Key factors of people’ s willingness to pay for green buildings in a less developed region in China: A pilot research effort in Shanxi Province

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Key factors of people's willingness to pay for green buildings in a less developed region in China: A pilot research effort in Shanxi Province

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Abstract: With the process of urbanization, China has entered into a booming of construction, and new buildings currently cost large quantities of natural resources and energy. Green Buildings are one of the approaches being implemented to help to mitigate the impacts of the building stock on the environment. However, the majority of green buildings are located in eastern region of China where the economies are more developed. For developing regions in the middle and western regions, green buildings are few. Low income is easily assumed to be the barrier, but research performed to test this assumption, is scarce. The authors of this paper chose Shanxi Province, a less developed region, as the area of investigation to investigate this issue. The authors developed a framework of consumer behaviour based on the Howard-Sheth model to find the key factors that affect people's willingness to pay (WTP), for which a questionnaire survey was conducted in the study area in Shanxi Province. The survey data were analysed by logistic regression and cross tabulation methods. The results revealed that rather than income, the knowledge related to green buildings and awareness of environmental protection had significant impacts upon green building WTP. Based on the analyses, several suggestions were developed, including: imposing certain demands on constructors of buildings to adopt green facilities, improving the publicity of green buildings, etc. This study investigated people's real attitudes toward green building and found a high WTP in the region, which deserves further attention from the relevant stakeholders in the future.

1. INTRODUCTION

With the rapid industrialization and economic development, the energy situation is very serious in China and may threaten the stability and security of the country. In such a tense situation, according to the 2013-2017 China Intelligent Building Industry Market Prospects and Investment Strategy Planning Analysis Report, buildings account for 33% of the total energy consumption and 27.6% of coal use, and 25% of greenhouse gas emissions. This "33%" is only the proportion of energy consumed during the construction and use of buildings. If we add the energy consumption of building materials during the production processes, the total energy consumption related to buildings shares 49.7% of the Chinese Society. Prior to 2013, China's construction was 40 billion square meters, but since then 16-20 billion square meters of new construction are being built every year (Mo, Chen, & Huan, 2013).

As a new attempt for reducing environmental impacts of buildings, by September 2016, there were 4,515 green buildings in China with a total construction area of 52,291 square meters (Ministry of Housing and Urban-Rural Development Centre of Technological Industrialization Development, 2017). As Amecke et al. (2013) stated, China's building stock is characterized by rapid new construction and demolition of older buildings and large scale urban expansion. As a result it is contributing negatively to a broad range of climatic conditions. But China is dedicated to developing and modernizing its technologies. Accordingly, China's foremost building energy efficiency priorities are designed to ensure that new buildings are built to high energy efficiency standards and are committed to improving the efficiency of heating and cooling and other equipment used in buildings. Hence, green buildings can be an effective path to sustainable development if properly designed, constructed and maintained.

Although green buildings are attracting attention in China, the distribution is unbalanced. As Ye et al. (2013) concluded "green building" labels cover a great number of provinces, autonomous regions, municipalities and Special Administrative Regions, within not only large cities, but also in a few small cities. However, the distribution of green buildings is mainly concentrated in the eastern region of China, which is the region with rapid economic development. A majority of the green buildings in China are in wealthy provinces, such as Shanghai, Jiangsu, Guangdong and Beijing. These four provinces together accounted for about 50% of the total number of green building certifications in China (Ye et al., 2013). Why are people living in west and middle regions of China reluctant to choose green buildings? Is it because of their low income or other factors? For development of green building, not only standard and policy play important role, citizens are also involved as consumers. Their willingness to pay (WTP) is considered to be an important factor that affects investments in green buildings. Most of the previous studies focussed upon green building standards, evaluation methods and indices, policies and development situations. For instance, Zhang et al. (2017) compared Chinese green building standards with western green building standards. Zuo and Zhao (2014) reviewed the current situation and future agenda of green buildings in China. Shi et al. (2013) identified the critical factors for green construction in China and analysed the barriers of development of green buildings. Ye et. al. (2015) reviewed all green building labels in China in detail. Although they noted the unbalanced distribution of green buildings in China, they did not discuss the reason. They gave little attention to the cause(s) of distribution differences or the reason(s) for low quantity of green buildings in China.

To fill this knowledge gap, the objective of this paper was investigating if people do or do not wish to invest in green buildings. The authors conducted a questionnaire survey to explore citizens' real attitudes toward green buildings. Then based on the analysis of the responses, suggestions and policy implications were developed to promote increased investments in green buildings in China.

Shanxi province, located in north and middle region of China, was chosen as the area of investigation. According to the National Ranking of GDP published by State Statistics Bureau of China in 2016, Shanxi ranked 24th among 31 provinces which means that compared with the developed regions such as Beijing or Shanghai, Shanxi province has an underdeveloped economy. As the most important coal base, throughout the ages, Shanxi province made and continues to make a great contribution to China's energy supply and expansion of national economic development. However, at the same time, a series of environmental problems and hidden troubles have emerged. For instance, the open pit mining destroys the ground surface and causes landslides and collapse. Drainage from coal production sites and from processing locations causes extensive water pollution. Additionally, air pollution is caused during coal transportation to energy transformation centres. Coal combustion produces large quantities of harmful particulate matter and gases which exacerbate the greenhouse effect and release SO_2 which causes acid rain, causing harmful impacts upon agricultural, forest and aquatic ecosystems. Especially in winter, northern China burns huge quantities of coal, which results in serious smog with high rate of PM2.5 and related substances, causing dramatic increases in human death rates due to respiratory and cardiac diseases. Berkeley Earth (2015) stated that "air pollution kills an average of 4000 people every day in China". The air pollution is worsened due to the fact that the traditional heating modes waste much of the energy.

The contents of this article are organized as follows: in Section 2, the authors presented a brief review to development process of green buildings in China and Shanxi Province, followed by an introduction to green building evaluation standards in China, including the related technical green building measures. In Section 3, the authors introduced the methodology they used. The Haward-Sheth Model was used to analyse consumers' behaviour from four factors, and the authors clarified how those factors were used in their research for this article. The analysis and discussion of the questionnaire results are presented in Sections 4 and 5. To sum up this study, in Section 6, the authors summarised the implications of their findings for governmental policies and actions to promote increased investments in green buildings. They also developed conclusions and recommendations for the future of green buildings in China

2. BRIEF INTRODUCTION OF GREEN BUILDINGS

2.1 Development process of green buildings in China and in Shanxi Province

The U.S. EPA stated "Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from design to siting, to construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high-performance building." (US EPA, 2016) In 1990s, introduction of these concepts into China was initiated. Since the United Nations Conference on Environment and Development in Rio De Janeiro, Brazil in 1992, the Chinese government has promulgated a number of related outlines, guidelines and regulations, and has vigorously promoted the development of green buildings. In September 2004, Use the words first and then the acronym, launched the National Green Building Innovation Award, which signified that the development of green buildings in China had entered a stage of integrated development. In 2006, the official form of the green building evaluation standard was officially issued. Since then, green buildings are being developed at an increasing rate in China as a result of strong national policies on energy conservation and emissions reduction (Shi et al., 2013). As the result of those efforts, the number of green buildings has steadily increased. In 2015, there were 1,098 new green buildings appeared which created a new record (Chinese Green Building Evaluation Label, 2017).

At the same time, in Shanxi province, investment in green buildings developed relatively late. Evaluation of the first group of green buildings was performed 2011. Since then until 2017, only 37 buildings including both public and residential buildings were evaluated by a professional judging panel and got the qualification to apply for the green building label certification (Ministry of Housing and Urban-Rural Development of Shanxi Province).

Green building label certification is applicable for both the design and operation stages. The evaluation at the design stage requires detailed blueprints and models as proof, and at the operation stage, the evaluation is applied for the building that has been operated for some years. However, a great amount labor and material resources are needed during both types of evaluations. The high costs of evaluations should be paid for by the developers, according to results of interviews with stakeholders in Shanxi Province. However, since some of those buildings have already been approved to be constructed as green buildings and the developers did not intend to get the certification. Consequently, to date, few residential buildings have been certified as ‘Green Buildings" in Shanxi Province.

2.2 Green Building Evaluation Standards and Supportive Technical Measures

Various green building rating systems have been established globally such as: The Building Research Establishment Environmental Assessment Method (BREEAM), which was founded in the United Kingdom in 1990. It was the first and most widely used green building evaluation method in the world. Similarly, the Leadership in Energy and Environmental Design (LEED), another popular evaluation standard that was adopted by over 165 countries and territories, was launched in the U.S. in 2003 (U.S. Green Building Council, 2016). These two green building labels are the only two internationally recognised green building labels, which have been adopted to evaluate green buildings in China.

Although interest in green buildings developed a little late in China, they received increased attention during the Five-Year Plan from 2011 to 2015. In China, the first national Green Building Evaluation Standard GB/T50378-2006 was promulgated and implemented in 2006. Due to the rapid development of green buildings in China and throughout the world, evaluation standards of green buildings and related regulations are also being improved constantly. Based on the initial policies, Ministry of Housing and Urban-Rural Development (MOHURD) made amendments and supplements to improve the evaluation standard. For instance, compared with the previous version, it extended the standard scope of application to all types of civil construction. The evaluation is divided into design evaluation and operation evaluation. Each type of green construction and operation evaluation is indexed with separate sets of scoring criteria. Extra points were added to encourage innovation and improvement of green building technology and management. As the result, the new form – GB/T50378-2014 was implemented since January 1, 2015. It includes seven categories – land saving and outdoor environment, energy saving, water saving, material saving, indoor environmental quality, operations and management and innovations. A number of specific and common measures for various categories are presented in Table 1 (GBT50378-2014 Green Building Evaluation Standard):

Table 1. Six categories of China's updated green building evaluation standard, GB/T50378-2014.

Categories	Aim	Technical measures
Land saving and outdoor environment	Enhance the full use of land.	Green roof, rational exploitation, underground space, high greening rate and etc.
Energy saving	Improve the thermal insulation performance of the building's envelope and use renewable energy.	Venetian insulation, double glazing window, radiant floor heating, solar water heater, sound controlled light illumination and etc.
Water saving	Improve the utilization efficiency of water resources.	Collection of rainwater.
Material saving	Use local materials to reduce pollution caused by transportation.	Big windows (save wall materials).
Indoor environment quality	Pay attention to the indoor air quality	Sound absorption board.
Operations and management	Use technology controlled by computers and networks to make life more convenient.	Intelligent housing system, good security.

Some technical measures could become important proof of grading. The authors selected eight technical measures as examples to introduce their functions and incremental costs that people have to pay**.** The incremental costs of technical measures of green buildings were sourced from the research of Sun, D. M. et al. (2008). Since their data were gathered in 2003, the authors of this paper adjusted the costs with updated current per square meter housing prices (Table 2).

Table 2. Incremental cost of technical measures

Technical Measures	Location of application	Incremental cost (Yuan/㎡)
Venetian insulating glass (*save space, sunshade, preserve heat, sound proof*)	All bathroom windows	90
Double glazing windows (*save energy, keep warm, thermal insulation, sound proof*)	80% of the buildings	280
Radiant floor heating	60% of the buildings	620
Electrical radiant floor heating system	40 of the buildings (bathroom)	120
Solar water heater	25% of the buildings	20
Sound controlled light illumination	All buildings (100%)	0.6
Reclaimed water reuse and Water-saving appliances	All buildings (100%)	150
Elevator shaft and sound insulation	All buildings (100%)	195
Intelligent housing system, security and property	60% of the buildings	1050
Total		2505.6

Source: Sun, D. M. et al. (2008)

As Sun, D. M. et al. (2008) stated that if a building is certified with requirements (shown in Table 3), the building may be accredited as a three-star green building. Hence, if there is a building which equipped with the 8 technical measures (listed in table 2), although it may not reach the three-star level, its grade of green building evaluation could be high.

Table 3. The requirements of three-star green building

Category	Three-star standard
Energy efficiency of building envelope	Achieve 65% of energy saving standard
Radiant floor heating	50% of the building
Solar water heater	50% of the building
Solar PV	Constitute 10% of energy proportion
Reclaimed water reuse and Water-saving appliances	The utilization rate of non-traditional water sources is no less than 30%
Indoor Environment Control	Meet the requirements of heat, sound, light and ventilation
Intelligent building	Meet the requirements of intelligent buildings

Source: Sun, D. M. et al. (2008)

3. THEORETICAL FRAMEWORK

3.1 The Howard-Sheth Model

There are various theoretical frameworks to describe and analyze the factors that affect consumer's purchasing behaviors. For instance, Guo et al. (2018) reviewed the theories of social psychology in exploring residential electricity consumption behavior. Sun, C., Yuan, and Xu (2016) applied the Contingent Valuation method to estimate the public's WTP for reducing air pollution in urban areas. Shuai et al. (2014) adopted the Dunnett's T3 test approach for single factor variance analysis to find the differences in consumers' WTP for low-carbon products among different types of consumers. de Medeiros, Ribeiro, and Cortimiglia (2016) used a model proposed by Zeithaml (1988) to investigate the relationships between consumer's perceived value for green products and the price elasticity of their purchases/investments. Juan, Hsu, and Xie (2017) identified behavioral factors that may affect consumer purchases of green buildings by using Howard-Sheth Model as the theoretical basis.

The Howard-Sheth Model is used to consider consumer's purchase behavior from four major perspectives: stimulate or *input factors* (input variables), *external factors*, *internal factors* (internal process) and reflect or *output factors* (Howard & Sheth, 1969).

Input factors are the factors controlled by the sales department, for instance the cost of the goods. External factors such as character traits and financial status of the consumer do not influence purchase behavior directly, however, they have significant impacts on purchase behaviors. Internal factors, mainly explain how input factors and external factors play roles in the psychological activities, will lead to the purchase decision. Output variables are the purchasing behaviors caused by the purchase decision process, which includes three stages: cognitive responses (attention and understanding), emotional responses (an estimate of the relative ability of a purchaser to satisfy his or her motives) and behavioral responses (whether the customer will buy or not).

Because the model emphasises the importance of input to the purchase decision making process, the model is important and is the most frequently quoted (Prasad & Jha, 2014). Although the model is not perfect enough to explain all buyer behaviors, it has already become a comprehensive theory of consumer's behavior as a result of empirical research (Horton, 1984).

3.2 Application of Howard-Shath Model

Promoting development of green buildings needs not only evaluation standards and policies, but also the efforts of consumers. Dwaikat and Ali (2016) found that green buildings cost less than their conventional counterparts. If so, there was no reason for people to refuse green buildings. Understanding the real attitudes of prospective green building users and the reason why green buildings were not prevalent in the study area can be used to help the government to formulate better policies to encourage the planning, development and operation of green buildings.

Based upon the theoretical framework of the Howard-Sheth Model, a prerequisite of purchase decision making is that costumers have knowledge of green buildings from the sales staffs that produce the information about the attributes of the product or brand. As a customer, among all information such as quality, price, distinctiveness, service and availability, quality and life cycle cost and benefits of green buildings are the most important aspects; for this research, they were considered as the input variables.

The, external factors included: gender, age, educational level and annual income, which also affect costumer's purchase decisions. Due to the complex impacts of input variables and external factors, the internal factors, which mainly deal with psychological variables (the cognition knowledge of green building and environmental protection awareness) are all involved in the purchase decision-making processes. The eight factors shown in Figure 1 were further developed in questionnaire survey to investigate consumer behaviour and acceptable cost of green buildings.

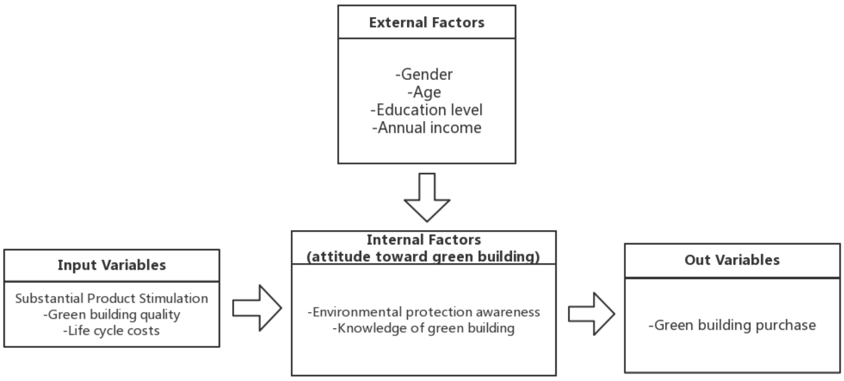

Figure 1. Application of Howard-Sheth Model

4. QUESTIONNAIRE AND RESPONSES

4.1 Questionnaire survey design

This research was conducted by using random sampling survey. Shanxi citizens were selected as respondents, and they were randomly and voluntarily selected to complete the online questionnaire survey. After the first questionnaire was developed the authors of this paper invited several people to fill in the questionnaire and to provide suggestions for improving the questionnaire. On the basis of their feedback, the questionnaire was revised. That version was used in the online questionnaire survey, which was shared by using the social software, called WeChat. A total of 491 valid responses were collected from June 27th to 28th, 2017. The average questionnaire answering time was 5 minutes 53 seconds. The number of people who successfully answered all questions accounted for 37% of the total number of visitors of the questionnaire site.

The questionnaire survey was divided into two parts. The first part included five questions for personal information, including age, gender, occupation, annual income and educational level. All these factors are likely to affect people's attitudes of green buildings. The second part, included twelve questions related to green buildings, mainly focused upon the respondent’s knowledge about green buildings and their real attitudes about green buildings. They were asked to choose three categories they wish to have on the green building among the total six categories (shown in Table 1). The remainder of the questionnaire was focused on the incremental costs of technical measures of green buildings that not only bring economic returns but also help to protect the environment. The detailed data of incremental costs (Table 2) were listed for considering acceptance level of green buildings and the key factors that affect customers to choose green buildings.

4.2 Results of analyses of the questionnaire respondent’s answers

The first four preliminary questions are about respondents’ identity and about their personal message. Among the 491 responses, approximately 45% of respondents were between the ages of forty-one to fifty. Three 323 of the 491 respondents were female and 168 were male. For the annual income, the vast majority of respondents earned less than 100,000 yuan per year. There were more 76 respondents earn less than 200,000 yuan. Only five respondents earned more than 500,000 yuan/year, which stands for high income level. Therefore, high housing prices are or would be a burden for most of the respondents, not to mention that they should pay more money for the incremental cost of technical measures.

With regard to the respondent’s educational level, the majority had obtained college degrees or above. Among all respondents, 55% of them heard about green buildings before and 45% did not. Hence, green buildings had been promoted and publicized but they still need more and perhaps different types of promotion. Most of respondents heard about green buildings from Internet. Other sources included work, media, education, radio programs, books and experiences of visiting a green building. Because only 2% of respondents heard about green buildings from realtors, education and policy support for land and built property agents are essential.

When respondents were asked to choose the definition of green buildings from three options, surprisingly, about 80% of respondents chose the right answer. There are perhaps two reasons. For those people who heard about green buildings before, the explanation of green buildings made an impression on them. Another reason was because the rudimentary knowledge of environmental protection helped them to choose the correct answer. After this question, an accurate explanation of green buildings was given. Then the respondents were questioned, now that you know more about the definition of green buildings, do you wish to live in a green building? The data revealed that, 98% of them chose 'yes'. This indicates that people would love to and have enough enthusiasm to support environmental protection via investments in green buildings.

For those respondents who chose 'yes' for the last question, they were asked to choose three functions that must be fulfilled within a green building. The top two choices were water saving and energy saving (see Figure 2). In particular, the number of people who chose water saving is much more than the others. The reason for this selection may be due to the shortage of freshwater resources in Shanxi. Since water and energy saving could reduce their expenses directly, cost can be one of the factors that could affect respondent's choices for green buildings.

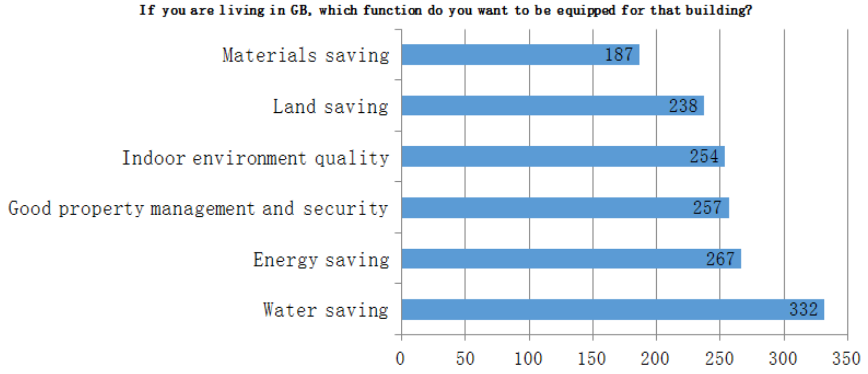

Figure 2. Respondents were asked choose three functions from all six categories

According to the six evaluation categories of green buildings, eight technical measures were listed and respondents were asked how much they were willing to pay for them (see Figure 3). There were approximately 100 respondents who were not willing to pay for the incremental costs of any of the technical measures. The price range that people were willing to pay was between 1-499 yuan. It was clear that WTP is sensitive to the costs. However, there were a few respondents who were willing to pay for technical measures with higher prices.

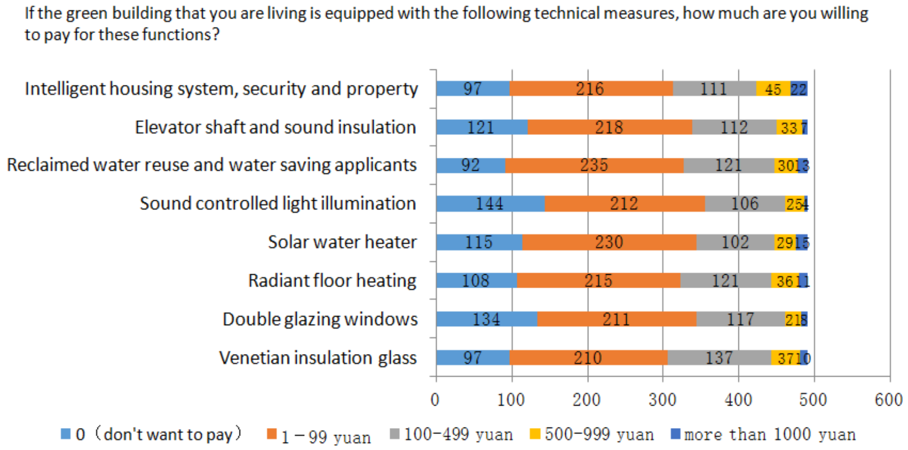

Figure 3. How much people are willing to pay for technical measures

After this, the exact price was given and the respondents were asked to decide whether they were still willing to pay for those technical measures. In the Figure 4, clearly the scope of the blue line (willing to pay) is bigger than the scope of green line (don't want to pay). Even for the technical measures with incremental costs higher than 500 yuan, about half of the respondents who were willing to pay. Hence, the incremental costs of technical measures were affordable for those respondents, even if they may be reluctant.

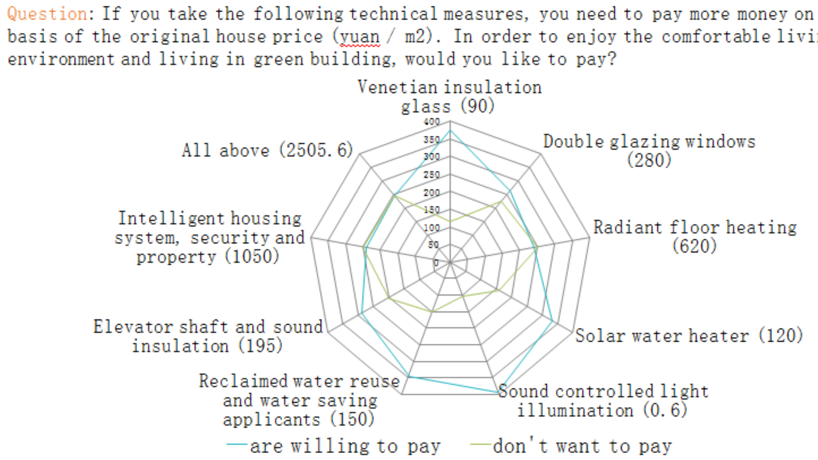

Figure 4. Number of people willing to pay (blue) vs not willing to pay (brown)

After the respondents were informed of the exact price for the technical measures, the last question was posed to them: "Do you want to live in a green building?" again. As shown in Figure 5, the number of respondents who chose "doesn't want to" increased by 72 respondents. For the respondents who wanted to live in a green building, the most common reason was "living in a green building could help to save energy and protect the environment" which is evidence of the respondents' environmental protection awareness (Figure 6). Hence, environmental awareness can potentially affect green building purchase decisions.

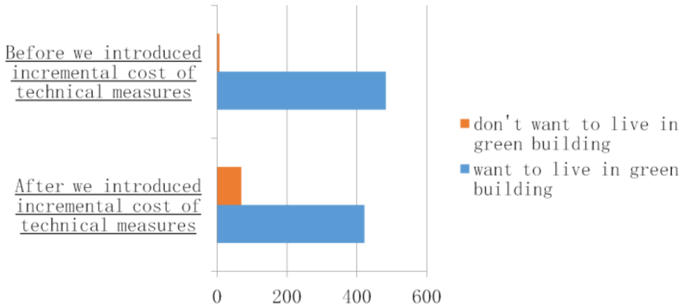

Figure 5. Comparison of the change in the quantity of respondents

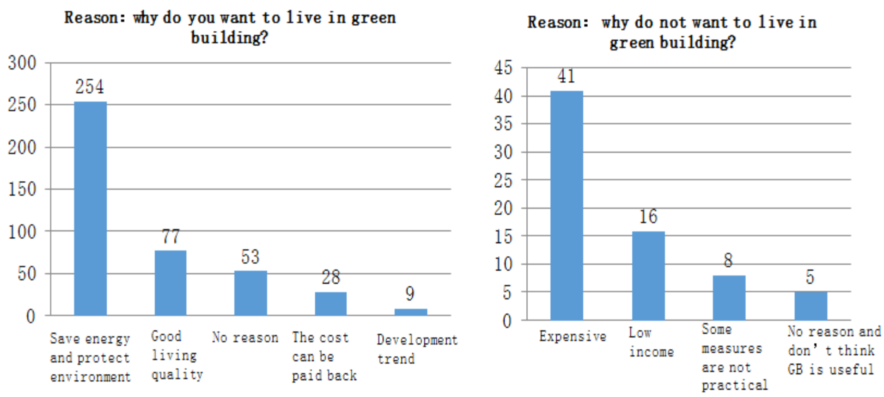

Figure 6. Reasons for respondents' choices

In conclusion, based on the questionnaire results and analysis, the income and environmental protection awareness, the knowledge of green buildings and personal attributes, all affected the respondent's attitudes toward green building purchases. In order to confirm these initial conclusions, the authors of this paper performed the quantitative analysis presented in Section 5.

5. QUANTITATIVE ANALYSIS AND RESULTS

5.1 Logistic regression analysis

Simple descriptive analyses provides researchers an overview of the variables but does not provide exact answers, hence statistical analyses are needed to verify whether the insights from the general observations are correct. Logistic regression is a probabilistic nonlinear regression model. It is a multivariate analysis method to study the relationships between nominal observations and influencing factors. Statistician D.R.Cox, developed this approach in 1958 as a statistical method; since then, it has been used widely in many fields, including medical and social sciences (Jin, Yan, & Zhu, 2015). With the advent of the information era, logistic regression is extensively used for many data mining applications. For example, credit risk models in the banking industry, customer preference models in retail, and for assessments of diverse segments of customers in all areas of business (Jin, Yan, & Zhu, 2015).

Based on the application of the Howard-Sheth Model for this research, except these four factors ("annual income", "gender", "whether people heard about green building before" and "environmental protection awareness"), we add more factors which be considered to influence respondents to choose green buildings. In the questionnaire, respondents were asked about the reasons they wanted to live in green buildings, by choosing their care level of good living environment, saving home expenses and high level, residential quality. It was essential to analyze whether their care level would affect their choice green buildings. In this study, logistic regression analysis was applied, with WTP of green buildings as the dependent variable, and the other seven factors as independent variables. The variables and results of the regression analysis are presented in Table 4. The significance of Omnibus Test of Model Coefficients was 0.007 and the results of use of the Hosmer and Lemeshow Test showed good model-fitting too. (The"B" refers to the partial regression coefficient). The analysis results showed that the regression coefficients of 'whether the respondent had heard about green buildings' and 'good environmental protection awareness' were 0.684 and 0.812, and the corresponding significance values were both less than 0.05. It means only these two factors had significant positive predictive decision-making impacts on the WTP of green buildings among the seven factors.

Table 4. Final fitting result of regression equation

	B	S.E.	Wald	df	Sig.	Exp(B)	95% CI for EXP(B)	
							Lower	Upper
Annual income	-.168	.251	.446	1	.504	.846	.517	1.383
Gender	-.312	.288	1.171	1	.279	.732	.416	1.288
Whether heard about green building	.684	.280	5.948	1	.015	1.981	1.144	3.431
Caring about good living environment	.390	.307	1.619	1	.203	1.478	.810	2.696
Environmental protection awareness	.812	.355	5.244	1	.022	2.252	1.124	4.513
Caring about saving home expenses	-.350	.335	1.093	1	.296	.705	.366	1.358
Caring about the grade of the residential district	.066	.243	.074	1	.786	1.068	.664	1.720
Constant	-.610	.981	.386	1	.534	.543		

5.2 Cross tabulation analysis

A cross tabulation analysis was performed to learn whether annual income level would affect the respondent's WTP for the eight technical measures. In the light of the results, more than 80% of the respondents' annual income was less than 100,000. The questionnaire results in the previous part indicated that for these respondents, when incremental cost is less than 500 yuan, most of them were willing to pay. Even if the cost was higher than 500 yuan, still about 50% of them were willing to pay for the technical measures. On the contrary, for those respondents who earned more than 500,000 per year, there were only 40% of them who were willing to pay for the cheapest technical measure. However, for the most expensive technical measures (the intelligent housing system and the security of green buildings), all of them were willing to pay.

Desire, status and luxury have been explored for so many years. Veblen suggested the act of buying expensive things was a means for people to communicate their social status to others (Veblen, 1899). Purchasing expensive houses or luxury goods is an approach to flaunt their considerable wealth. These psychological factors coupled with the effect of annual income have brought about the above-mentioned proportions. However, how well the annual income affected the respondent's WTP must be analyzed further.

Here, the Chi square test, which is a very common hypothesis testing method, was used for testing the association between two categorical variables. Table 5 shows the Chi square independence test between annual income and WTP for incremental cost of technical measures. The results were opposite from the author's expectations; the Chi square test results were not significant (all p-values were more than 0.05). These results demonstrated that annual income and WTP for incremental costs of technical measures are independent of each other. However, even though, according to the Chi square test, there were no significant effects does not mean that there was no effect. Income more or less affected people's consumption behaviors. Whereas, income was not the most important barrier that make people refuse accept green buildings.

Table 5. Chi-Square test of whether annual income affects people's WTP

Green building technical measure (cost, Yuan per m2)	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Venetian insulation glass (90)	1.514[a]	3	.679	.734	.171	.049
Double glazing windows (280)	2.698[a]	3	.441	.456	.069	.021
Radiant floor heating (620)	2.496[a]	3	.476	.471	.196	.044
Solar water heater (120)	.837[a]	3	.841	.831	.507	.073
Sound controlled light illumination (0.6)	7.420[a]	3	.060	.055	.478	.083
Reclaimed water reuse and water saving applicants (150)	3.570[a]	3	.312	.305	.044	.016
Elevator shaft and sound insulation (195)	2.353[a]	3	.502	.516	.307	.059
Intelligent housing system, security and property (1050)	7.493[a]	3	.058	.050	.013	.005
All above (2505.6)	3.754[a]	3	.289	.299	.041	.013

5.3 Discussion

In accordance with questionnaire survey results, some assumptions were made based on the seven factors, and the quantitative analyses were performed, as stated in the last section, by using logistic regression analysis and cross tabulation analysis. The quantitative analysis results indicated that only "whether heard about green building" and "good environmental protection awareness" have significant impacts on WTP for green building purchases. Cross tabulation tests analyzed whether annual income affected respondent's WTP or not, for the incremental costs of technical measures. According to the respondent's answers, it is important to note that it may be the difficult to pay for both the housing and technical measures at the same time. This means that if someone wants to buy a one hundred square meter house, he/she needs to pay 250,560 yuan more for a green building than for an ordinary building. This may be a burden especially for respondents whose annual income is less than 100,000, although it could be paid back in the future. Possibly because of this, there were 72 respondents who changed their choices. However, for the last question, there were still about 85% of the respondents who chose green buildings. This suggests that although the higher initial costs are a burden for most respondents, the incremental costs were still affordable. Hence, low income actually was not a fundamental barrier for their potential investments in green buildings.

In regard to gender, the proportion of male and female respondents differed very little in regard to the proportions who were WTP or not WTP. For the educational level, as Coddington (1993) pointed out, higher income and more education would help to make people to have more tendency of green consumption. However, since many serious environmental problems are occurring in China and almost all Chinese are already concerned about environmental protection, our research results showed that education level was not a factor that affects people to choose green buildings. After all analysis of this research, the factors that affect people's WTP effectively are "knowledge related to green building" and "environmental protection building".

6. IMPLICATIONS, CONCLUSIONS AND RECOMMENDATIONS

In China, green building is a relatively new approach which helps to reduce pollution, energy wastage and to improve the health of the population. A number of improvements still need to be made. The most excellent green building could be traced back to the construction for the Beijing Olympic Games in 2008, which was mainly promoted by the government (Shi et al., 2013). Hence, the development of residential green buildings still need to be improved.

Analyses of the research results, revealed, that the factors that affected people's WTP to invest in green buildings was not income level but were more related to "knowledge related to green buildings" and "environmental protection awareness" in Shanxi Province.

The reasons for the small numbers of green buildings in Shanxi Province might be the lack of policies to promote green building construction. Government, industry association and enterprises should provide more support and guidance for construction and purchase of green buildings. In particular, government can play an increasingly pivotal role during the whole process, especially in the context of severe air pollution and the need to shift from the current societal system that is heavily dependent upon fossil-fuels to systems that are based upon renewable energy and improved energy efficiency.

Based on the questionnaire results, the authors of this paper propose that governments should expand their emphases upon green building in the following ways:

The government should promulgate relevant policies and laws to promote information dissemination about the urgent need for the transition to the Post-Fossil Carbon Society and that Green Buildings can be an integral part of the needed changes.

The government should provide policies and financial support to developers by establishing tax incentive measures, deficit subsidies, financial discounts, pre-tax loans and other methods to encourage them to become effective in planning and construction of green buildings.

The government should provide financial measures to stabilize the housing prices, and thereby reducing financial burdens for citizens to invest in the environmentally friendlier green buildings.

Government should encourage more enterprise and industrial construction to invest to green buildings by simplifying evaluation procedures and by reducing the evaluation fees.

Based upon the high WTP for green buildings found in this research, the authors suggest that governments may consider imposing certain green building standards on all new constructions. By using mandatory green building requirements, the evaluation procedure could be simplified and there will be no need to apply for the certification. Such measures can benefit the community with reduced prices for green buildings.

Greater environmental protection awareness could increase the focus on green consumption. The quantitative analysis result of this research found that expanded emphasis upon environmental education for citizen to enhance environmental protection awareness is an essential approach to affect people's WTP for green buildings.

There are 17 green building standards at the national level and more than 50 standards at the province level, which often cause confusion for industries and citizens in general and for associations and enterprises, in particular, because standards are slightly different (Ye et al., 2015). For instance, in Taiyuan city, the capital city of Shanxi province, the evaluation standard for green building evaluations is known as DBJ04-255-2007. In its preface, there is a saying that “The principle of this standard is the localization of the national green building evaluation standard for construction (GB/T50378-2014). Some of the indexes have been embodied and extended.” Hence there is the possibility that the same building gets different evaluation results depending upon how the evaluations are performed. Additionally, the developers may choose the more beneficial evaluation approach to obtain more benefits. Therefore, it is necessary to promulgate relevant laws and to unify the evaluation standard. In addition, simplifying the evaluation procedure to create easy and transparent accreditation is urgently needed.

The questionnaire adopted in this research was distributed by the authors by using a social media called WeChat, and asked their friends to fill in it voluntarily. Therefore, the problem remains that whether this sampling properly represents the Shanxi Province people. Further research is needed to overcome this limitation. Moreover, similar, comparative research should be done in developed regions to provide a more solid foundation to find solid answers to the author’s research questions.

The results of this research illustrate one way of exploring the WTP, and the results represent at least a part of Shanxi people’s attitude towards green building which indicated a high acceptance of green buildings. This finding deserves further research from relevant stakeholders throughout all provinces of China and in other countries.

REFERENCES

Amecke, H., Deason, J., Hobbs, A., Novikova, A., Yang, X., & Zhang, S. (2013). "Buildings Energy Efficiency in China, Germany, and the United States". *Climate Policy Initiative*. Retrieved from https://climatepolicyinitiative.org/wp-content/uploads/2013/04/Buildings-Energy-Efficiency-in-China-Germany-and-the-United-States.pdf.

Berkeley Earth. (2015). "Air Pollution Overview". Retrieved from http://berkeleyearth.org/air-pollution-overview/ on September 17,2017.

Chinese Green Building Evaluation Label. (2017). "Statistics of National Green Building Label". Retrieved from http://www.cngb.org.cn/index.action?sid=402888b74f68e52e014f696c7643000c on September 15, 2017.

Coddington, W. (1993). *Environmental Marketing: Positive Strategies for Reaching the Green Consumer*. . New York, NY: McGraw-Hill.

de Medeiros, J. F., Ribeiro, J. L. D., & Cortimiglia, M. N. (2016). "Influence of Perceived Value on Purchasing Decisions of Green Products in Brazil". *Journal of Cleaner Production*, *110*, 158-169.

Dwaikat, L. N., & Ali, K. N. (2016). "Green Buildings Cost Premium: A Review of Empirical Evidence". *Energy and Buildings*, *110*, 396-403.

Horton, R. L. (1984). *Buyer Behavior: A Decision-Making Approach*. Columbus, OH: Merrill Publishing Company.

Jin, R., Yan, F., & Zhu, J. (2015). "Application of Logistic Regression Model in an Epidemiological Study". *Science Journal of Applied Mathematics and Statistics*, *3*(5), 225-229.

Juan, Y., Hsu, Y., & Xie, X. (2017). "Identifying Customer Behavioral Factors and Price Premiums of Green Building Purchasing". *Industrial Marketing Management*, *64*, 36-43.

Mo, L., Chen, M., & Huan, Y. (2013). "A Brief Talk on the Current Situation and Development Trend of Green Building in China". *Sichuan Building Materials*, *39*(5), 5-7.

Prasad, R. K., & Jha, M. K. (2014). "Consumer Buying Decisions Models: A Descriptive Study". *International Journal of Innovation and Applied Studies*, *6*(3), 335-351.

Shi, Q., Zuo, J., Huang, R., Huang, J., & Pullen, S. (2013). "Identifying the Critical Factors for Green Construction–an Empirical Study in China". *Habitat International*, *40*, 1-8.

Shuai, C.-M., Ding, L.-P., Zhang, Y.-K., Guo, Q., & Shuai, J. (2014). "How Consumers Are Willing to Pay for Low-Carbon Products?–Results from a Carbon-Labeling Scenario Experiment in China". *Journal of Cleaner Production*, *83*, 366-373.

Sun, C., Yuan, X., & Xu, M. (2016). "The Public Perceptions and Willingness to Pay: From the Perspective of the Smog Crisis in China". *Journal of Cleaner Production*, *112*, 1635-1644.

Sun, D. M., Yuan, L., Li, J., & Cheng, K. (2008). "Investigation and Analysis on Construction Cost of Green Building in China". Retrieved from https://wenku.baidu.com/view/a1102709763231126edb11da.html?from=search on September 15, 2017.

U.S. Green Building Council. (2016). "What Is Leed". Retrieved from https://www.usgbc.org/help/what-leed.

US EPA. (2016). "Green Building". Retrieved from https://archive.epa.gov/greenbuilding/web/html/about.html on September 15, 2017.

Veblen, T. (1899). "Excerpt from the Theory of the Leisure Class". *Dictionary of American History*. Retrieved from http://www.encyclopedia.com/history/dictionaries-thesauruses-pictures-and-press-releases/excerpt-theory-leisure-class-1899-thorstein-veblen on September 15, 2017.

Ye, L., Cheng, Z., Wang, Q., Lin, W., & Ren, F. (2013). "Overview on Green Building Label in China". *Renewable Energy*, *53*, 220-229.

Zhang, Y., Wang, J., Hu, F., & Wang, Y. (2017). "Comparison of Evaluation Standards for Green Building in China, Britain, United States". *Renewable and Sustainable Energy Reviews*, *68*, 262-271.

Zuo, J., & Zhao, Z.-Y. (2014). "Green Building Research–Current Status and Future Agenda: A Review". *Renewable and Sustainable Energy Reviews*, *30*, 271-281.