*, who intentionally buy or build a green building for their use or for investment purpose. People in this category base their decision on previous experiences or knowledge acquired from the media and possesses an appreciation for green construction. (Shiv & Fedorikhin, 1999). 2) *Occupants* who live or work in green buildings with little input or choice into the building design or materials. This is a much larger category as LEED certification is primarily used by commercial and multi-occupant buildings as opposed to homes or private. People in this category may or may not be green oriented. 3) *Visitors*, who are using or passing by a green building for a short period of time, subjects in this category are made aware through some sort of media that this building is green. The primary purpose of communicating the value of green buildings is to increase the satisfaction or delight of these visitors, to raise awareness and support for green oriented behavior and better green built environment.

There is a long history of research about well-being in the built environment. This research has addressed many important outcomes such as happiness (Diener 1984; Wright 2006) and job satisfaction (Johnston, Varadarajan, Futrell, & Sager 1987) as well as different types of well-being such as personal, psychological, and subjective well-being (Wright & Bonett 2007). Most of the research on well-being tends to share three characteristics for human well-being (Cropanzano and Wright 2001; Diener 1984). First, well-being is a subjective experience; second, well-being includes the presence of both negative and positive emotions; and third, well-being is a global judgment (Radford, et al. 2013). As well-being includes the presence of both negative and positive emotions, In this study, the authors consider the occupant's perception of green buildings, with contradicting emotions toward the environment, as a key factor for enhancing their well-being and creating a sustainable relationship with their built environment.

The purpose of the current research is to elucidate the perceptions that building occupants and visitors have with respect to green buildings and propose a theoretical model that explains the process that leads to their evaluations of these built spaces. In addition, we disclose an important issue; the conflict between the architects' perception versus users' perception of green buildings. This research draws from research about green products in marketing and develops and applies it to the context of green building design and occupant behavior. Some external influences such as belief in the need for sustainability, and schema congruity will also be discussed.

Perception of green products

Essoussi and Linton (2010) stated that the process of buying green is still difficult to understand. Generally, consumers express a concern for the environment, but their attitudes do not always translate into a purchasing behavior. Further, attitudes in relation to concern for the environment have not been explicitly analyzed and the relationships between green attitudes and values and behavior are still ambiguous. (do Paço, Alves, Shiel, & Filho, 2013). Understanding the mechanism of perception of green products is useful for a number of reasons: from the consumer perspective, a product that is environmentally preferable relative to comparable products is a green product (Bonini & Oppenheim, 2008; Chen, 2001; Hopkins & Roche, 2009; Tseng & Hung, 2013), similarly for building design – a green building is environmentally preferable relative to comparable conventional buildings. Perception of green products has long been studied in the field of marketing which eventually established a sub discipline known as green marketing. In building design and construction practices, perception of green building has received little attention in the literature; instead, numerous studies discuss the users' satisfaction and comfort in green buildings through post occupancy evaluations (Altomonte & Schiavon, 2013; Baird & Field, 2013; Hitchings, 2009; Huang et al., 2012; Lee & Guerin, 2009; Liang et al., 2014).

There is much that can be learned by drawing from this extensive literature in the domain of green marketing. We propose that enhancing the green consumer experience in the design and construction of green building practices will lead to more sustainability in the urban environment. For example, marketers use the term *servicescape* to describe the physical environment in which a service exchange takes place (Bitner, 1992) and *atmospherics* to describe the ambient and design factors that influence in-store consumer behavior (Kotler, 1974). Exploring the interaction between occupants and visitors with the purposeful design elements of green buildings, will help architects to understand how people respond to these spaces and will also help engender greater acceptance of green building practices and the green aesthetic. This is crucial to the growth of green buildings and a more sustainable built environment. As noted by Kotler (1974, p. 48) "One of the most significant features of the total product is the place where it is bought or consumed. In some cases, the place, more specifically the atmosphere of the place, is more influential than the product itself in the purchase decision. In some cases, the atmosphere is the primary product". Green buildings need to ensure that they are thinking of the total product – both the aesthetics of the building but also the experienced functionality and satisfaction of occupants.

In this paper we draw from three marketing concepts that have been used to study green consumer behavior: *Schema Congruity*, which links the perception and preferences of consumers to the congruity of the product appearance and function with certain schema exists in the market (Meyers-Levy & Tybout, 1989; Purcell, 1986); *Stimulus Organism Response* or S-O-R model, which added many personal and environmental related, factors to the simple stimulus response model (Jacoby, 2002; Vieira, 2013); and Peattie's (2001) concept of *confidence* and *compromise* as two factors associated with any green purchasing situation.

People make evaluative judgments of objects based on the comparison between their past knowledge and experience in the product category (Schema) with new stimuli that they are being exposed to. Research has consistently shown that consumers prefer goods that have moderate incongruity with respect to existing products (Bloch, 1995; Meyers-Levy & Tybout, 1989). The level of congruity between products and their associated product category schemas affects processing and evaluative judgments of a product (e.g., Cohen and Basu 1987; Fiske 1982; Fiske and Pavelchak 1986). Products that are a perfect match with past schema are seen as uninteresting or boring, while products that are a complete mismatch cause people to withdraw as they are unable to reconcile the new stimulus with the product category. In contrast products that are moderately incongruous engender more effortful processing of the stimulus, and hence become more interesting and more engaging (Myers-Levy and Tybout 1989). Similarly green buildings tend to challenge the conventional 'building' schema, by using different materials and spatial configurations. This should engender more effortful processing and more interest, however the building cannot be so different that people cannot reconcile the structure with their building schema. To date there is no work in the literature that has addressed the role of schema congruity in building design.

Mehrabian and Russell (1974) propose the S-O-R model to demonstrate the effect of environmental factors on the behavior of consumers in a purchase situation (Chang, Shu, & King, 2014; Joseph-Mathews, Bonn, & Snepenger, 2009; Vieira, 2013). The environment within which the decision is made serves as a stimulus to the decision maker. Mehrabian and Russell propose that the environment could be positively loaded (i.e. novel, surprising) or negatively loaded (uninspiring, usual, dull). The environment has the potential to create arousal on the part of the individual (Richardson, Jain, & Dick, 1996). A positive load would result in pleasurable arousal. This would manifest itself through feeling good, joyful or happy. On the other hand, a negatively loaded environment would lead to feelings of disappointment, lack of fulfilment or a sense of loss. In green buildings, we argue that positively or negatively loaded environment will have similar effects on laypeople, these effects will influence

the approach or avoidance behaviors toward sustainably designed buildings. Studying the design of green buildings in light of S-O-R model could help in fostering more positive attitudes and behaviors to sustainable environments.

Peattie (2001) explains the purchasing behavior of green consumers in a matrix, he introduced an alternative approach to understanding green consumer behavior. This matrix brings together two key variables that affect the likelihood of any purchaser being influenced by environmentally related criteria when considering a purchase: the degree of *compromise* involved and the degree of *confidence* in the environmental benefits of a particular choice. Many green purchases involve some form of compromise over conventional purchases. The compromise can take a variety of forms including: Paying a green premium, accepting a lower level of technical performance in exchange for improved eco-performance, or travelling to non-standard distribution outlets (Peattie, 2001). In green buildings, the compromise can also take a variety of forms including: accepting lack of personal control on indoor air temperature due to the automated HVAC systems required for energy saving purposes, also accepting the look of certain types of recycled finishing materials to conserve the natural resources, or having the location of the building in a reclaimed site for the sake of sustainability. The second dimension, confidence, concerns the certainty that people have that their actions or the actions of others are making a difference. While many products make some sort of green claim, consumers also have an underlying cynicism towards green product claims. For example, hotels will ask consumers to hang up their towels to reduce the environmental footprint, but the astute and cynical hotel guest will question how much of a difference this really makes and whether the hotel's motivations are environmental or more likely financial. Therefore, according to Peattie (2001) confidence stems from whether the issue is a real problem, that the offering from the company is better than competitors, and that buying the product will make a material difference. Certification systems are often used as a device to raise confidence and counter consumer skepticism towards green products and service. A pervasive understanding of the level of confidence perceived and degree of compromise offered by laypeople in a green building is crucial to architects and engineers while making sustainable design decisions.

Factors involved in the perception of green buildings

Recognizing the behavioral and psychological influence on green building design that can be drawn from consumer studies and marketing, it is important to understand the factors in building design that surround the perceptions of green buildings. These factors may include general public perceptions garnered from media, the presence and influence of certification systems such as LEED, and the aesthetic incongruity of the design relative to conventional design schemas. Therefore, we will proceed to review the factors that influence the perception of green building design and categorize them under the environmental categories of green building rating systems and the experiential categories of a physical setting. The categorization also considers two levels of interaction with a green building: *Initial Perception* and *Extended Interaction*. With initial perceptions (first impressions) one is primarily influenced by publicly available information that is independent of the experience in the space. This may include media stories, information published, word of mouth anecdotes about the building and awareness of certification. These factors together with past experience with buildings will help form the category schema that will be used to evaluate the building from a primarily aesthetic perspective. In the second stage of perceptions, extended interaction, building users experience the building and gain a more complete picture about the advantages and disadvantages of the building. This includes the evaluation of building competency in terms of some functional and non-functional issues. Doxtater (2005) suggests five categories that can be used as indicators for laypeople's perception of their experience in a building: task performance, way finding, social territories, cultural expression, and visual and nonvisual aesthetics.

Task-performance is the efficiency of physical tasks depending upon the environment as a "tool," e.g., producing things, moving people and objects, storing goods or information, adjacencies, communicating with others,

accessibility, making places secure, avoiding injury, and reducing interruption or disturbance while working. Way finding is the cognitive connection of landmarks and other characteristics by particular users with particular destinations across a larger spatial setting. Social territories are environmental activities that have the primary intention of maintaining social identities and organization of individuals and/or groups. Which aspects of the environment are appropriated for dangerous behavior, privacy or exclusivity (including crowding), spontaneous socialization. Cultural expression refers to attaching spatial and object associational/symbolic meaning in a setting for some social purpose. How do historical references, artwork (beyond visual aesthetics), personalization, organizational or professional themes, or religious artifacts help influence values or beliefs? Are there patterns of formal, ritual-like spaces and activities through the setting?. Visual and non-visual aesthetics are inherent or personally developed responses to natural and architectural forms that are perceptually pleasant or unpleasant. Visual and spatial pattern, the kinesthetic movement of the body, texture, color, sound, aroma, warmth, coolness -all can be stimulating, boring, or offensive (Doxtater, 2005).

Figure 1 shows these factors in a form of a puzzle as all factors are interrelated and depend on each other. At the heart, four main factors are laid as the central constructs: Building certification level, belief in sustainability, schema congruity, and users experience in the building. Surrounding the certification level, three major factors, which are used in every green building rating system are environmental categories of evaluation: energy savings, water efficiency, and materials and resources. These three factors are also connected to the sustainability of the site which also affects the level of certification and the confidence in sustainability. Indoor air quality is another important environmental category used in green building rating systems and it is laid at the bottom connected to energy savings and of course it directly affect users experience of a building.

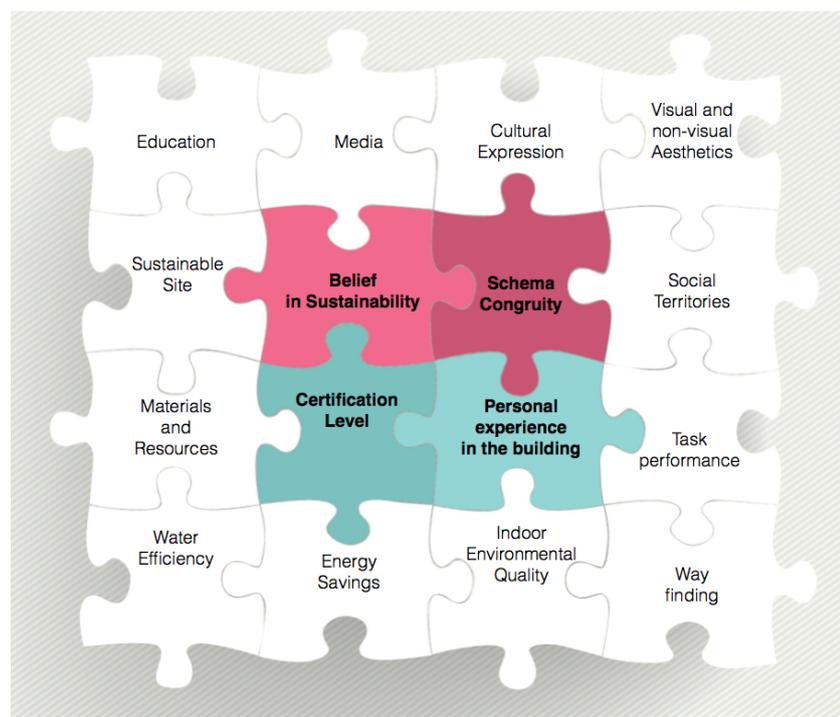


Figure 1. Factors affect the perception of a green building

Belief in sustainability is surrounded by sustainable site as an environmental category of green building evaluation, education and media as these form peoples understanding and beliefs. On the right hand side of the puzzle, schema congruity and users' experience of the building are surrounded by Doxtater's five categories of experience: cultural expression, way finding, task performance, social territories, and visual and non-visual aesthetics. These five environmental categories are experiential categories that indicate the users' experience of a building. By looking at the sub factors that surround the four

core factors, one can easily notice that five of them are the main five environmental categories commonly used in green building rating systems, and five of them are experiential categories that are rarely considered in green building rating systems, in addition the other two sub factors – education and media – commonly affect the perception of any object in the world. By reflecting the S-O-R model, schema congruity concept, and Peattie's concept of confidence and compromise, on these factors, a conceptual framework has been generated for the perception of green buildings at the initial perception stage that eventually evolves to an evaluative judgment for green buildings in a later stage.

Conceptual framework

At very early stage of contact with a green certified building, laypeople's perceptions are driven by their belief in the need for sustainability and the degree of certification of the building as it indicates the environmental considerations of the design. In a green purchasing situation, Peattie (2001) indicates similar components and motivations. However, unlike Peattie's matrix which links the degree of confidence, that the product will make difference in terms of its impact on the environment, to the personal evaluation of the product's attributes by each purchaser, in the context of green buildings, the degree of confidence is linked to the level of certification which is always concluded by a third party who evaluates the design and construction of the building, without much knowledge about the details offered for laypeople. Also in Peattie's matrix the degree of compromise is related to the level of confidence in a green product, while in a green building perception, the degree of compromise is affected by person's belief in sustainability as a catalyst for willingness to compromise. Figure 2 adapts Peattie's matrix to the initial perception of a green building,

Based on Peattie's matrix, the level of confidence and degree of compromise leads to four different green purchasing situations: Higher confidence with lower compromise is a win-win situation, higher confidence with higher compromise is a feel good purchase, lower confidence with lower compromise is a why not purchase, and lower confidence with higher compromise is a why bother purchase. The four situations are affected by the purchaser's degree of belief in the importance of green products.

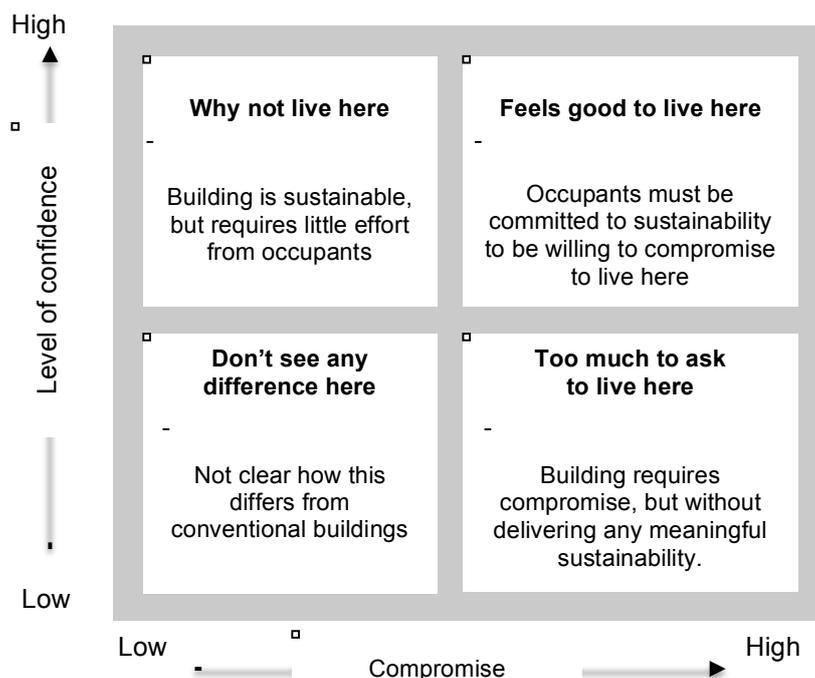


Figure 2. The green building perception matrix.

In contrast to green products, we have modified Peattie's matrix to reflect perceptions of green buildings. In this taxonomy we specify four situations based on the level of confidence and the degree of compromise as perceived by the layperson. The definition of the level of confidence in green building perception is similar to the level of confidence in a green purchasing situation as both express the confidence that a product or a building will make a difference in terms of its impact on the environment. However, the degree of compromise has different forms in both cases. In a green product purchasing situation, the compromise can take a variety of forms including: Paying the green premium, accepting a lower level of technical performance in exchange for improved eco- performance, or travelling to non-standard distribution outlets. These kinds of compromises offered by the purchaser and are not driven by the product's attributes (Peattie, 2001). In green buildings, the compromises will take a variety of different forms for the user or visitor. For example, users may need to accept a lack of personal control on indoor air temperature due to the automated HVAC systems required for energy saving purposes, accept the look of certain types of recycled finishing materials to conserve the natural resources, accept the design incongruity with conventional buildings and anticipated level of comfort, or may have to travel to a building in a reclaimed site for the sake of sustainability. If these kinds of compromises are offered to green building occupants by the designers, then laypeople will have a degree of acceptability for them.

According to the proposed model, there are four major situations laypeople have at the very early stage of contact with a green building. First, is the ideal cell in this matrix: *why not live here*. In this cell, the building exhibits high confidence for users through certification, while at the same time users give little up in the form of compromise. This is the win-win situation where consumers can support green buildings, while having to make few changes to their own actions or behaviors. This is the ideal cell, however, we know that this is also likely the most difficult cell to achieve. For example, many of the compromises inherent in green buildings serve the purpose of achieving certification, and hence high confidence. Therefore, it is likely that there will always be some compromise, the challenge for designers to achieve this cell is to identify the compromises that are the least significant for users, while minimizing the impact of the more important compromises. The next cell, *feels good to live here*, also describes a high confidence situation, however, in this case there is greater compromise required of the building users. The compromises may be no greater than the first cell, however, they may be compromises that are more substantial and important to the building user. A building in this cell of the matrix will require a great deal of compromise from the building occupants, therefore, it is likely to appeal primarily to occupants who place a great deal of importance on green building and are willing to make personal sacrifices to live and work in this environment.

In contrast to the first two cells, are buildings that are low in confidence. These buildings either have lower certification levels or perhaps none, while at the same time they are promoted as green. In cell three, *don't see any difference here*, there is little difference in this building from conventional buildings. The confidence is low, while at the same time there is little compromise demanded of the user. This cell is likely to encompass minor changes to existing buildings, or buildings that are paying lip-service to green building practices while making few changes. The average user is going to see little difference between this building as a conventional building. Buildings in this cell are likely offering only incremental green building changes, and would therefore offer little interest as they do not differ substantially from the building schema. Moreover, buildings in this cell will do little to advance the cause of green building design. Finally in the fourth cell, are the situations that will alienate building users and tarnish the reputation of green building design. In this cell, *too much to ask to live here*, there is little confidence in the positive impact that the building is making, while at the same time it is demanding a great deal of compromise from the building users. Unfortunately, this is a common occurrence in green building design as users feel that they are making all the sacrifices without really understanding the benefit that the building has to the environment (Mansour 2012). If the

building is indeed making very little environmental difference, while at the same time demanding a great deal of compromise from users, then we must question the usefulness of such a building. However, in many cases this is a function of poor communication and marketing. If users are not fully aware of what green building really entails (Kagawa et al 2007), then they may only be cognizant of the dimensions that affect them, while not being aware of the benefits of such a space. Therefore, all is not lost, and buildings in this cell could be moved up to cell number 2, if they do indeed belong there.

Conclusion

Although schema congruity is rarely reflected on building design perception except some building exterior studies (Nasar, 1994), it is helpful to apply the concept of schema congruity in the case of green building design perception with its incongruity with the design schema of the existing conventional buildings. The incongruent design features such as using native or adapted plants around the building, lack of control over building internal environment to save energy, using automated washroom fixtures to save water, and some visual characteristics such as using unfinished and recycled materials in the interior decoration might help in developing the proposed matrix in a detailed manner. Also, using the S-O-R model for analyzing the series of consequent stimuli that affect laypeople's judgment on a green building is critical for designing better sustainable buildings in the future.

In this study we propose a framework for the mechanism of people's perception of green buildings. The perception model is based on Peattie's 2001 green purchasing matrix. Although proposed model is based on Peattie (2001) matrix, there are some intrinsic differences between green consumers and green building users. For example, in the case of a commercial or office building, the user will not buy this building, so that when discussing laypeople's behavior as green consumers, the economic factor is not on the same scale of importance in a green purchasing situation. Also building users are not consuming the building for the entire life cycle, unlike most green products. These two factors affect the perception of building users in a positive sense because they do not have to pay a premium, so that they are willing to give higher degree of compromise and they might have higher level of confidence based on their belief in sustainability.

There are four major factors affect the perception of green buildings: degree of belief in sustainability, degree of green certification, the congruity of design with the existing schema of similar conventional buildings, users' personal experience in the building. Occupant's belief in sustainability, and a building's degree of green certification are the major drivers of laypeople's judgment on a green building. More deeper or final judgment depends on one's evaluation of building's design schema and its congruity with the existing schema in conventional buildings, and one's experience of building systems over period of time. Occupants' experience can be categorized in to five categories of experience; task performance, social territories, way finding, cultural expression, and visual and nonvisual aesthetics (Doxtater, 2005). The environmental and experiential factors constitute certain judgment, which influence the level of confidence one has in a green building, this degree of confidence is similar to the confidence one has for a green product. The judgment also affects the degree of compromise, which laypeople can offer as a trade for having the environmental benefits of a green building.

Improving the profile of green building design, and hence engendering more design and construction of green buildings is intricately tied to the engagement of laypeople and consideration of their well-being. Successful green buildings must not only use appropriate materials and resources in constructs, but must also demonstrate ongoing sustainability through conservation of energy and resources such as water. To be successful, this requires the participation and engagement of occupants of the building. Therefore, the engagement and commitment of occupants to the mandate of green buildings is an important factor that must be considered at all phases of the design process. The current paper offers just a first idea about how designers can develop a better

understanding of the factors that will motivate occupant satisfaction with a green space. Future research is still required to understand qualitatively and quantitatively how this will influence users ongoing interactions with green space and the desire for more green building design.

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