Basic Research for Causal Analysis of a Low-rate of G-SEED Certified Apartment Buildings

Kim, JungHwa[1], Lee, Hyun-Soo[2], Park, Moonseo[3] and Lee, Seulbi*[4]

Abstract: As environmental issues have been increased globally, eco-friendliness in the construction area, which accounts for more than 30% of total GHG gas emission has being urged. In response, the Korean government has implemented G-SEED(Green Standard for Energy and Environmental Design) certification from 2002. However, total number of certified apartment buildings is only around 1% of total number of approved apartment buildings. As a basic research to find out reasons of low rate of the certification, this paper analyzes consumers' decision-making process in G-SEED certified apartment building market comparing to non G-SEED certified one and draw System Dynamics modeling based on causal relationship. As a result, consumers' demand for the certified one is increased by 'Perceived Relative Utility' which is resulted from comparison process with non-certified one. The 'Perceived Relative Utility' is ascended upward steadily by 'Relative Perceived Price' considered as relatively short-term effect and 'Favorable Image of Certified Housing' referred to long-term effect.

Keywords: Green Building Certification, G-SEED, Apartment Building, System Dynamics, Consumer Decision-Making

I. INTRODUCTION

A. Background and Objective

As global warming is accelerated, there has been many efforts to reduce GHG gas emission globally. In a bid to reduce GHG gas emission in construction area, some developed countries such as U.S.A and Great Britain have introduced green building certification reported to be very effective to GHG gas reduction(Yeom 2013). South Korea also has adopted similar certification called G-SEED (Green Standard for Energy and Environmental Design) from 2002. However, even after more than 10 years total certification numbers in apartment building area still around 1% of total approved apartment building numbers(G-SEED Certification Integrated Operation System 2015).

The objective of this paper is to find out the reasons of low rate of G-SEED certification by presenting decision-making process of certified apartment building market participants and analyzing the process using system dynamics method.

B. Scope and Process

This paper is limited in apartment building area accounted for 36% of total energy consumption and is only focused on consumer's decision-making process even the market could include many other participants. The process of this research is as below.

1) Learning about G-SEED certification by literature review 2) Finding out how the features of G-SEED certified apartment buildings affect consumer's decision-making 3) Analyzing the causal relation of the factors leading to consumer's decision-making using system dynamics method.

II. LITERATURE REVIEW

A. G-SEED Certification and its Effects to Consumer

G-SEED certification has been implemented to realize sustainable development and induce resource conserved and eco-friendly buildings(Green building improving law, Article 16). Living in G-SEED Certified buildings results in tenants' health and productivity improvement due to designing nature ventilation and using products emitting low indoor air pollutants such as VOC-zero paint for getting scores of indoor environment part(Cho 2013). Furthermore, tenants could save maintenance costs such as electricity and water bill 8~9% steadily due to installation of high-efficiency air-conditioning system, water-saving faucet or toilet and waste-water reuse system (Jonathon W. and MaryEllen C. N. 2014). However, increased construction costs for acquiring G-SEED certification makes sales price higher which is a burden on consumer.

Most previous studies about G-SEED certification targeting consumer dealt attractiveness and satisfaction of consumer about certified apartment buildings. Lee and Choi(2012) analyzed that consumers consider G-SEED certified apartment building as a high-quality premium brand because G-SEED name itself has eco-friendly image. Lee and Shin(2009) also showed the results that consumers recognize certified buildings as better quality buildings and could pay more than the other.

B. System Dynamics

System dynamics is one of a prevalent modeling methods to suggest analytical solutions for nonlinear phenomena such as social, economic, industrial and environmental problems. This paper use system dynamics because of its effectiveness for analyzing complicated system.

---

[1] MS course student, Department of Architecture and Architectural Engineering, Seoul National University, lespriti@snu.ac.kr

[2] Professor, Department of Architecture and Architectural Engineering, Seoul National University, hyunslee@snu.ac.kr

[3] Professor, Department of Architecture and Architectural Engineering, Seoul National University, mspark@snu.ac.kr

[4] *Combined master's and doctoral course student, Department of Architecture and Architectural Engineering, Seoul National University, lee130@snu.ac.kr
 (*Corresponding Author)

The 6th International Conference on Construction Engineering and Project Management (ICCEPM 2015)
Oct. 11 (Sun) ~ 14 (Wed) 2015 • Paradise Hotel Busan • Busan, Korea
www.iccepm2015.org

Table 1. Shows a basic diagram of system dynamics.

TABLE I
BASIC DIAGRAM OF SYSTEM DYNAMICS

| Diagram	Explanation	
A ⟶ B (+)	When other conditions are the same	When Factor A increases (decreases), Factor B increases (decreases)
A ⟶ B (-)		When Factor A increases (decreases), Factor B decreases (increases)
A ⟶╫⟶ B	Including weighted delayed time between two factors	
Flow	Flows : Define the rate of change in system and control quantities flowing into and out of stocks, also called 'Rates'	
Stock	Stocks : Define the state of a system and represent stored quantities, also called 'Levels'	

III. MODEL DEVELOPMENT

### A. Decrease in Demand due to Additional Cost

Very similar with other goods when housing price is increased its demand is decreased as well(Whang et al. 2010). Increased 'Certified Housing Sales Price' due to 'Certification Additional Cost' causes higher 'Certified Housing Purchase Price' results in 'Certified Housing Demand' decrease.

B. Demand Change according to Perceived Relative Price
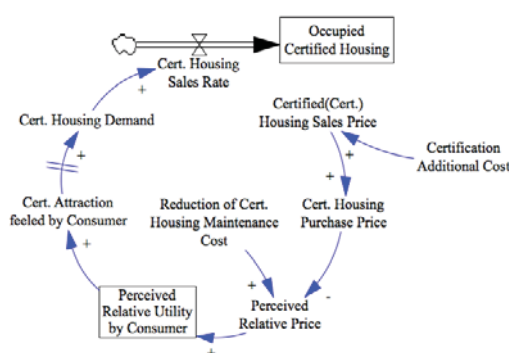
Reasonable consumers would buy housing if present value of housing benefit flows(value of housing benefit flows ÷ discount rate) which could be acquired quarterly is perceived as more than 'Certified Housing Purchase Price'(Lee 1997). Main benefit of certified housing is maintenance cost reduced 8~9% quarterly('Reduction of Cert. Housing Maintenance Cost). Higher 'Perceived Relative Price' means higher 'Perceived Relative Utility by Consumer' causes 'Certified Housing Demand'.

C. Increase in Demand due to Favorable Image Formation
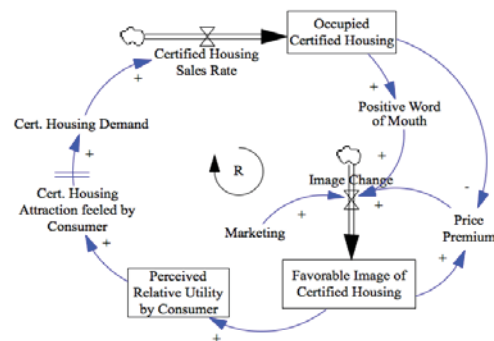
Consumers make effort to get maximized utility by comparing, analyzing and evaluating many alternatives. The housing quality assessment is difficult before buying and living a house. The risk from uncertainties such as financial, psychological and efficiency called perception risk tend to be relieved by consumer through word of mouth, marketing, brand and price premium of the product at exploration phase(Yoo 2012). High-quality image of certified housing formed from 'Positive Word of Mouth', 'Marketing' of supplier and 'Price Premium' is accumulated as 'Favorable Image of Certified Housing'. Increased favorable image of certified housing improves 'Perceived Relative Utility by Consumer'. Subsequently, it creates 'Certified Housing Demand' when external factors classified into market condition, related policy and regulatory, geographical condition, area and price is in a best circumstances after some time delay(Choi 2013).

IV. CONCLUSION

This paper presents consumers' decision-making process in G-SEED certified apartment building market comparing to non G-SEED certified one using System Dynamics method. Should 'Perceived Relative Utility' become higher, consumers' demand for the certified housing would be increased. It is affected by short-term and long-term factors that are 'Relative Perceived Price' formed from comparison between reduced maintenance cost and increased purchase price and 'Favorable Image of Certified Housing'. This paper only covers consumer aspect except supplier. Therefore, supplier decision-making modeling is needed for analysing whole market condition and reasons why certification rate is still low.

V. ACKNOWLEDGEMENT

REFERENCES

[1] W. Jonothan, C. N. MaryEllen, "LEED Economic Assessment Progrma(LEAP)", *Proceeding:ICSDC 2011 : Integrating Sustainability Practices in the Construction Industry*, pp. 144-150, 2011.
[2] J. H. Lee, "Housing Economics : Theory and Practice", Dawoo-Munhwa Press, pp. 10-97, 1997.