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Ecosystem Visualization and Analysis of Chinese Prefabricated Housing Industry

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Abstract

Prefabricated housing has proven to achieve high quality, reduce costs and improve housing environmental performance. While prefabricated housing has been widely constructed in many jurisdictions, it is still in its infancy in China. However, the prefabrication sector in China is in transition as the macro environment is changing and new participants are expected to enter architecture, engineering and construction (AEC) industry who will have to work cooperatively as well as competitively with the existed companies. Such changes and strategic activities have impacts on every participant within the ecosystem. A better understanding of the whole industry as well as the participants' strategic positioning will help companies develop their survival strategies. This paper aims to establish the prefabricated housing ecosystem in China based on the business ecosystem theory and to analyze the interrelationships among the major participants. A conceptual model of the ecosystem is established through literature review. Subsequently, the social network analysis (SNA) approach is employed to quantitatively analyze the strategic relationships between property developers and contractors who have adopted prefabrication in their residential projects. Finally, Node XL software is used for visualization and data analysis. Through the SNA measurements, the top 3 property developers and contractors are identified and several clusters are uncovered, which suggests a cooperation tendency among local actors.

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Keywords: prefabricated housing, business ecosystem, visualization, strategy

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1. Introduction

Construction is a key industry for many economies as it contributes largely to their GDP. In China, it accounted to 27.8% of the national GDP in 2014. However, the output and productivity data from the National Statistical Yearbook (2005-2014) shows that the construction industry has fallen behind other industries such as manufacturing in last decade in terms of productivity and efficiency. This has been blamed on the lack of technical innovation and fragmentation of the construction value chain [1]. Thus, there is a need for the construction sector to improve its efficiency by adopting an innovated technology such as prefabrication.

Prefabricated housing, otherwise known as prefabrication or offsite construction, offers substantial opportunities to improve project performance, both in terms of efficiency and quality. Moreover, it facilitates in reducing project costs and enhancing environmental performance [2-6]. This construction technique is well accepted and has been successfully implemented in many countries including Japan, Sweden and America. However, prefabricated housing still remains in its infancy in China.

In order to advance with this new technology, the Chinese government is currently sparing no effort to promote it nationwide. This effort on the part of the government has resulted in a radically changing policy environment for the prefabrication sector. Given that prefabricated housing requires much more cooperation among its major players [7] and that it often draws new entrants into the industry, the structure in which the industry functions is also set to transform. In such circumstances, dominant companies may lose their leadership whereas previously marginal ones may gain market advantage [8]. To remain competitive in this dynamic environment, developing effective strategies will be vital to the companies' survival and growth. Moreover, companies may need to have a clear knowledge of their own strategic positioning, while they will also need to identify other firms with similar strategic positions in order to develop and implement their strategies [9-10]. Mapping the prefabricated housing ecosystem through a graph is one of the effective means that allow companies to gain knowledge regarding their position and the position of other firms as well as the relationships that exist between them.

Previous researches have examined several aspects of prefabrication in the housing sector, such as the constraints or the challenges it faces [5, 11], its decision making strategies [4] and policymaking [1]. However, there are only a limited number of studies that have investigated the subject area by viewing it as a reticular system or have examined the positioning of companies in the business ecosystem. Thus, the objectives of this paper were to establish the prefabricated housing ecosystem in China based on the theory of business ecosystem (BE) and to determine the positioning of major participants. Furthermore this paper also analyzed the interrelationships between the participants, particularly, between the contractors, property developers and customers.

This paper is presented in 7 sections. The next section, section 2, presents a review of previous research on prefabricated housing and business ecosystem. Section 3 of this paper describes the research methods employed in this research. Section 4 identifies the major participants and establishes the prefabricated housing ecosystem in China. Section 5 describes the data collection and analysis methods. Section 6 discusses the findings from the analysis and finally, section 7 draws the conclusions for this study.

2. Literature Review

2.1. Prefabrication

Prefabrication, also referred to as offsite construction or modular construction, is a construction process where building components are manufactured and assembled in a factory instead of the construction site before the final erection [12-14]. This modern method of construction has been well documented and is widely recognized to provide several benefits. The main reported benefits include its facilitation towards achieving high quality construction, reducing health and safety risks, improving in the planning, control and