

A Comparative Analysis of Construction Industry International Performance between China and United States Using the International Advanced Index

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Abstract

The double-dip recession in the United States and the debt crisis in Europe have provided opportunities for international contractors in developing countries. The rise in construction activity in developing countries has caused an increase in competition in the global market. The Chinese construction industry has undergone a dramatic change caused by their internationalization strategy in recent years. Significant achievements have been made by the Chinese construction industry. This paper compares the Chinese and United States' construction industries based on the International Advanced Index which was a new measure generated to address problems identified with current measures in the literature. IAI measures the international performance of a country's construction industry by adopting the Depth Index (revenue composition), Height Index (top enterprises) and Width Index (fields involved). The key finding is although achievements have been gained by the Chinese construction industry in recent years, the gap in performance in comparison with the United States' construction industry is increasing. The implication of this result is that the current development strategy of the Chinese construction industry in the international market is problematic.

Keywords: International Advanced Index, Comparative Research, Chinese Construction Industry, U.S. Construction Industry

1. Introduction

The global construction market has been enduring difficult economic problems during the past four years. However, even as the United States continues to stave off the prospect of a double-dip recession and European nations are suffering the debt crisis, opportunities are emerging for international contractors in developing countries, particularly those rich in resources. At the same time, the rise of construction activity in developing countries has caused an increase in competition in global market.

The Chinese construction industry has undergone a dramatic change caused by internationalisation in recent years. In the last 10 years, the Chinese construction industry has made remarkable achievements, through gradually opening up and becoming integrated into the international construction market.

Although the Chinese construction industry has exhibited significant activity in the international market in the last decade following the entry into the World Trade Organization (WTO), in comparison with developed countries there are also some serious problems. There is much rhetoric on achievements, however there has been little research that makes comparisons between various countries.

This paper will firstly discuss the trend of the international construction market and the new features of the Chinese construction industry. A literature review on performance measures has been comprehensively conducted and reported in previous papers (Loncan & Nique, 2010, etc.), however, a brief summary of the key issues is provided in this paper. Because of the problems of measurements which have been highlighted in previous research, the International Advanced Index was introduced to measure the international performance of the United States and Chinese construction industry. The International Advanced Index generated by Zhang and London (2010) is used for measuring the international performance of a country's construction industry by adopting the Depth Index (revenue composition), Height Index (top enterprises) and Width Index (fields involved). Comparative research methodology is adopted to study the differences between the US and Chinese construction industry's international performance. The results of the comparisons between the two countries will then be discussed and implications of the findings are considered for policy makers and construction organisation senior executives.

2. International construction market and Chinese construction industry

Due to the instability of the global economy, the international construction market has been continuously marginally shrinking in recent years. The global shift in the international construction market can be seen in the results of Engineering News Report (ENR)'s Top 225 International Contractors list. The Top 225 as a group generated \$383.66 billion in 2010 contracting revenue from projects outside their home countries, which is slightly lower than 2008's figure of \$390 billion (Reina & Tulacz, 2011).

Contractors are shifting their focus to new and emerging markets, which can be seen in the Top 225's regional revenue breakdowns. International revenue fell 6.6% to \$94.18 billion in Europe. It also fell 6.6% in the Middle East to \$72.43 billion and 6.5% to \$32.61 billion in the U.S. By contrast, international contracting revenue rose 25.6% to \$34.05 billion in Latin America and in the Caribbean, 6.7% to \$60.59 billion in Africa and 4.7% to \$76.64 billion in Asia and Australia. This shift in focus is leading to upheaval for major international contractors (Reina & Tulacz, 2011). The shift could be caused by the mining sectors in these countries and the associated infrastructure required.

Chinese contractors "are becoming bigger competitors," according to Yves Gabriel, CEO of Bouygues Construction, "We are mainly competing [with Chinese contractors] in Africa for the moment, but these companies might probably come in Europe in the future". Chinese construction enterprises have accounted for 51 among the world's top 225 international constructors. The total international revenue of these 51 Chinese construction enterprises is more than \$57 billion, which is 14.9% of the total international revenue of the Top 225 (Reina & Tulacz, 2011). The Chinese construction industry's achievements need to be considered in terms of its internationalisation strategy.

Historically, prior to 1979 the internationalisation of Chinese construction enterprises originated from the Chinese Government's Economic and Technical Aid programs. These activities always provided financial donations to other developing countries and this was mainly for political purposes. During this period, Chinese construction enterprises were typically involved in financial aid projects in some developing countries with funds provided by China. However, project funding originated from the Chinese government during this period and therefore Chinese construction enterprises did not participate in any decision-making activities. As a result of the government leadership approach in decision-making the internationalisation of these enterprises can be considered to be passive (Low and Jiang, 2003). However, the Chinese construction industry still accumulated some experience and a pool of talent was trained for the future internationalisation of Chinese construction enterprises. The real internationalisation of enterprises started when the implementation of China's reform and opening-up policy began in the 1980's. Since their entry into the World Trade Organization (WTO), the internationalisation of the Chinese construction industry has moved into a new era. Along with the Chinese construction enterprises' emergence into the international market changes have occurred in relation to their size, financial advantages and the Government's support. In the last 10 years, after entry into the WTO, the Chinese construction industry has made achievements in economic growth, employment and technological advancements and these are now considered.

Firstly, the Chinese construction market is extremely large and growth has been rapid. By 2007, the Gross Output Value (GOV) of the Chinese construction industry has been over \$806 billion (NBSC, 2008). After the accession to WTO in 2001, the annual growth rate of the GOV increased significantly, from 10% to more than 20% (Zhang & London, 2010).

Next, the Chinese construction industry provides a diverse range of jobs and offers many new opportunities. By the end of 2007, there were more than 33 million people working in the Chinese construction industry (NBSC, 2008). Prior to joining the WTO employment rates in the Chinese

construction industry was in a decline. Specifically, after joining the WTO the employment numbers in the Chinese construction industry increased by 6% every year, except in 2004 (Zhang & London, 2010). The growth could be caused by the “going out” (internationalisation) support strategy whereby the Chinese government provides some tax and financial support to the enterprises involved in the international market.

In addition, the level of technology has continuously improved. The level of technology is mainly reflected in the Value of Machines per Laborer (VML) measure. The VML has increased from \$747/Person in 1997 to \$1455/Person in 2007 (Zhang & London, 2010).

There are macroeconomic indicators which provide insights on the impact of joining the WTO, and there are also indicators and trends in relation to industry organization economics. The classification of firms in the Chinese construction industry has changed from three categories (State Owned Enterprises, Urban and Rural Collectives and Rural Construction Teams) to five categories: State Owned Enterprises, Collective Owned Enterprises, Private Owned Enterprises, Enterprises Funded by Hong Kong, Macao and Taiwan, and Foreign Founded Enterprises. The trends are:

- State Owned Enterprises and Collective Owned Enterprises show a clear trend of contraction, and their dominance declines correspondingly as expected. The number of firms has been reduced from more than 9600 to 5300 and the proportion of the total number of Construction Enterprises has been reduced from 22% to 10% (Zhang & London, 2010).
- Private Owned Enterprises are growing rapidly and becoming the main force in the industry. The number of firms increased from 3500 in 1997 to nearly 50000 in 2007 and GOV increased from \$8.5 billion to \$585 billion (Zhang & London, 2010). This increase is mainly benefited from the development of private economy.
- Enterprises Funded by Hong Kong, Macao and Taiwan and Foreign Founded Enterprises did not increase rapidly in the beginning after China joined the WTO. An explanation for this could be that the first five years after entering WTO, there was a protection stage for the Chinese construction industry. After this stage ended in 2006, there still was no significant change. It is difficult to speculate on the reason for this lack of change in this category and would require further research.

Finally, the organisational structure of the Chinese construction industry has changed after joining the WTO. In order to adapt to the new international environment and industry competitiveness, the Chinese government in 2001 introduced the "construction enterprise qualification grades standards". After its implementation in 2002, the Chinese construction industry initially formed a structured system, which composed of the general contractors, professional contractors and labour subcontractors. General contractors dominate the market. However, both the number of firms and the Gross Output Value of professional contractors and labour subcontractors are increased gradually.

The Chinese construction industry has changed dramatically in the last decade in terms of classification of firms and organisational structure. The market volume, employment and level of

technology have also changed in the last decade. The Chinese construction industry has also improved dramatically in relation to international performance. This raises another question regarding international performance: How does the performance of the China construction sector as a developing country compare with that of the US a developed country?

3. International Advanced Index

Two types of measurements are commonly used in the discussion concerning performance, development level or position in the world. The first type is called the one-dimensional financial measurement. For example, GDP and GNP are typically used to measure a country's development level, performance and position in the world. At the industry or firm level, the measurement is related to financial issues, such as total revenue, international revenue, Return on Assets and Return on Sale (Loncan & Nique, 2010). It has been highlighted that this type of one-dimensional measurement doesn't reflect all facets of performance and could lead to misunderstandings (Sullivan, 1996).

The other measurement we propose is called a complex multi-dimensional measurement method. This method is used for comparison between countries by various researchers whereby all the aspects separately. It is a good comparison strategy to find the gap and difference in each element, and hence to generate an appropriate refined development strategy that targets the particular weakness in the current strategy (Wei & Han, 2002). However, this complex comparison doesn't currently quantitatively measure all the elements and indicators that are discussed in the literature (Wei & Han, 2002). In addition, this kind of measurement is commonly generated based on one or two countries' situation and data availability. Therefore it is difficult to be used internationally (Wei & Han, 2002). Consequently an alternative measurement method for a certain country's construction industry's performance and position in the international market has been proposed (Zhang and London, 2010). This method of measurement is based on a quantitative approach and can be used internationally.

Zhang and London (2010) generated a multidimensional quantitative measurement model called the International Advanced Index, according to the characteristics of the construction industry. The International Advanced Index (IAI) is a quantitative measure and index system which intuitively reflects the performance and position of certain country's construction industry in the international market. The International Advanced Index for construction industry is proposed through the following index:

- Depth Index (DI): is defined as the ratio of overall international revenue of all companies of the country to total international revenue of all the companies of all the countries.
- Height Index (HI): is defined as the quantity and quality of a certain country's top enterprises. It is measured in the ratio of the number of a certain country's enterprises in the top international constructors list, which is only the quantity issue. In order to consider the quality issue, a "weight" index is considered, which also reflects the distinction between the different rankings in the top list.

- Width Index (WI): is defined as a certain country's enterprises' market involvement in different specialized fields of the construction industry. It is measured in terms of the average of the ratio of the number of specialized fields that a certain country's each construction firm is involved with to the total number of specialized fields within the construction industry. However, specialization and diversification are two different development strategies. Firms can be successful in either way. In order to reflect this issue, in this paper, the influence in international market of a company listed in the top 10 of any specialized fields is considered as the same with a company involved in all the fields of construction industry. This means that if there are nine fields in the construction industry and a company is only involved in one field, it is listed in the top ten of this field. The number of its involved fields will be counted as 9 and not 1.

In summary, the International Advanced Index of a certain country's international construction industry is the sum of DI, HI and WI, because the "advance" of a certain country's construction industry could be reflected from these three aspects. This research will calculate the International Advanced Index of Chinese and US construction industry between 2000 and 2009, and hence be used to explore and compare the trends of the Chinese and US construction industry's international performance.

4. Comparative research

Comparative research is the methodology that was used for the research reported in this paper. Comparative research is the act of comparing two or more things with a view to discovering something about one or all of the things being compared (Heidenheimer *et al.*, 1983). Comparative research is a research methodology in the social sciences that aims to make comparisons across different sectors. A major problem in comparative research is that the data sets in different groups may not use the same categories, or define categories differently (for example by using different definitions of poverty).

There is not an agreed opinion on when the practice of comparative research began. Comparing things could be considered to be the essential to basic scientific and philosophic inquiry (Deutsch, 1987). Textbooks on this form of study were beginning to appear by the 1880s, but its rise to extreme popularity began after World War II (Clasen, 2004). This technique often utilizes multiple disciplines in one study. The multidisciplinary approach is good for the flexibility it offers (Jones, 1985). Quantitative analysis is much more frequently pursued than qualitative, and this is seen in the majority of comparative studies (Deacon, 1983 and Esping-Anderson, 1990).

Comparative research can take many forms. Two key factors are space and time. For the space perspective, cross-national comparisons are very common. There are numerous reasons that cross-national comparative research has become an important methodology for the social scientist. Globalization has been a major factor by increasing the desire and possibility for intellectual curiosity about other countries and cultures, and providing the background and environment. Information technology has enabled greater production of qualitative and quantitative data for comparison, and international communications technology has facilitated this information to be easily spread (Clasen, 2004). Recurrent interregional studies include comparing similar or different countries or sets of

countries, comparing one's own country to others or to the whole world (Heidenheimer *et al.*, 1983). For the time perspective, the historical comparative research approach involves comparing different time-frames. The two main choices within this model are comparing two stages in time (either snapshots or time-series), or comparing the same thing over time (Deacon, 1983).

For this paper, because the Chinese and U.S. construction industries will be analyzed, there is place difference. In addition, this paper will also compare the performance and position of the Chinese/US construction industry between the different time (2000 and 2009) in order to find the development of the Chinese/US construction industry. Therefore, this paper will adopt both cross-national and historical comparisons. The international performance of the Chinese and US construction industries between 2000 and 2009 based upon the International Advanced Index will be compared to identify the changes in both countries' construction industry and differences between countries.

5. Data collection

In this paper, the analysis is limited to the Chinese and United States multinational construction enterprises. The importance of multinational enterprises in leading and shaping the performance of the industry is paramount and it has been acknowledged by various researchers and social institutions in the world (United Nations, International Monetary Fund, etc.) because of their massive financial, technological, human, intellectual, and organizational resources (Kanter, 1995 and Korten, 1999). In the international construction sector, most of the direct participants are multinational enterprises. In this sense, the level of multinational enterprises' development could be considered as the indicator of the country's level of development. Therefore, in this paper, the multinational enterprises will be studied as cases.

The annual report on the top 225 international contractors provided by Engineering News-Record (ENR) will be adopted; however, some limitations should be discussed. Firstly, the quality of the data depends on the willingness of firms who wish to participate in the ENR's survey. Firm's level of participation can influence the data and ranking. For example, the lack of participation by British contractors-Trafalgar House PLG in 1996 and Kvaener Group and Bovis Construction Ltd in the ENR survey in 1999 resulted in a dramatic change in the data and ultimate rankings. In addition, the authenticity of data depends on the firms' honesty. Despite these limitations the data provided by the ENR is also the most comprehensive data set currently available.

For the International Advanced Index of the Chinese and United States construction industry in the international market, it is difficult to gather data for the Depth Index. Therefore, adopting the ENR's statistics, Depth Index is generated as the ratio of overall international revenue of all Chinese or US companies to total international revenue of all companies in the list. In addition, Height Index is measured as the number of a country's construction enterprises in the top 225 international constructors list and the "weight", which is the value of the average international revenue in the top 100 international constructors to the average international revenue in the rest 125 (Zhang & London, 2010). The "weight" is called Gap index (GI) which is the indicator of the gap between the top international constructors. The smaller value indicates the smaller gap between these top companies, and vice versa. The formula of HI is as follows:

$$HI = \frac{\text{No. of CCCEs in top the 100 ICs list} \times GI + \text{No. of CCCEs in the rest 125}}{225} \quad (1)$$

$$GI = \frac{\sum_{i=1}^{100} f(T_i)}{\sum_{i=101}^{225} f(T_i)} \times \frac{125}{100} \quad (2)$$

Though the previous International Advanced Index considers the differences between the top 100 and the rest of the 125 construction companies by using the Gap Index, the difference between each company should also be measured, not only in groups. Therefore Zhang and London (2011) developed a rank score to reflect this issue. According to the rank of these companies listed in the top 225 international constructors, the top company is given a score of 225; the second is 224 scores, and so on. The High Index of a certain country's construction industry is the average rank score to the total number of companies in the list, 225. The higher value of High Index shows the better performance of the country's construction industry in the global market. The High Index is calculated by the following formula:

$$HI = \frac{\text{Average Score of CCCEs in the top 225 ICs list}}{225} \quad (3)$$

Furthermore, according to the classification of ENR, there are 10 specializations in the construction industry. However, the data of Industrial sector and Petroleum sector are categorised in the same group by ENR. Therefore, in this research, these two sectors are considered as one field in construction industry. In this sense, there are nine fields in total in the construction industry. ENR also provides the number of Chinese and United States construction enterprises listed in the top 10 of each specialized fields. The formula for generating WI is:

$$WI = \frac{\sum_{i=1}^N f(W'_i)}{N} \quad (4)$$

$$N = \text{No. of CCCEs in top 225 IC list} \quad (5)$$

$$f(W'_i) = \frac{W'_i - M + 9M}{9} = \frac{W'_i + 8M}{9} \quad (6)$$

$$W'_i = \text{No. of fields each CCCE involved} \quad (7)$$

$$M = \sum \text{NO. of CCCEs listed in top 10 of each field} \quad (8)$$

6. Results and discussion

Although China is one of the most ancient civilizations in human history, it has recently in the last decade made dramatic moves towards modernization and marketisation. After the implementation of the "reform and opening-up policy" in the 1980's, China embarked on a road of revival. In 2007,

Foreign Direct Investment (FDI) in China reached 83.52 billion U.S. dollars, ranking No. 6 in the world, accounting for 16.7% of the total of developing countries. China's level of FDI ranks first among developing countries for the last 17 years consecutively (National Bureau of Statistic of China, 2008). It has often been claimed by both the popular business media and academic experts alike that the 21st century will be the Chinese century (Dyer, 2009; Thayer, 2009; Chan, 2008; Smith, 2006 and Hines, 1997).

Regardless of the rhetoric it is important for us to understand these most recent changes on construction industry performance. The Chinese construction industry has undergone a dramatic change caused by internationalization in recent years, and as a result became integrated into the world economy to a greater extent. Chinese construction enterprises have accounted for 54 among the world's top225 international constructors in 2009 (Reina & Tulacz, 2010). The total international revenue has change from \$5.4 billion in 2000 to \$50.6 billion in 2009 (Reina & Tulacz, 2001 and 2010).

The International Advanced Index has risen from 0.939 to 1.0329(Table 1). The Depth Index has increased from 0.046 to 0.132, which means the Chinese construction companies have received a greater share in the international market, and the Width Index has also increased from 0.4412 to 0.467, indicating that Chinese construction companies have been involved in an increasing number of fields in the international construction market. The Height Index declined from 0.4518 to 0.4339, which means Chinese construction companies' ranks are very low, even though the number of Chinese construction companies listed in the top 225 is increasing.

In contrast, as a traditional developed country, United States plays an important role in the world. Many sectors of the United States lead the world economy. The total revenue from the international market of US construction companies has increased from \$25 billion to \$49.76 billion. Though there are only 20United States construction enterprises listed in the ERN top 225 international constructors in 2009, which declined from 73 in 2001, the International Advanced Index of US construction industry has dramatically increased from 1.0509 to 1.5221(Table 1). However, the Width Index has decreased from 0.215 to 0.135, which means the percentage of international revenue of US construction industry in the international market is reducing. This decline could be caused by the improvement and growth of developing countries' construction industry and their activities in the international market. The Width Index and Height Index were more than 50% growth from 2000 to 2009, which indicates that the US construction companies have involved and affected more fields of international construction market, and the top construction companies' 'quality' is increasing.

From Table 1, the International Advanced Index of both the Chinese and US construction industries have increased from 2000 to 2009. However, the growth rate of the Chinese construction industry is only about 10%. In contrast, the US construction industry has achieved 50% growth in 2009, compared with 2000, based on the International Advanced Index. The gap between the Chinese and US construction industries has increased, from 0.1119 in 2000 to 0.4892 in 2009. In addition, the quality of Chinese construction companies is decreasing. Also, the fields which Chinese construction industry companies are involved in are not significantly increasing. However, the US construction companies enter into more fields, and actually nearly all the fields. Therefore, it could be claimed that,

China's construction industry has made some achievements from internationalization. However, compared with developed countries, the benefits derived from internationalization by the Chinese construction industry are much less. There appears to be a trend of a widening gap between developing and developed countries within the context of internationalization. This result is somewhat perplexing as one assumes that internationalisation provides benefits. It could not be simply said that internationalization is not advantageous for the Chinese construction industry. We can only speculate that perhaps the incorrect process of internationalization has been adopted by the Chinese construction industry. The internationalization strategy undertaken by this developing country requires modification or fine-tuning in order to narrow the gap of growth rate with developed countries.

Table 1: Comparison of Chinese and US construction industry

<i>Index</i>	<i>Chinese construction industry</i>		<i>US construction industry</i>	
	<i>2000</i>	<i>2009</i>	<i>2000</i>	<i>2009</i>
<i>DI</i>	<i>0.046</i>	<i>0.132</i>	<i>0.215</i>	<i>0.135</i>
<i>HI</i>	<i>0.4518</i>	<i>0.4339</i>	<i>0.3671</i>	<i>0.5093</i>
<i>WI</i>	<i>0.4412</i>	<i>0.467</i>	<i>0.4688</i>	<i>0.8778</i>
<i>IAI</i>	<i>0.939</i>	<i>1.0329</i>	<i>1.0509</i>	<i>1.5221</i>

7. Conclusion

With the development of internationalization and globalization, the Chinese construction industry has become involved in the international market more and more deeply. Some changes and developments have occurred in the Chinese construction industry, including 1) the Chinese construction market is extremely large and growth has been rapid; 2) the Chinese construction industry now provides a diverse range of jobs and offers many new opportunities; 3) the level of technology has continuously improved; 4) the classification of firms in the Chinese construction industry has changed from three categories (State Owned Enterprises, Urban and Rural Collectives and Rural Construction Teams) into five categories: State Owned Enterprises, Collective Owned Enterprises, Private Owned Enterprises, Enterprises Founded by Hong Kong, Macao and Taiwan, and Foreign Founded Enterprises; and 5) the organizational structure of the Chinese construction industry has changed after joining the WTO.

By conducting the comparative analysis between the Chinese construction industry and the US construction industry in 2000 and 2009 based on the International Advanced Index, we have found that both Chinese and US construction industries have made some improvements. However, the gap between the construction industry performance of these two countries is becoming larger, especially in the number of fields they are involved in and the ranking of the top companies. This situation should be of interest to policy makers as they seek to generate appropriate strategies for the Chinese construction industry's further development. It is speculated that the current development strategy

could be reconsidered. In particular the process of internationalization could be more carefully reviewed to search for ways to narrow the gap with developed countries, for example, by involving more construction fields and improving the position of the Chinese construction companies in international competition. Internationalization is a popular strategy, however, based upon the findings of our research; it is argued that internationalization may not necessarily change the position of Chinese construction companies in the international market. It appears that Chinese construction companies may still be at a disadvantage when they compete with companies from developing countries. Therefore, specific ways on how to improve the competitiveness of Chinese construction industry is an area worthy of further research.

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