emerald PUBLISHING International Journal of Building Pathology and Adaptation

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Journal:	*International Journal of Building Pathology and Adaptation*
Manuscript ID	IJBPA-06-2017-0027.R3
Manuscript Type:	Original Article
Keywords:	Green specifications, Sustainable development, Developing countries, Factor

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Abstract

Purpose – Green building specifications, ~~are~~as some of the most important strategies for energy saving, ~~and~~ describe the best practice in the field of sustainable construction. They have great effects on resource saving and environmental protection. The demand of sustainable construction has spurred the emerging and development of green building specifications. However, there are many factors that affect the adoption of green building specifications in China. Therefore, the purpose of this paper is to investigate the factors that ~~affect~~ exert influence on the adoption of green building specifications in China.

Design/methodology/approach – Based on the comprehensive literature review, a questionnaire survey has been conducted ~~to~~ with major stakeholders in the construction area to identify issues concerning the adoption of green building specifications in China. 18 variables that affect the adoption of green building specifications were summarized~~specifications in were summarized~~. Then, in this study, ~~uses~~ factor analysis and the mean score method are adopted to analyze 18 variables which were ~~got~~ obtained from the questionnaire.

Findings – By ~~Using~~ using the rank analysis and factor analysis, the variables have been ranked, analyzed and categorized into five independent factors that are~~. They are summarized as~~ (1) green technology and techniques, (2) awareness and attitude, (3) policies and regulations, (4) ~~market~~markets, and (5) economics. Besides, in ~~This~~ this study, ~~provides~~ a variable reference is provided for policy makers to put forward focused policies and incentives for green building specifications implementation and industry practitioners to better understand green understand of green building specifications adoption in China.

Originality/value – This paper makes a contribution to the understanding of the factors that affect the adoption of green building specifications in China. The results can also contribute to better adoption of green building specifications in other developing countries.

Keywords – Green building specifications, factors, Sustainable development, Sustainable development;
Paper type Research paper

1. Introduction

The construction industry has a profound impact not only on economic development and public social life, but also on the natural environment. (US Green Building Council (USGBC, 2003)).The construction industry has consumed more global nonrenewable and renewable resources ~~like~~ such as water, raw materials and~~,~~ energy, ~~and so on~~ and ~~emits~~ emitted waste such as air pollution (Tatari and Kucukvar, 2011) or physical waste (Berardi, 2013). Consequently, it is ~~important~~ significant to find a sustainable way to reduce waste, improve efficiency and use renewable energy resources in the construction industry~~.~~. With the rising global attention (Kibwami & Tutesigensi, 2016) and the demand for sustainable construction, building green ~~building~~ buildings has been an efficient way as it can minimize the impact on the natural environment and~~,~~ ~~maximizing~~ maximize human health. It also uses energy-efficient appliances and systems to utilize fewer resources, like water ~~and~~, electricity, gas and energy, and increases the use of recycled materials, like natural linoleum or bamboo flooring to reduce waste during the construction process. (Yudelson, 2009a, Zhang et al., 2011). It has been claimed that green buildings can not only give the construction industry environmental, economic and social ~~benefits ,~~benefits, but also can ~~give~~ provide a sustainable development opportunity as it can minimize the pollutants~~,~~ renew natural resources… ~~and so on~~ through sustainable buildings. Consequently, the research on the concepts and practices of green ~~building~~ buildings has been accepted and ~~used~~ adopted both in developed and developing countries. (Gou & Xie, 2016)

Green building specifications or guidelines have been proved that they ~~should be~~are the critical ~~method~~ methods for the AEC area as the solution of environmental problems (Potbhare, 2009~~.~~). Hill and Bowen 1997 ~~say~~ hold that specifications and contracts are ~~important~~ of great importance for sustainable construction. Green building specifications or guidelines are the critical principles in the AEC area and can be seen as innovation

for future construction projects (Crawley and Aho1999). In ~~Previous~~ previous literature, it has been mentioned that specifications should be a promising solution for many environmental problems in the construction industry (Meryman and Silman, 2004; Collins, 1994). Crawley and Aho (1999) ~~emphasized~~ emphasize the important effect of ~~the~~ green building specifications for environment ~~protect~~ protection in construction projects. In turn, the increase use of sustainable materials can promote the emergence of green building specifications (Chick and Micklethwaite, 2002).

With the fast development of ~~economic~~ economy and ~~construction of~~ urbanization, China is experiencing ~~the with high~~large-scale construction ~~work~~period. Statistically, the new buildings will use 40% cement and steel ~~of~~ in the world ~~the world's~~ with the amount of 2 billion m^2 (Qiu, 2010). China has already ranked ~~in~~ the second largest building energy user in the world and has been expected to grow fast in the next few years. Besides, compared to the developed countries such as the UK or the USA, the life of the buildings in China is about 30 years, which is quite shorter ~~to~~ than 80 years in ~~European~~ Europe or 44 years in the USA (Hu et al., 2009). Consequently, using green building to alleviate the energy consuming in construction is important. To achieve ~~the~~ this aim, green building specifications are the critical guarantee ~~to help the~~for stakeholders ~~with~~ to realize green ~~buildings~~ building construction. China is one of the few countries ~~which~~ that ~~makes~~ make green building specifications according to its own domestic situation. As a typical example of ~~the~~ developing countries, China has issued several Chinese specifications for green building/~~energy~~ energy-efficient ~~efficient~~ building assessment or design codes (GOBAS-Group, 2003; MOHURD and GAQSIQ, 2006; MEP,2007, Yong G, Dong H, Bing X, et al). There is ~~few~~ little literature on ~~the~~ green specifications adoption especially in developing countries~~—~~. ~~The existed~~ literature on developing countries ~~are~~ including India, ~~Turkey ,Indonesia~~Turkey and Indonesia exists, ~~and so on~~ but there is no ~~detail~~ detailed research on ~~Chinese~~ China's green ~~specifications~~ specification adoption. Despite the recognition of the importance of specifications in the application of green construction, there are no detailed studies that ~~focused~~ focus on the potential factors that affect the adoption of green building specifications in ~~Chinese~~ China's construction area. Therefore, it is necessary and useful to have a comprehensive investigation and survey. As China ~~has been~~is the typical and important developing country at sustainable construction and it has its own different standard ~~system~~systems, conducting some researches that focus specifically on the adoption of green specifications ~~it has been~~ is worthwhile and ~~important~~significant ~~to do some research focused specifically on the adoption of green specifications~~. The research can help green specifications work well and give advice on sustainable construction in developing countries. Consequently, it ~~can help~~is conducive to ~~reduce~~ reducing resource waste and ~~improve~~ facilitating ~~better~~ sustainable development in developing counties.

The concept of green building specifications is referred to a series of guidelines, codes or standards, relating to the green constructions with emphasis on the environmental friendliness, together with the concerns on economics and social development. Despite the recognition of the importance of green building specifications in the application of green construction, there are a few studies ~~the studies~~ on the potential factors that affect the adoption of green building specifications in the construction area~~ are few~~. In this research, factors of green building ~~specifications~~ specification adoption are investigated through ~~a~~ the literature review and questionnaire survey. Therefore, the aims of this research lay in two parts: (1) ~~Classify~~ classifying the general factors ~~to~~ concerning the adoption of green specifications in China; (2) being ~~Propose~~ proposed as a useful reference for the government to ~~promote~~ drive the adoption of green specifications.

2. Influencing Factors for the adoption of Green Specifications

There were few ~~researcher~~ researchers and practitioners who ~~has~~ have investigated the barriers that hinder the adoption of green specifications in construction. In the previous research, the factors such as higher cost, lack of knowledge and awareness of sustainable construction have been listed.

Meryman and Silman (2004) argued ~~3~~ three factors ~~which~~ were quite important when using specifications for sustainable construction. They identified that economy, policies and techniques ~~the economic, policy-related and technical~~ were the barriers ~~that~~ in the USA sustainable engineering practice activities. ~~Using high~~ High-volume ~~volume~~ fly ash concrete, recycled concrete aggregates, and supplementary cementitious materials are recommended to overcome the barriers. Abidin (2010) considered that the pace of action towards sustainable application depended on the consciousness, knowledge as well as an understanding of the

consequences of individual actions. Lam et al. (2009) categories cost, delay, technical issues, contractual considerations, and management were the factors that influence the adoption of green specifications in Hong Kong. Potbhare et al.（2009）formulated an implementation strategy for the rapid adoption of green guidelines for the developing nations, based on the detailed review of the major green building guidelines globally and contextual information of the Indian society which were collected through a survey questionnaire.

In recognition of these contributions to the knowledge of green specifications in China, and based on the research in the field, an initial list of the identified variables specifically for China was compiled and synthesized in this paper. Table 1 shows a list of variables summarized from the previous related literature.

3. Research method

3.1 Research framework

In this paper, the basic research method is shown ~~Below~~ below~~is the basic research method for this paper~~. Firstly, the literature review, pilot survey and ~~questionnaire~~ questionnaires were used to make a survey ~~of~~ on the factors that affect the adoption of green specifications. Then, ~~means~~ technology and factor analysis were used adopted to analyze the data.

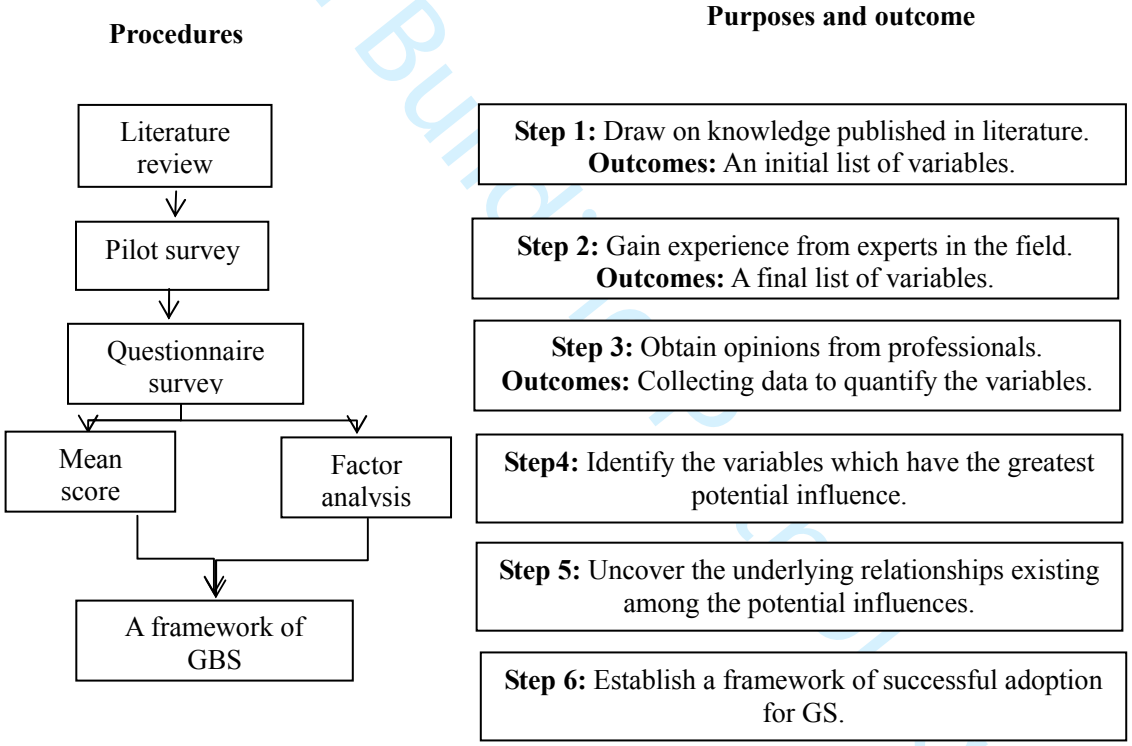

Figure 1 Framework of the paper's research

3.2 Data collection

3.2.1Preliminary factors

Based on the comprehensive literature review's result above, a questionnaire was designed and evaluated. A pilot study was conducted to refine and revise the questionnaire. Three industry professionals who had experience of more than 10 years in this area were invited to comment on the identified variables ~~identified~~, considering the background and the market of ~~the Chinese~~China's construction industry, and ~~whether~~ any factor that could be deleted from ~~,~~ or added to~~,~~ the list. The final list of 18 proposed factors hindering the adoption of green specifications formed the main content of the questionnaire design (Table 1).

The questionnaire was composed of two parts. To be specific, ~~The~~the first part was designed to collect basic information regarding the respondents' company type, position, years of experience, and the basic information of their knowledge and experience in green specifications~~.~~; ~~The~~ the second part consisted of the aforementioned 18 preliminary factors. At the end of the questionnaire, a blank box was provided to allow the respondents to add any additional factors, if any. The respondents were asked to evaluate the degree, to which each item was a barrier to green specifications adoption using a five-point Likert scale. The meanings of the points are: 5 represented "strongly agree," 1 represented "strongly disagree," and the middle position was neutral.

3.2.2 Data collection

The questionnaire survey was conducted in Mainland China from April 2 to May 27, 2017, and 300 industry professionals in China were randomly selected for the survey through the online questionnaire platform www .sojump.com. At last, 128 valid questionnaires were collected with the rate of 42.6% that ~~. This rate~~ was consistent with the norm of 20 – 30% in construction management surveys (Hwang etc.2015). Among the valid questionnaires, 27% of the respondents were managers and 73% were engineers and technicians. About the years of construction work experience, 18% had more than 20 years of experience in this area~~,~~; 39% had 10 to 20 years of experience~~,~~; 27% had more than 5 to 10 years of experience~~, which could affirm~~. Then, the reliability and quality of data are proved.

Table 1 Potential factors for adopting green specifications based on Potbhar et al. (2009) and Lam et al. (2009) ect.

No	Barriers variables (Bvs)	Sources
V1	higher initial cost of GB adoption	Potbhare et al. (2009a), Potbhare et al. (2009b),Collins (1994), Lam et al (2009), Lam et al (2010)
V2	higher cost pressure without the benefits of economies of scale	Potbhare et al. (2009a), Potbhare et al. (2009b), Collins (1994), Lam et al (2009), Lam et al (2010)
V3	lack of market demand on green buildings	Lam et al (2009), Lam et al (2010), Shi et al. (2013),Chan(2016)
V4	limited support from the senior management for GS adoptions	Lam et al (2009), Lam et al (2010), Shi et al. (2013),Chan(2016)
V5	lack of local R&D institutes and services	Potbhare et al. (2009a) ,Lam et al. (2009), Lam et al. (2010)
V6	unfamiliarity with green technologies	Lam et al. (2009), Chan (2016), Shi (2013)
V7	conflicts with aesthetic issues	Shi et al. (2013), Lam et al (2009), Lam et al (2010)
V8	poor reliability and quality of specifications	Lam et al (2009) ,Ye et al. (2015)
V9	incomplete legal framework issues	Potbhare et al. (2009a), Potbhare et al. (2009b), Meryman (2004)
V10	lack of governmental regulations and incentives	Potbhare et al. (2009a), Potbhare et al. (2009b), Meryman (2004)
V11	inadequate green material supply chain	Kibert (2008), Hwang and Tan (2012)
V12	lack of benchmarking system	Chan (2016), Chen & Chambers (1999), Meryman & Silman(2004)
V13	lack of technology and testing institutes for green specifications	Potbhare et al. (2009a) ,Lam et al (2009), Lam et al (2010)
V14	lack of marketization of specifications	Potbhare et al. (2009a), Lam et al (2009), Lam et al (2010)
V15	lack of knowledge on green technology	Lam et al. (2009), Shi et al. (2013)
V16	unwillingness to change the conventional way	Chan (2016), Chen &Chambers (1999), Meryman & Silman (2004)
V17	low public awareness of environmental issues	Meryman & Silman (2004), Mollaoglu et al (2016), Chan(2016)
V18	lack of technology innovation	Potbhare et al. (2009a), Mollaoglu et al (2016)

3.3 Data analysis

The ~~Mean~~ mean score method and factor analysis were used to identify and analyze the barriers that affect the adoption of green specifications by SPSS 10.

3.3.1 MS technology

The mean score method is a simple and effective method ~~to~~ of ~~rank~~ ranking the relative ~~important~~ importance, and it has been used in previous project management studies (Chan et al. 2003; Chan and Kumaraswamy 1995). In this paper, the same method was ~~used~~ adopted to analyze the data collected from the questionnaires. The five-point Likert scale (1 = least important, 2 = slightly important, 3 = important, 4 = very important, and 5 = most important) was used to calculate the mean score of each variable, which showed the relative importance level of each variable.

3.3.2 Factor analysis

Factor analysis is a statistical technique which is used to find clusters of the related variables. It can be ~~used~~ employed to represent the relationships among sets of many interrelated variables (Norusis 2008~~,Huang~~, Huang et al. 2008). It has been widely used in previous studies ~~, e.g.,~~ as ~~in~~ Lu et al. (2008) and Wang and Yuan (2011). In this study, factor analysis is ~~used~~ conducted to extract the factors and explore the underlying relationships among critical factors~~among the critical factors~~.

Before using this method, various tests were ~~needed~~ indispensable ~~to~~ for ~~examine~~ examining the appropriateness of the factor analysis on ~~to the~~ factor extraction. In this ~~paper ,the~~paper, the Kaiser-Meyer-Olkin (KMO $\geqslant$ 0.50; Kaiser 1974) measure and Bartlett's sphericity test ($p < 0.05$; Bartlett 1954) were ~~uesd~~ conducted. The KMO value is ~~between~~ from 0 to 1. If the KMO is close to "1", the ~~correlations~~ correlation patterns are relatively compact, which means the results are reliable (Field 2005~~).),~~ ~~While~~ while if the KMO is close to "0", the ~~correlations~~ correlation patterns are diffused, which means it is not appropriate for factor analysis (Norusis 2008). According to ~~Kaiser(~~Kaiser (1974)~~,if~~, if the KMO value is greater than ~~0.5 ,it~~0.5, it means the sample is acceptable for factor analysis. Bartlett's test of sphericity is ~~used~~ employed to examine whether a specific correlation matrix is an identity matrix. If the value of the Bartlett's test of sphericity is large ~~with~~ when the associated Sig. is small, ~~it means~~ the correlation matrix is appropriate for factor analysis (SPSS 1997).

4. Research results and discussions

4.1 Rank analysis

In this part, the mean score method was ~~used~~ adopted to identify and analyze the influence of the variables on the adoption of green specifications in construction projects. The results of mean scores and the ranking for the 18 variables can be seen in Table 3.

The results ~~shows~~ show that~~,~~ the mean values of the variables are ~~between~~ from 3.0 for ~~the~~ 3.394 to 4.0 for ~~the~~3.992. The top five critical variables are~~, namely~~ (1) lack of governments' policies and regulation, (2) legal framework issues, (3) higher initial cost, (4) unfamiliarity with green technologies, and (5) bad reliability and quality of specification. The first and second variables as ranked by all respondents, are "the lack of governmental regulations and incentives" (mean = 3.992) and "legal framework issues" (mean = 3.937), which is thus considered as the greatest obstacle inhibiting the adoption of green specifications in ~~the Chinese~~China's construction market. "High initial adoption cost" (mean = 3.921, SD = 0.965) is ranked as the third obstacle. The fourth- and fifth-ranked factors are "~~Unfamiliarity~~ unfamiliarity with green technologies" (mean =3.890) and "bad reliability and quality of specification" (mean =3.819), respectively.

4.2 Factor analysis

~~Using~~ Conducting factor analysis with component analysis and the varimax rotation, ~~the~~ 18 variables are divided into 5 compents according to the underlying interrelationships that existed among them. The Bartlett's test of sphericity (χ^2 =898.398, df =153, significance level = 0.000) was significant ($p < 0.05$), and the value of the KMO index (0.897) was above 0.50 (Table 1). Therefore, the data in this paper were appropriate and suitable for factor analysis.

From the consequence in Table 2, five clusters whose eigenvalues were greater than 1 through principal component analysis were extracted. The total variance cumulatively explained by the four extracted components ~~account~~ accounts for 71.392 percent. The results of the matrix can be seen in Table 2. Each of the 18 critical factors belonged to only one of the five factors with the factor loading value ~~exceeded~~ exceeding 0.50.

Table 2 KMO and Bartlett's test

Kaiser-Meyer-Olkin measure of sampling adequacy	0.897
Bartlett's test of sphericity	
Approx. x 2	898.398
df	153
Sig.	0.000

Table 3 Total Variance Explained for Critical Factors

Factor	Initial eigenvalues		
	Total	% of variance	Cumulative %
1	6.956	38.644	38.644
2	1.405	7.805	46.450
3	1.216	6.755	53.205
4	1.034	5.747	58.951
5	1.006	5.590	64.541

Table 4 Results of factor analysis for factor Matrix after Varimax Rotation

Variables	Mean value	SD	Rank	Factor, variable groupings				
				1	2	3	4	5
V13	3.661	0.986	9	0.723				
V8	3.819	0.987	5	0.701				
V18	3.693	0.913	7	0.683				
V6	3.890	1.018	4	0.651				
V7	3.638	0.879	10	0.628				
V5	3.661	1.071	8	0.559				
V16	3.394	1.070	18		0.780			
V17	3.409	0.979	16		0.635			
V15	3.394	0.910	17		0.622			
V4	3.591	0.995	12		0.596			
V10	3.937	1.052	2			0.809		
V9	3.992	0.988	1			0.797		
V12	3.591	0.770	13				0.669	
V11	3.591	0.770	14				0.648	
V3	3.787	0.914	6				0.607	
V14	3.606	1.085	11				0.546	
V2	3.543	0.990	15					0.862
V1	3.921	0.730	3					0.723

5. Findings and discussion

5.1 Factor 1: Green technology

The "green technology" factor consists of six critical variables: (1) lack of local R&D institutes and services, (2) lack of technology and testing institutes for green specifications, (3) conflicts with aesthetic issues, (4) poor reliability and quality issues of specification, (5) unfamiliarity with green technologies, and (6) lack of technology innovation. The six critical variables under this component focus on the green technology when green specifications adoption. This component accounts for 38.64% of the total variance explained among all of the critical variables (Table 3).

The green specifications in China ~~has~~ have just been issued only a few years ago. Now, there is no systematic technology institute for green specifications' research and ~~revised~~revision. The general green specifications are generally recommended specifications; they ~~need to be~~should be developed when they are in different provinces. ~~But~~ However, there are no local ~~institute~~ institutes that focused on the research work of local specifications. The specifications need to be considered in life cycle sight and differ according to the characteristics of different climatic regions and different types of buildings. Besides, in China, there are ~~no does not have a~~ special ~~technology~~ technologies and testing ~~institute~~ institutes to examine the ~~practical~~ practice of green specifications, and ~~has no~~ detail technical specifications for examining green buildings are lacking.

The aesthetic appearance of a building ~~can has~~may conflict ~~conflicts~~ with green ~~specifications~~ specification adoption. Clients often focused on the aesthetic appearance~~. But~~, but the adoption of green specifications can cause the degradation of aesthetic appearance (Pierce 2000). For example, as to the ~~install~~

installation of solar panels, architects have to spend time on how to integrate it with the materials on the façade or the house roof (Shi *et al*. 2013).

Although China has achieved obvious progress in specifications and R&D work for green ~~building~~ buildings in recent years~~in China has achieved obvious progress in recent years~~, and many problems still exist. The promulgation of legislation and mandatory green specifications and regulations that set boundaries for market activities is a government function that is crucial for ensuring that green specifications are widely accepted in the market (Potbhare et al., 2009; Qian and Chan, 2010). However, in China, governments have issued a series of green specifications, but the implementation ~~efforts~~ of these policies ~~are~~ is either inadequate or absent. Most of the green specifications are voluntary, while mandatory green codes and regulations are lacking, causing individuals to eschew the adoption of green specifications.

Eisenberg et al. (2002) stated that~~,~~ insufficient knowledge and unfamiliarity with green materials and~~,~~ products ~~that~~ related to green technology are certain barriers to green ~~specifications~~ specification adoption. When ~~Compared~~ compared with~~to~~ the conventional technology, green technology ~~are~~ is usually complicated (Tagaza and Wilson, 2004). Unfamiliarity with ~~the~~ green technology, lack of the knowledge of the green specifications may affect the adoption behavior Zhang et al. (2011).

Another barrier is the lack of technology innovation~~. It is~~, mainly because of the shortage of R&D research investment in ~~Chinese~~ China's building sector. In order to achieve sustainable development for the construction area, it is important to make innovation for construction technology (Vanegas and ~~Pearce ,~~Pearce~~1997~~, 1997). ~~However ,in~~However, in China, the research grant for the building area is only 0.4% to 0.6% ~~0.4 to 0.6%~~ in the GDP of the total construction area (~~Mao ,2015~~Mao, 2015).

5.2 Factor 2: Awareness and attitude

Four variables (including ~~Limited~~ limited support from the senior management for GS adoptions; lack of knowledge on green building specifications; unwillingness to change the conventional way; and low public awareness of environmental issues) should be grouped into this underlying factor for the successful adoption of green specifications owing to the strong correlations ~~among themselves~~inside. This factor should be the most important one in ~~term~~ terms of the percentage of covariance among variables.~~among the variables.~~

Support from the top management directly affects the adoption of green specifications (Meryman & Silman, 2004). The employees can accept and adopt green building specifications better if the senior management want and commit to environmental ~~issues(~~issues (Ball, 2002).

The lack of knowledge on adoption of green specifications is a significant barrier that ~~preventing~~ prevents the adoption of green specifications. Due to the uncertain performance, a construction enterprise can reject to adopt green specifications as the adoption of green specifications may ~~cause~~ result in extra costs.

Another technical barrier is the unwillingness to change the conventional way, as noticed by Meryman and Silman ~~(2004~~(2004). This is the same ~~to~~ as the findings ~~by~~ of Chen and Chambers (1999). The traditional ideas are still deeply rooted in the construction areas in China. Most construction enterprises always ~~construct~~ carry on their construction work depending on their experience and~~,~~ unwilling to change, let alone adopt the new green specifications.

The public environmental awareness ~~also~~ is also closely related to the adoption of green specifications. In China, although people are recognized and affected by the environmental issues, majority of them attribute the problem to the responsibility of government involvement or companies' participation (CEAP, 2007). In order to improve the awareness of the environment, the knowledge and cognition on benefits of ~~adoption of~~ green specifications adoption of all parties, including policy makers, owners, designers, construction personnel and the public, ~~need to~~should be further enhanced in China (Shi *et al* ,2013).

5.3 Factor 3: Policies and Regulations

This factor consists of two critical variables, accounting for 8.01% of the total variance explained among all critical factors. Through the understanding of the indices' meaning, the factor was the ~~themed~~ theme without ~~difficulty~~ difficulties as ~~policies~~ policy and ~~regulations~~ regulation barriers, including: (1) lack of legal framework for green specifications and (2) lack of governmental regulations and incentives for green specifications adoption(Table 2).

Having an efficient legal framework and procedure is the basic guarantee for the successful adoption of green specifications. The effective legal framework involves related policies, regulations, codes and specifications to guide all ~~the~~ stakeholders including ~~stakeholders' included~~ government ~~official~~officials, designers, contractors and developers ~~behaviors~~ to adopt green specifications well during the green construction process. In China, the ~~basic~~ basically necessary legal framework ~~to~~ for ~~support~~ supporting the adoption of green specifications is inadequate as China has a short time for its own green building specifications (Shi *et al.* 2013).

The lack of government policies and incentives for green specifications adoption is identified as the foremost barrier in the research result. Currently, the Chinese government has ~~set up~~issued a series of green specifications on building development, focusing on structural quality, energy saving, and green materials. However, most of them are voluntary policies which cause the ~~fail~~ failure of their execution. Consequently, enterprises ~~do not~~fail to adopt green specifications, and government ~~department~~ departments also fail to supervise the entire chain.

In order to overcome this obstacle, policy guidance from the government department is a critical method. The ~~Government~~ government can provide effective financial incentive measures, such as tax ~~incentive~~incentives, financial discounts, deficit subsidies and pre-tax loans for green specifications adoption. Construction companies benefit from the policies and will be more willing to adopt green specifications. Besides, some of the specificaitions can be formulated as mandatory environmental requirements, such as government green procurement policies and~~,~~ mandatory requirements in the public sector projects ~~and so on~~. Environmental considerations can be integrated with the ~~purchasing~~ purchase policies like environmental or green procurement policies (Russel, 1998). Government green procurement policies can ~~lead and~~ give practice ~~for~~ to enterprises for green specifications adoption. There are many countries in the world that have green public procurement (Bouwer, 2006; Kippo-Edlund, 2005; Ochoa&Erdmenger, 2003). Currently, China has a high proportion of the public sector among the construction industry. Mandatory requirements in the public sector projects ~~give~~ provide practice examples and~~,~~ lead ~~and promote~~ the private sector to adoption green specifications.

Reasonable incentives can encourage the market to pursue GS. Since 2001, the Buildings Department of Hong Kong has implemented incentive schemes in the building sector to promote the adoption of green technologies. Under these schemes, ~~a~~ the gross floor area (GFA) exemption is granted to developers of buildings with green features (Mao *et al.*2015). Thus, in mainland China, more incentives are required, not only to develop green specifications, but to offset the additional costs involved in it as well.

5.4 Factor 4: Market

This factor contains four critical variables: (1) lack of market demand on green buildings; (2) inadequate green material supply chain; (3) lack of benchmarking system; (4) Lack of marketization of specifications. This cluster is responsible for 6.53% of the total variance explained among all critical factors (Table 2).

Market demand also affects the adoption of green specifications. With the high ~~cost of the houses' price~~housing price in China, ~~public~~ consumers pay more attention ~~on~~ to the buying cost and the quality, rather than the construction method or the process of their buildings. Lack of market demand ~~on~~ for green buildings causes ~~the lack~~the failure of ~~adoption of~~ green building specifications.

The ~~Inadequate~~ inadequate green material supply chain is another challenge for green building specifications. As ~~the Chinese~~China's green technology and materials market is not mature now, green technology and materials ~~is~~are expensive when compared ~~to~~ with the conventional ~~material~~ materials and technology. Although stakeholders want to ~~use~~ carry out green specifications, they have risk ~~to~~ of ~~get~~ getting and ~~use~~ using green materials. The uncertainty of supplies and information is a significant barrier against green specifications adoption ((Love, Holt, Shen, Li, &Irani, 2002; Shi et al., 2012)~~. This can~~, and it can cause a delay for constriction work. ~~There~~Thus, inadequate green material supply chain~~inadequate of green material supply chain~~ hinders the adoption of green specifications.

China has just ~~establish~~ established its green building specifications system for a few years~~.~~. There are few ~~The~~ benchmarking examples of construction projects with green specifications adoption in China ~~are few~~((Lee & Chen~~,2008~~, 2008). Besides, In China, there is no ~~does not have a~~ relative database for green buildings~~. This causes~~, which causes the situation that the construction enterprises have no references for green

specifications adoption behavior.

There lacks ~~Lack of~~ marketization ~~of~~ for specifications. Take UK for example~~,~~ . BSI plays an important role ~~at~~ in the adoption of green ~~specifications ,~~specifications ~~the specifications~~ are in a state of marketization. ~~But~~ However, in China, the government department ~~has~~ with the total control power of the specifications~~. The government department~~ sets and reformulates standards that is the SQDOHURD (Standard Research Institute of Housing and Urban-Rural Development of the People's Republic of China). A non-governmental organization ~~Nongovernmental organization~~ plays a limited role in developing and embedding standards in China~~. This~~, which has led to the disconnection between market demand and ~~the~~ green specifications~~green specifications~~. ~~Also~~In addition, it lowers the green innovation of construction enterprises. Now, the Chinese government has changed the ~~standards~~ standard system step by step. It intends to give more freedom to the non-governmental ~~nongovernmental~~ organization for issued standards~~standards issued~~.

5.5 Factor 5: Economics

This factor ~~is named~~refers to "economics," and contains two ~~critical variables :~~critical variables: ~~(1~~(1) higher adoption cost ~~and ,(~~and, (2) higher cost pressure without the benefits of economies of scale. Furthermore, ~~The~~ the two variables account for 7.31% of the total variance explained among all critical factors (Table 2). In China, cost has been considered as one of the major and sensitive obstacles that hinders ~~the~~ green specifications adoption~~ by most stakeholders. It is~~, and it is consistent with ~~the~~ previous studies' results (Kunzlik, 2003; Meryman & Silman, 2004; Ofori and ~~Kien ,2004~~Kien, 2004; Liu et al., 2012).

From ~~Studies~~ studies, it ~~have~~ has been ~~recognized~~ found that the higher initial ~~adoptipn~~adoption cost is mainly associated with the considerations for decisions of green specificaitions adoption (Kunzlik, 2003; Meryman & Silman, 2004). Extra cost of ~~adopt~~ green specifications is the prime ~~obstacle(~~obstacle ~~Ofori(~~Ofori and ~~Kien ,2004~~Kien, 2004). The adoption of green specifications ~~needs the use of~~should adopt green techniques and ~~green~~ materials~~ ,such~~, such as ~~the use of the~~ equipment for water or energy savings and ~~,~~ high performance insulation protection ~~and so on~~ (Hwang and Tan, 2010). Consequently, all of these can cause the increase of the extra initial cost. ~~Consider that~~In this case, most stakeholders consider the extra cost as a considerable loss of their profits. Liu (2012) argued that the control of cost is one of the biggest challenges for the stakeholders to adopt green specifications. Zhang et al. (2011) proved that the cost of using green materials will be from 3% to 4% ~~more~~ when compared ~~to~~ with using conventional construction materials.

The higher extra cost with the lack of ~~economy~~ economies of scale ~~of scale~~ is also considered as a pressure for ~~the~~ green ~~specifications~~ specification adoption. Lack of the economic scale due to the insufficient ~~quantities~~ quantity demand means ~~the~~ an increase in cost per unit as fewer units are produced. Currently, to achieve the expected economies of scale for green ~~specificaitions~~specifications in ~~China~~ China, ~~needs~~ the government support is necessary ~~to achieve~~. In China, the stakeholders will not be able to adopt green specifications, as they cannot receive direct and quick monetary profits but the higher adoption cost. Therefore, researches on how to ~~increase~~ enhance the market competitiveness for green specifications adoption and~~,~~ how to assist the promotion of green specifications adoption ~~is needed~~are ~~–~~imminently necessary.

Shi (2012) recommended the use of life cycle approach for the sustainable construction in China. Lam (2009) suggested that further studies should be performed on possible savings in life cycle cost and the possible costs of environmental remediation for green specifications~~–~~. Previous studies encouraged the adoption of green specifications. Therefore, in order to ~~relief~~ relieve the adoption cost barriers faced by stakeholders, more successful benchmarking practices should be shown on the economics scale benefits of green specifications in China. Besides, the effective lead and support from the senior management can directly ~~affects~~ affect the adoption of green specifications (Meryman & Silman, 2004).

Shen et al. (2010) pointed out that the government's guidance and support is the key to ~~adopt~~ green specifications for construction enterprises. Guide and support can lead and increase the demand of the green building market. It can also give finical support for the development of green technology~~-~~. With the demand increase and ~~the support of the~~ green technology, ~~examples of the buildings~~ those who adopt green specifications can be good practice for other construction enterprises. Cost of adoption green specifications can been offset by scale economy. The awareness and attitude of different stakeholders can be ~~improved~~enhanced. Nowadays, the Chinese government now has considered to mandatorily ~~make the adoption~~adopt ~~of~~ green specifications ~~mandatory~~ in some pilot cities.

6. Conclusions and implications

The construction industry has consumed more ~~of the~~ global resources~~.~~. Sustainable construction is a useful way for ~~resources~~ resource saving and sustainable development. Green specifications are the basic guarantee and reference for sustainable ~~construction.However~~construction. However~~,in~~, in China, ~~the~~ green building specifications has not been well used which hindered the process of sustainable ~~construction.This~~construction. This study presents a comprehensive explanation of the barriers that hinder the adoption of green ~~buildings~~ building specifications in China. Based on literature review, 18 critical barriers that affect the adoption of green building specifications in China are initially identified by ~~using~~ conducting the questionnaire survey ~~approach~~. In order to understand the interrelationship among factors better and clearly, this paper uses factor analysis and rank ~~techniques~~ technique method for further ~~analysis.The~~analysis. The study has identified that ~~government~~ government-related ~~related~~ factors are the foremost factors for the adoption of green specifications in China. ~~Using~~ By making factor analysis, the basic 18 critical variables are categorized into five factors: (1) green technology and techniques, (2) awareness and attitude, (3) governments' policies and regulations, (4) market demand, and (5) cost. The results also indicate that the most dominant one of the five clusters pertains to regulations and policies. The findings ~~attempt to~~tend to highlight the factors that affect the adoption of green specifications in China, and give policymakers advice to better implement green specifications in China. Results show that solutions to overcome the barriers in China~~Chin is~~ mainly ~~depends~~ depend on the government. The results can also give other developing countries reference for better adoption of green specifications.

The research result is important as it focuses on the adoption of green building specifications in China at a time when the country ~~sees~~ experiences huge development in the construction environment allied to huge requirements in sustainable technology. The findings in this paper have ~~put forward~~shown some insights for the recognition of factors in the adoption of green building specifications in ~~China .~~ China, and~~It provides~~ reliable guides and appropriate ~~decision~~ decisions for green ~~buildings~~ building specifications adoption and environment improvement ~~,~~are provided for China's ~~construction~~construction ~~industry.Therefore~~industry, which~~, this~~ may contribute to the enhancement of ~~the adoption of the~~ green building specifications and ~~give~~ provide ~~China'~~ China's construction industry with ~~,~~a decent environment~~.~~. In ~~Future~~ future research, ~~needs to explore~~ the ~~faactors~~factors that affect the adoption and implementation of green building specifications in other countries and on other aspects should be explored.

Acknowledgments

The paper is supported by the National Thirteen-Five Year Research Program of China (2016YFC0701600) Technical standard system and key technology of construction industrialization. The authors are gratefully for the research group who have given suggestions and made efforts on the subject.

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