urbanization and sustainability concepts will be comprehensively incorporated in the urbanization process. Sustainable buildings, renewable energy and green traffic systems will be highly promoted by the central government. Thus, China's urbanization process generates a strong driving force for the implementation of sustainability strategies in the construction industry.



Figure 1.Multi-level perspective on sustainability transition of the Chinese construction industry.

Currently China is the world's largest energy consumer and CO_2 emitter. To deal with rising pressure of emission reduction from home and abroad, the Chinese government has formulated an obligatory target: the CO_2 emission intensity (CO_2 per GDP) in 2020 must decline by 40% to 45% compared to the value in 2005. The Chinese government understands that the construction industry needs to take measures to respond to its high energy consumption and CO_2 emission. The *Twelfth Five-year Plan for the Construction Industry* points out that currently the sustainability performance of the industry is weak, thus promoting energy conservation and emission reduction is one of the major tasks of the industry. The plan also puts forward a quantitative goal: the energy consumption of the industry per value added generated by the industry needs to decrease by 10% in 2015 compared to it in 2010. It is clear that the serious situation of China's energy consumption and CO_2 emission generates huge pressures for the construction industry to contribute to China's overall energy conservation and emission reduction and emission reduction goal.

Urbanization and energy consumption provides strong drivers for promoting sustainability of the construction industry. However, an opposite socio-technical landscape, cultural preference, do exist which reinforces the current operation mode of the industry. Many clients and local governments pursue the concepts of "large, high, new, luxurious and unique" of construction projects and consequently, recent years have seen the continuous emergence of excessive luxurious public buildings. Currently the construction area of public buildings accounts for less than 4% of the total area of urban buildings in China, however the energy consumption of public buildings constitutes 22% of the total building energy consumption. The central government realized this problematic cultural preference and has released a series of regulations trying to rectify this excessive preference of luxury buildings. In 2007, 5 central government departments jointly released a regulation, Opinions on Strengthening Construction Project Management of Large Public Buildings, which clearly states that some local governments excessively pursue the uniqueness of architectural appearance, ignoring building function, the consumption of natural resources, the local cultural characteristics, economic feasibility and the harmonious relationships between buildings and the environment. The regulation indicates that a regulatory system for energy conservation of public buildings will be established. In 2012, the government started the revision process of the existing energy standards for public buildings issued in 2005, trying to increase the energy conservation articles in the standard. It seems that the cultural preference of luxuries and uniqueness is so strong that the central government is trying very hard to combat with this preference, which is a huge obstacle of sustainability.

Socio-technical regime. Socio-technical landscape provides both driving forces and obstacles for the promotion of sustainability in the Chinese construction industry. Under the landscape, the socio-technical regime is struggling about whether embracing sustainability, and many drivers and barriers of sustainability coexist.

In terms of the awareness of sustainability, many Chinese construction corporations simply believe sustainability equals to environmental protection or green construction, ignoring the social and economic dimensions of sustainability. In terms of the concept of green construction, ambiguous understanding of green construction still has been discovered to be one of the most critical barriers of promoting it in China. However, even though the concept of sustainability is not popularised in most corporations, the importance of environmental protection, emission reduction and energy conservation is generally recognised. The landscape of energy consumption and climate change in China has force the government to adopt a strict energy conservation policy, reflected by its *12th Five-year Plan for Energy Conservation and Emission Reductions* released in 2012.

Economic implications of promoting sustainability are interpreted differently by corporations. Many Chinese corporations lack the motivation to pursue sustainability since they believe it will not contribute to their competitiveness. However, some Chinese developers have discovered that developing sustainable projects can gain good corporate image which is important intangible asset of corporations, and also the unique sustainable projects satisfy the demands from a certain group of clients who have high expectations on sustainability. A major argument from the Chinese construction corporations undermining adopting sustainability strategies is that pursuing sustainability generates additional cost, which has been identified to be one of the most critical barriers prohibiting

sustainability by many scholars. However, there are evidences from Chinese construction corporations that promoting sustainability leads to long-term cost saving mainly due to the reduction of material, energy and maintenance costs. For instance, the adoption of on-site recycling methods reduces material consumption, and thus material cost. The adoption of renewable energy and low-carbon appliances will significantly reduce long-term energy cost. The long-term economic benefits from implementing sustainability strategies still need to be understood and accepted by most construction corporations in China.

Besides from economic performance, sustainability also has many management implications. It has been discovered that incremental time, which affects corporations' schedule management, and limited availability of suppliers, which affects corporations' supply chain management, are two serious barriers of sustainability, suggesting that construction corporations are aware that promoting sustainability may generate management problems. Luckily, some Chinese construction industry associations are trying to identify sustainability leaders and introduce their experiences to the industry. For instance, China International Contractor Association has organized social responsibility assessment for international contractors and released instruction manuals on social responsibility for Chinese international contractors. This association also arranges workshops and seminars on management system to help corporations improve sustainability performance.

Niche-innovations. There are different kinds of innovations, including managerial, technological, institutional and social innovations. Sustainability transitions involve many potential solutions rather than just one, two or sometimes three alternatives as was the case in many historical transitions (Geels 2010; Lachman 2013), so these different kinds of innovations all have a role to play. However, compared to other kinds of innovations such as managerial and social innovations, technological innovation is put much more emphasis by the government. The Chinese government has a strategic plan for the development of sustainability technologies in the construction industry. According to the 12th Five-year Plan for Technology Development of Green Buildings, issued in 2012 by the Ministry of Science and Technology, three major areas of technologies are identified important and the research of them will be strongly supported by the government. By contrast, there is no guidance of promoting other kinds of innovations. Even though technology development plan has been put forward, there are still huge challenges concerned with the effective application of these technologies. For instance, the lack of competent architects and an integrated interdisciplinary design system is a huge challenge undermining the application of core sustainability technologies.

DISCUSSIONS AND CONCLUSIONS

Based on the above MLP analysis, it can be concluded that on every level both drivers and barriers exist. The main drivers for the sustainability transition of the Chinese construction industry are: 1) the huge transition pressure generated from urbanization, energy consumption and climate change, 2) most corporations' awareness of energy conservation and emission reduction, 3) some corporations'

realization of the economic benefits of adopting sustainability strategies, 4) some industry associations' commitment in popularizing management experience of sustainability leaders, and 5) clear technological niche-innovation plan. By contrast, the main barriers for the transition are: 1) the strong stability of China's cultural preference for luxury buildings, 2) most corporations' lack of clear understanding of sustainability, 3) the economic benefits of sustainability have not be realized by many corporations, 4) implementing sustainability strategies may requires many management changes of corporations, and 5) the efficient application of niche-innovations are impeded by some factors, such as the lack of competent architects.

According to the MLP, transitions start to happen when niche-innovations accumulate enough momentum, to break the old regime which has been destabilized by the pressures from the landscape level. In order to promote the industry to efficiently transition to a more sustainable industry, the first strategy is to help sustainability niche-innovations gain enough momentum. Sustainability education needs to be strengthened since the niche-innovations need to be adopted by relevant professionals who master them. Not only architects, but also engineers like civil engineers, and managers such as project managers, should have sustainability awareness. The second strategy is to accelerate the destabilization process of the current regime. The government should create a policy environment which can identify relatively sustainable construction corporations and select them to be the winners in the market, i.e. to make sustainable corporations also competitive. It is recommended that economic incentive policies, such as taxation reduction, and international cooperation should be strengthened by the government to further improve the economic competitiveness of the sustainable construction corporations. China has successfully adopted strong economic incentive policies and strengthened international cooperation to boost the wind power industry, which currently is the largest in the world, and relevant experiences from the energy sector can be used to promote the growth of sustainability-oriented construction corporations. The third strategy is to gradually influence the culture in the landscape level. Currently the environmental pollution in China is severe and the general public is aware of this pollution. Recent years have seen the emergence of environmental parades from the public. It is recommended that the central government should not keep silence about the severity of the environmental problems and by contrast, the central government should take advantage of the general public's deep concern of the environment and leads the cultural shift of the society. Various media, such as the TV shows, the newspaper, and the government official website, should be used as platforms introducing and popularizing the concept of sustainability. Environmental information disclosure and accountability system for construction projects should also be established, thereby transforming public environmental concerns into construction corporations and local governments' environmental protection pressures, which will gradually alter their cultural preference towards sustainability.

This paper adopts the MLP to analyse the sustainability transition of the Chinese construction industry. Driving forces and obstacles from the social-technical landscape, social-technical regime and niche-innovation levels are identified and discussed. The complexity of sustainability transition is revealed and three strategies are proposed to facilitate the transition process of the Chinese construction industry.

Although this paper is focused on China, the conceptual framework of the MLP can be applied to construction research in other regions.

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369

Developing Green Building in the Manner of Industry Cluster

Junyan Jin¹; Yue Shi²; and Shoujian Zhang³

¹Postgraduate, Department of Construction and Real Estate, Harbin Institute of Technology, Harbin 150001, China. E-mail: jjyyuyue@126.com ²Postgraduate, Department of Construction and Real Estate, Harbin Institute of Technology, Harbin 150001, China. E-mail: 495201516@qq.com

³Professor, Department of Construction and Real Estate, Harbin Institute of Technology, Harbin 150001, China. E-mail: zhangsj@hit.edu.cn

Abstract

With global climate change issues and the increasingly serious energy crisis, low carbon idea and green idea are penetrated into many industries. Firstly, the paper is based on the industrial agglomeration theory and industrial gradient transfer theory. Considering the current situation of green building development in China, the paper proposes to develop green building in the way of industry cluster, which is more conducive to improve the green building technology and the rate of green building. Secondly, on the basis of diamond model theory, the paper summarized the factors which affect the competitiveness of green building industry. Also, it analyses our regional green building industry qualitatively. Thirdly, the paper takes the method of empirical research. By comparing results of the cluster analysis and the mean green building amount 72 cities already have, it reaches the conclusion that cluster analysis can be used as a method of green building industry gradient division.

INTRODUCTION

The construction industry is one of the three areas of energy consumption in China. On one hand, the building lighting, heating, air conditioning and electrical equipment consumes a lot of energy. On the other hand, it consumes a lot of cement, steel, non-ferrous metals and glass and other building materials in the building construction process. The construction of green buildings becomes one method of reducing carbon emissions in the construction industry. Green building saves energy, protect environment, and is efficient. It is helpful of reducing carbon emissions, bringing the best economic benefits for the community.

The Chinese government has issued a series of regulations and policies to promote and oversee the development of the green building industry. In 2006, China developed a long-term economic and social development strategy of development planning; "green building" was included in the planning. June 1, 2006, the Ministry of Housing issued a "green building evaluation criteria". April 27, 2012, the Ministry

of Finance and the Ministry of Housing and Urban jointly issued the "Opinions on expediting the development of green building", documents show wishes to 2020, the proportion of green building new buildings account for more than 30%. May 2012, the Ministry of Housing and Urban-Rural Development announced the "five year building energy special plan" for the next five years to promote energy conservation in buildings of building a comprehensive policy to make statements.

However, compared to the green building industry in developed countries, the number of green building projects in China is less than normal, and lower green building coverage. Green building industry clustering effect can improve this situation, effectively improve the level of green building technology, and improve the government's laws and regulations and market leading role. With the mature green building mode, reduced demand in the market, such as the scarcity of production factors under the negative effects of the green building industry by gathering diffusion changes resulting effect led to the construction of green buildings nationwide project to improve green building penetration, reducing carbon emissions.

BACKGOUND

Green building. According to Chinese "Green Building Standards" (GB50378), definition of green buildings, "green building refers to the entire life cycle of the building, those building which could maximize the conservation of resources, protect the environment and reduce pollution, provide people with healthy, suitable and efficient use of space, be in harmony with nature".

In foreign countries, green building started earlier, green building research is more mature. In the United States, mainly due to the impact of green building and urban distribution is the income level of the city, the concentration of government agencies and service level of development (Cidell 2009). Green building owners address concentrated in the city or the Pacific Rim region of California (Kahn and Vaughn 2009). The scale and level of economic development, the number of green building projects and the city's real estate market has a positive correlation (Fuerst et al. 2011).

Green building industry. Green building industry refers rental transaction until downstream, property management, business services, finance and other stages of the exhibition from upstream planning, financing, design, survey, to building materials manufacturing, equipment manufacturing, construction and manufacturing midstream, to achieve environmental protection, energy saving, industrial system of green development.

Industrial development from industry to industry cluster diffusion iterative process. Industrial cluster refers to a number of different companies (can be the same department or different departments of the enterprise), concentrated economic geographical phenomena in the same geographical space formed, emphasizing space companies get together phenomenon, highlighting the role of the external economy, need to eliminate as companies scale brought uneven geographical concentration effects.

According to industry cluster theory, in the early stages of industrial development, with resource development areas, and supporting the construction of production facilities, subject to the requirements of the economies of scale inherent drive, will inevitably lead to different levels of scale to produce the same product or a

similar product companies are concentrated; by under the external driving force of economy of scale, in order to improve productivity, reduce transaction costs and information costs, and enhance the competitiveness of enterprises, the enterprise is bound to be transferred to the relevant product cluster Development. Therefore, it forms industrial agglomeration.

Professor Michael (2002) at Harvard Business School presented Porter diamond theory, also known as the diamond theory for analyzing how a country to achieve competitive advantage in the international arena. Porter argued that if an industry of a country or a region competitive, depending on the six factors. Among them, the factors of production, demand conditions, business strategy, structure and competition in the industry, related industries and pillar are four basic factors, government actions and opportunities are two secondary factors. The four basic elements through the interaction of an industry in a country or a region's competitive advantage play a decisive role, and the opportunity to play a role in government action and indirect effects of competitive industries through four basic elements.

Graham et al. (2004) characteristics of the diamond industry for building the model was revised proposed construction industry hexagon model, model includes industrial properties, elements, human resources, demand, government, corporate strategy and decision-making as well as cultural and opportunities aspect.

Economics, geography, industry, spatial agglomeration forces and dispersion forces exist, the cumulative effects of market proximity and supply neighboring bring circulation will lead to industry concentration, but can lead to excessive industrial clustering factor rising costs and intensified competition in the industry, resulting in crowding, resulting in industrial dispersion.

According to the theory of industrial gradient transfer, with industrial clustering intensifies, leading to increased industry competition within the region, increasing labor costs, lower product demand, followed by industrial agglomeration advantages will be weakened, replaced by diffusion industry. Gradient differences in economic development space, making the migration of economic activity through capital investment, technology dissemination and labor, a steering force from one area.

Combined with the development of the characteristics of green building industry, we can see that the process of the development of green building industry has to adapt to regional industrial clusters and industrial development of decentralized alternate. Industrial agglomeration theory can choose green building as early development, after the green building industry system matures, it can make use of the theory of industrial dispersed nationwide promotion. A total number of urban green building projects and the city's GDP, there is a close relationship between the commercial real estate area and commercial housing price factor.

Advantage of green building. People involved in green building projects, including investors, owners, government agencies, lenders, suppliers, designers, contractors, consultants and so on. Green building can bring more benefits to the project participants.

For the government, its green building can bring in terms of stakeholder. Due to lower overall energy consumption of urban, conventional energy development and investment needs will reduce spending on public finances will be reduced; increase due to low-carbon buildings brought help to improve employment opportunities for local consumption levels, thereby enhancing the region's GDP.

For consultants, green building will generate additional consulting fees, including the additional cost of green building design, the application of green building certification consulting fees required inspection and monitoring costs. According to a study by the US Green Building Council of New York is the cost of green building, LEED-certified project consulting fees increased, green building design costs accounted for 0.14% of the original design fee to apply for LEED certification consultancy fees accounted for the original design 0.08%, accounting for 0.27% fee monitoring acceptance of the original design fee of.

For investors, owners, contractors, the possible economic incentives from the government to obtain additional price or rent, higher occupancy rates, you can save electricity and other energy sources, will help to enhance the corporate image. Some academic studies abroad have proved that green buildings lower vacancy rates and higher rent levels. Eicholtz and others in 2009 to 694 green office buildings have been studied, and compared the similar non-green buildings in the surrounding individual buildings, concluded that the Energy Star green building can get 3.3 % additional rent, sale prices about 19% higher than non-green buildings.

Users of green building operating costs lower than non-green buildings, improve employee productivity, reduce employee population lives, and help to improve the corporate image. Industrial advantages of green buildings can encourage more regional and business development of green building, green building technologies to improve the level, thus promoting the rapid development of green building.

METHODOLOGY

The literature review conducted aided in having a better understanding of green building and green building industry. On the basis of diamond model theory, the paper summarized the factors which affect the competitiveness of green building industry. Also, it analyses our regional green building industry qualitatively. Then, the paper takes the method of empirical research. With the help of SPSS software, it takes advantage of GDP, population, per capital disposable income, commercial real estate area, housing price data of 72 cities who have owned green building, and classifies the 72 cities into six categories according to cluster analysis method. By comparing results of the cluster analysis and the mean green building amount 72 cities already have, it reaches the conclusion that cluster analysis can be used as a method of green building industry gradient division.

QUALITATIVE ANALYSIS

Porter's diamond model based on six elements combined with China's national condition; obtain green building industry more competitive areas.

Production elements. Specific factors of production, including human resources, labor quality, the degree of employee education, business assets, new building materials, equipment, number of units, number of firms and other factors. Porter

believes that advanced factors of production in the region has an important role to gain a competitive advantage.

In our regional points in the Yangtze River Delta, Pearl River Delta and the Beijing-Tianjin region labor-intensive, high-tech industrial concentration, corporate capital account for a large proportion of corporate capital nationwide is attracting a large number of labor force migration. According to the theory of comparative advantage, the Yangtze River Delta, Pearl River Delta and the Beijing-Tianjin region is more suitable priority to the development of green building industry gathering.

Demand. Yangtze River Delta, Pearl River Delta and the Beijing- Tianjin-Tangshan area attracts a large number of domestic and foreign high-tech talent, and current news reports, some foreign employees to leave China because of air issues, indicating that people in these areas demand for green ecological lifestyle is large, and thus has a more green buildings discerning customers in these areas will help the region's businesses through advanced levels of productivity and management to enhance their competitiveness, thereby enhancing the competitiveness of industries in the region. The number of existing green building research also shows that the Yangtze River Delta, Pearl River Delta, Beijing- Tianjin- Tangshan area have been signs of green industry cluster.

Related and supporting industries. Upstream and downstream industries green building industry, from design to property management, have impact on the green building industry gathering.

In terms of design, green building design research Institute mainly China Academy of Building Research, Tianjin Branch, Shanghai Branch, Beijing Tsinghua Urban Planning and Design, Architectural Design Institute. The green building design mainly concentrated in Shanghai, Beijing, Tianjin, three cities.

In real estate development, two of the largest investments in green building companies are Vanke and green real estate company headquartered in Shenzhen and Shanghai respectively.

Therefore, this factor to consider, the Yangtze River Delta, Beijing and Tianjin compare priority for the development of green building industry gathering.

Government policy. Shenzhen Municipal Government in July 19, 2013 issued a "Shenzhen Municipal People's Government Order (No. 253), Shenzhen to promote green building approach", clearly put forward for green building according to different stars different rewards, penalties for non-green building. These policies can be in terms of development, Shenzhen green building industry, play a stimulating effect.

Foshan City issued a "Shunde accelerate the promotion of green building advice", provides all or part of the use of financial resources and other construction projects to be included in the scope of the focus of green building, and in the future to achieve the three-star green building standards will receive 80yuan / square m reward.

Haidian District, proposed that "all new buildings must be green buildings have been built did not meet building will be transformed into a green building". Recently, the implementation of low-carbon eco-building program was officially launched in northern Haidian. Yu Dongwei who is the project leader said Haidian