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Agglomeration and Competitive Position of Contractors in the International Construction Sector

Zhen Yu Zhao¹; Chao Tang²; Xiaoling Zhang³; and Martin Skitmore⁴

Abstract: The international construction sector is an important contributor to international economic cooperation, and recent decades have witnessed the dramatic development of the Engineering News Record (ENR)'s top 250 or 225 international contractors (TICS250) in the global market. World agglomeration and competitive positioning has a significant influence on engineering companies' selection and development of their international markets. Based on the location quotient index and the Boston Portfolio Matrix, an agglomeration level and competitive positioning model is presented for international engineering contractors. Assessment methods are introduced to quantitatively analyze the competitive statements of international contractors collected from the ENR, the main focus being on the difference in agglomeration levels between 13 contractors from 2009-2013. The competitive positions and diversified changes of contractor clusters in 9 different industries from 13 countries are also analyzed to highlight the differences in their agglomeration levels and competitive position. The study establishes referential methods for contractors to understand their development patterns and competitive statements in the global market and is of a significant importance for developing relevant strategies.

CE Database subject headings: International construction sector; contractors; agglomeration; competitive position; international comparison.

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Introduction

The globalization of the world economy, especially the process of economic modernization in developing countries, has helped maintain the sound development momentum of the international construction sector. According to statistics published by the *Engineering News-Record (ENR)* (2014), the international revenue of *ENR*'s top 250 or 225 international contractors (TICS250) from projects outside their home countries reached USD 543.97 billion in 2013, an increase of 6.44% on 2012. The emergence of relatively new industries, such as telecommunications, water/sewer waste and hazardous waste disposal has helped transform construction into an industry with complete facilities and advanced technology from civil engineering based projects. For international contractors, the global market is developing into a flourishing but competitive international place. All international contractors are keen to devise development strategies by taking this into account in their market selection and risk management (Jiang et al. 2014). It is therefore important to understand the business diversification and competitive situation of leading international contractors. To do this, the performance of contractors from different countries needs to be examined to inform on the characteristics of the contractors involved.

ENR is the most influential magazine in engineering construction worldwide. It compiles and publishes the rankings of the top 225 international contractors annually, including the total, international and submarket revenues of each firm, and comments on regions and markets, as well as providing industry views and predictions. Since 2013, the number of companies in the rankings list has increased to 250. The rankings list is well recognized by industry players and

renowned as a distilled barometer of the annual global construction and engineering market. *ENR* also provides a comprehensive and historical database of international construction activities and the major actors (Drewer 2001), including its *International Market Analysis, Past Decade's International Contracting Revenue, Top 250/225 International Contractors List* and *Top 250/225 Global Contractors List*.

Following on from the theory of industrial agglomeration, this paper explores the agglomeration level of typical international construction contractors from 13 countries around the world. Based on the model of competitive positioning, a 5-year period of time (2009-2013) is analyzed, focusing on the changing competitive position of contractors in 9 different sectors. It is anticipated that the results will help adjust construction firms' strategic approaches to gain competitive advantage and sustain positional advantage in international markets.

Literature Review

An extensive review of the related literature indicates that existing research mainly focuses on internationalization theories, agglomeration performance and competition positioning as detailed in the following subsections.

Internationalization theories and the construction industry

International construction occurs where a company resident in one country performs work in another country (Ngowi et al. 2005). The topic has attracted many studies, including:

(1) Studies on the relationships between construction activities, marketing and economic

development. The role of construction, for example, is known to change with economic development (e.g., Low 1994), while it has long been considered that the share of construction spending in GDP first grows during less developed country (LDC) status, peaks during newly industrializing country (NIC) status and then declines as countries move from NIC to advanced industrialized country (AIC) status (e.g., Crosthwaite 2000).

(2) Niche theories, as well as theories of resource partitioning and the internationalization of firms, have been applied to construction practices. Zhao and Yao (2014), for example, treats the international construction project contracting market as an ecosystem and establishes an ecosystem model to examine balance in system; ‘niche width’ is been introduced as an indicator to reflect the resource utilization of international construction companies (Yang et al. 2013); and Korkmaz and Messner (2014) explore the concept of competitive position and continuity in the context of the mode and scope of competition of United States and Turkish construction firms in the international market.

(3) In addition, the key competitiveness indicators for assessing contractor competitiveness in the Chinese construction market have been identified (Tan et al. 2007; Zhao and Shen 2008), while the strengths, weaknesses, opportunities and threats (SWOT) approach has been used to analyze Chinese contractors in international construction markets (Zhao et al. 2009). Through the analysis of 94 market entry cases, Chen and Messner (2009) identify and define a taxonomy of 10 basic entry modes for international construction markets, comprising strategic alliances, build-operate-transfer equity projects, etc.

Agglomeration performance and competition positioning

Porter's (1990) "industry cluster" is a current concept in economic development. Doeringer and Terkla (1995), for example, examine the literature regarding industry clusters and identify "geographical concentrations of industries that gain performance advantages through co-location". "Agglomeration performance" is the key to defining the basic but distinctive characteristics of an industry cluster and Driffield and Munday (2000) demonstrate that the spatial agglomeration of an industry is a significant determinant of its comparative advantage, thus providing evidence of agglomeration benefits to both domestic and foreign firms. The different approaches to help examine the agglomeration performance of firms include the Concentration Ratio (CRn), Herfindahl-Hirschman Index (HHI) (Aiginger and Pfaffermayr 2004) and Location Quotient (LQ), with high LQs being interpreted as an indicator of a cluster (Miller et al. 2001; Carroll et al. 2008).

"Competitive position" defines a firm's relative posture in a competitive space (Yang et al. 2013). A company has a competitive advantage whenever it has an edge over its rivals in attracting customers and defending against competitive forces (Korkmaz and Messner 2014). International contractors perform quite differently in uncertain environments where competition position is critical for survival. International revenue can reflect a contractor's success in developing overseas markets and is one of the most important indices for gauging its global competitiveness (Daniels and Bracker 1989).

Research methodology

Construction activity data are usually poor and erratic in both domestic and international contexts (Ruddock 2002; Ye et al. 2009). *ENR*, however, offers a relatively objective and comprehensive historical database for studies of international construction activity. The empirical setting for the study is the 250/225 TICS from 2008 to 2013. This involves a sample of international contractors from 13 countries comprising the United States, Canada, Britain, Germany, France, Italy, Netherlands, Spain, Australia, Japan, China, Korea and Turkey. The values of their gross domestic products (GDP) are obtained from the World Bank national accounts data (2009-2013) (World Bank 2015).

Location quotient

Construction is a major industry throughout the world, accounting for a sizeable proportion of most countries' GDP (Crosthwaite 2000). LQs have been adopted by economists for a number of years to measure a region's industry specialization (Chung and Kalnins 2001). The LQ essentially compares an area's competitive position with a larger geographic area, such as a state or nation. International industry LQs can be calculated by comparing an industry's share of national gross output value with its share of global total output as

$$LQ = \frac{e_i / \sum_{i=1}^n e_i}{E_i / \sum_{i=1}^n E_i} \quad (1)$$

where e_i denotes the turnover of contractor group i in a given industry, including general building, transportation, industrial process/petroleum, power, manufacturing, water/sewer waste, hazardous waste and telecommunication; E_i is the GDP in contractor i 's country; and n

is the number of countries that have entered that industry. By calculating the LQ of contractor groups, contractors can locate their position in the international construction sector. High LQ values indicate better agglomerations and the more advantage they have in the industry. Generally, contractors with $LQ > 1$ are considered to be specialized in that industry (Miller et al. 2001) as the agglomeration performance of contractor group i is higher than average, while $LQ > 1.5$ indicates that contractor group i has a decided advantage over its opponents. Contractors with $LQ < 1$, on the other hand, have an agglomeration performance below average and play a passive role in the international construction sector without any advantages of industry agglomeration.

Agglomeration growth rate

To further compare a contractors' competitive position in the international construction sector, the agglomeration *growth rate*, reflecting the contractors' concentration trend between two period, is calculated as

$$P = \frac{LQ_{it} - LQ_{io}}{LQ_{io}} \times 100\% \quad (2)$$

where LQ_{it} denotes the agglomeration performance of contractor group i at time t and LQ_{io} is the agglomeration performance of contractor group i at time o . The agglomeration performance in the sector is growing and cluster advantage is increasing if it is positive; the reverse if it is negative.

Competitive position matrix

Management consultants at the Boston Consulting Group (BCG) developed the Boston

Portfolio Matrix in the early 1970s to help managers in large corporations decide in which business units to invest. The location of a business unit on this matrix indicates its market growth rate (percentage annual growth rate of the market in which the business operates) and relative market share (Singh 2004). Here, we propose a modified model from the BCG Matrix to help contractors allocate resources to gain advantage in the future and in which agglomeration performance can be inferred. This classifies contractors into four groups based on their agglomeration level and growth rate as shown in Fig. 1 and summarized in Table 1. These comprise:

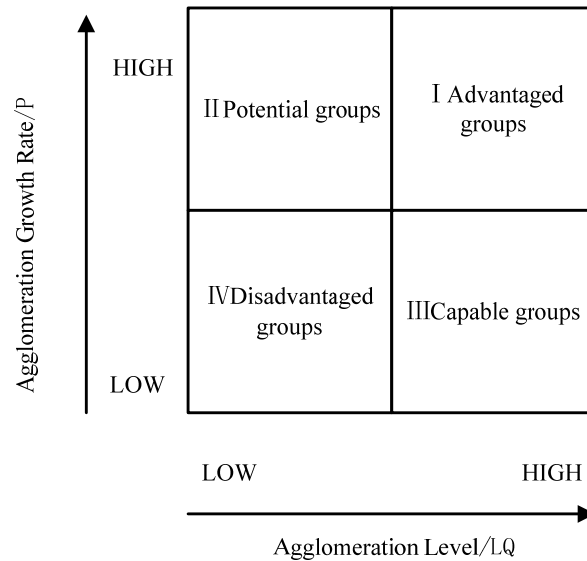


Fig. 1. Competitive position matrix of international contractors

Table 1. Contractor classification based on LQ and P

Quadrant	I	II	III	IV
Index value	$LQ > 1, P > 0$	$LQ < 1, P > 0$	$LQ > 1, P < 0$	$LQ < 1, P < 0$
Contractors Classification	Advantaged group	Potential group	Capable group	Disadvantaged group

I. **Advantaged group** (high agglomeration level/ high agglomeration growth).

Contractors in this group are well gathered and growth is high. The group is currently

enlarging and strengthening. Advantaged contractors are considered unbeatable in comparison with other contractors.

- II. **Potential group** (low agglomeration level/ high agglomeration growth). Potential contractors generate little revenue because they have a low agglomeration level, but they have high growth agglomeration so have the potential to perform well.

- III. **Capable group** (high agglomeration level/ low agglomeration growth). Contractors in this group are well clustered, so they have ability to gain attention and exploit new opportunities. With low agglomeration growth, Capable contractors still need to increase their degree of specialization.

- IV. **Disadvantaged group** (low agglomeration level/ low agglomeration growth). Disadvantaged contractors' agglomeration performance is weak, so more work is needed to become advanced and, as agglomeration growth is also low, work is also needed to improve the situation.

Agglomeration performance in the international construction sector

The 13 countries' whole construction industry LQ results from eqn (1) are shown in Table 2.

Table 2. Agglomeration level in the international construction sector

Country	Year					Average	Change characteristics	Growth rate /P
	2009	2010	2011	2012	2013			
America	6.920	5.271	5.161	5.178	4.856	5.477	decreasing	-29.83%

Canada	0.367	0.265	0.140	0.075	0.065	0.182	decreasing	-82.30%
Britain	0.334	0.261	0.215	0.164	0.069	0.209	decreasing	-79.36%
Germany	1.331	1.392	1.345	1.368	1.333	1.354	stable	0.11%
France	3.674	3.745	3.376	3.544	3.890	3.646	stable	5.89%
Italy	1.359	1.645	1.441	1.279	1.100	1.365	stable	-19.10%
Dutch	0.438	0.443	0.339	0.316	0.397	0.387	stable	-9.31%
Spain	1.673	2.246	3.266	3.871	3.967	3.005	increasing	137.10%
Australia	0.307	0.254	0.172	0.190	0.230	0.231	decreasing	-25.24%
Japan	2.511	1.906	1.936	1.910	1.821	2.017	decreasing	-27.50%
China	7.597	9.139	8.670	9.052	9.886	8.869	increasing	30.13%
Korea	3.428	3.355	4.110	5.829	5.510	4.446	increasing	60.73%
Turkey	0.126	0.131	0.127	0.116	0.130	0.126	stable	3.02%
<i>Average</i>	<i>2.313</i>	<i>2.312</i>	<i>2.331</i>	<i>2.530</i>	<i>2.558</i>	<i>2.409</i>	<i>stable</i>	<i>-2.74%</i>

According to Table 2, it is apparent from between 2009-2013, the average LQ of all contractors that, while significant differences exist between the 13 contractor groups, agglomeration performance in the international market is stable (but only 5 out of 13 are stable). With LQs>5, the Chinese and American contractor groups maintain a clear advantage by their superior agglomeration performance; the French, Spanish, Japanese and Korean contractor group also have a considerable advantage with LQ>1.5; the German and Italians appear well clustered with LQ>1; while, with an LQ<1, contractors from the Canada, Britain, Netherlands, Australia and Turkey are weak in agglomeration performance. To summarize, The United States and Asian contractors perform well in agglomeration, as do European contractors except the British and Dutch. The agglomeration levels of two groups, namely Australian and Canadian contractors, dropped by 25.24% and 82.30% respectively during the past 5 years.

Competitive positions in the international construction sector

The *ENR*'s top 250/225 list divides international construction resources into 9 sectors of general building, transportation, industrial process/petroleum, power, manufacturing, telecommunications, water supply, water/sewer waste and hazardous waste. In this section, the agglomeration levels from eqn (1) and growth rates from eqn (2) are used to illustrate the changes in typical contractor competitive positions in the 13 countries from 2009-2013 for the first 5 of these resource sectors.

Competitive position in general building

General building is one of the three traditional sectors, with an income of USD 116.7 billion accounting for 20.7% of the 2013 revenue share of the sample of contractors. As Fig. 2 shows, the contractor groups are unevenly distributed, indicating apparent differences. The Asian contractors, such as Chinese and Korean, although slightly down in 2010 and 2011, are growing overall and belong to the Advantaged group.

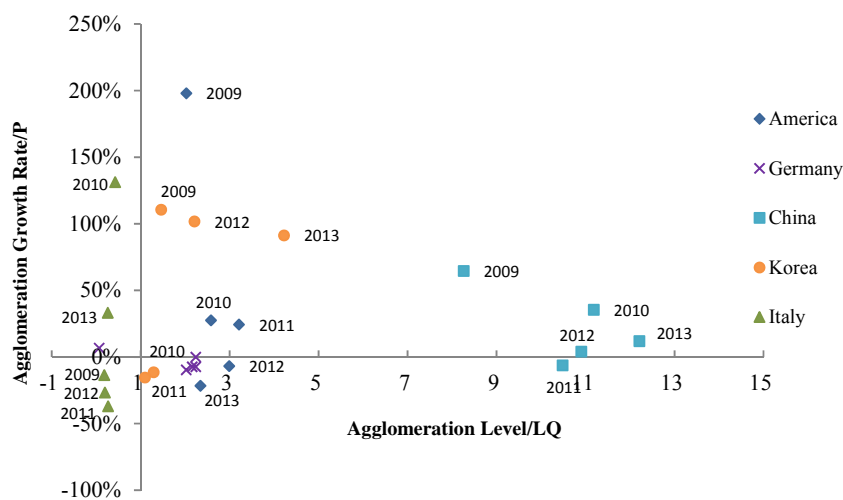


Fig. 2. Competitive position in general building

The Chinese international contractors engaged in this sector are represented by the China State Construction Engineering Corporation (CSCEC) and the China International Trust and Investment Corporation (CITIC). CSCEC has been ranked in the top 225 international and global contractors since 1984. Leaping to 20th in the international contractor list and number one in the global contractor list, CITIC was ranked 52nd of the world's top 500 enterprises in 2014. CITIC has been mainly involved in Engineer-Procure-Construct (EPC), Public Private Partnerships (PPP) and Build-Own-Transfer (BOT) projects, and has contracted for many large and extra large-scale infrastructure projects and well as some representative general building projects such as the Venezuela Tiuna Social, Venezuela Junin Industrial Park Project and DBR (Domaines Barons de Rothschild) -CITIC Chateau Project.

Since the 1980s, Italian, Japanese and British contractors have been attempting to win United States market share to increase their revenues. Fig. 2 also shows that the position of Italian contractors has strengthened in recent years, moving from the Disadvantaged to the Potential group, while the German contractors have stable strength in the sector compared to contractors from other countries. In the past five years, the U.S. contractor transfer from the Advantaged to Capable group has resulted from a large reduction in business scale.

Competitive position in transportation

With as much as 25.2% of business concentrated in this sector, transportation has always been the largest international contracting sector. After a small decline, transportation income

reached to USD 1367.0 billion in 2013. As Fig. 3 shows, most contractor groups have decreased by different degrees over the time.

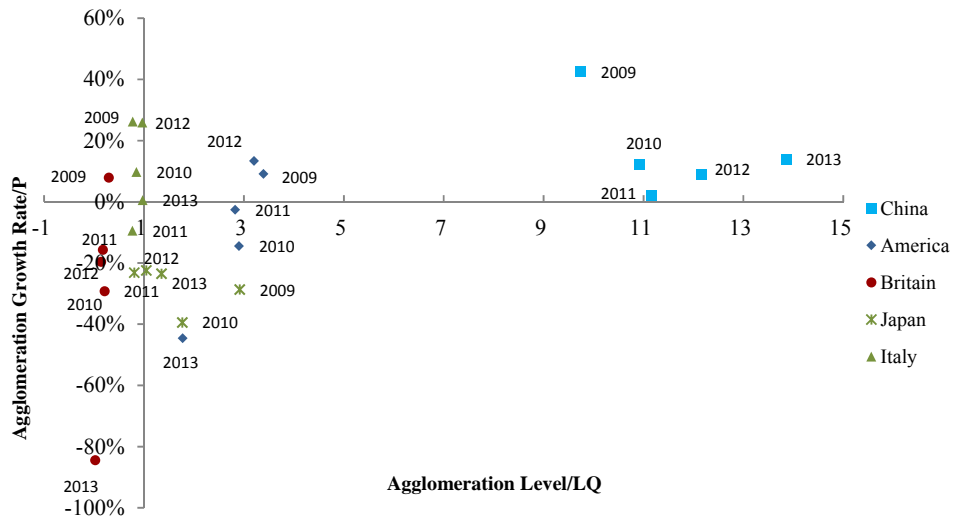


Fig. 3. Competitive position in transportation

From 2010, British contractors started to subside into the Disadvantaged group; United States contractors slipped back to the Capable group though their inability to increase agglomeration performance; while Japanese contractors have had slight fluctuations in competitive position with no strengthening. In contrast, the Chinese group has experienced the fastest growth, with the China Communications Construction Company Limited topping first place in the list of TOP10 transportation enterprises in 2014, an increase of one place from the previous year.

The development of Italian transportation contractors benefits from the South American market, one of the most important for Italian contractors. As a result, while the agglomeration performance of the Italian group has grown no greater, contractors from the Potential group grew into a Capable group over the 2009-2013 period. According to a survey of the Economic

and Commercial Counsellor's Office of the Embassy of the People's Republic of China in the Republic of Italy (ECCO 2010), infrastructure construction is their main form of international project contracting, with railway construction projects accounting for 24.7%, bridge construction 18.2% and subway projects 8.5% of the total. In the international market, toll expressway projects constitute 90% of all Italian projects.

According to Organization for Economic Cooperation and Development forecasts, the demand for airports, ports, railways, petrochemical and other industries worldwide will total USD 11 trillion by 2030 (OECD 2012). The urgent need for updates, maintenance and upgrades to existing infrastructure in developed countries and investment demand for industrialization and urbanization in developing countries are expected to jointly boost the development of the international construction sector. This being the case, the consequent opportunities for international engineering transportation will be significantly increased.

Competitive position in industrial processes/petroleum

Industrial processes and petroleum are classed together in the top 250/225 list of international contractors, with industrial processes declining since 2013 and the price of crude oil greatly decreasing — leaving contractors facing challenging times in the sector.

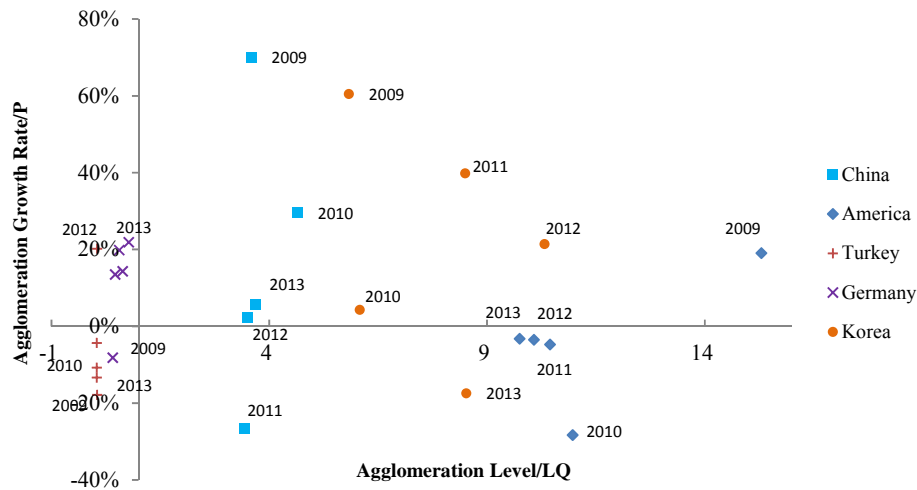


Fig. 4. Competitive position in industrial processes/petroleum

With the current disinvestment in global oil, American and Chinese contractors in the industrial process/petroleum sector are enduring varying degrees of diminishing agglomeration performance. According to a China University of Petroleum report issued in 2010 (Wang 2011), due to the international investment environment and internal management systems, about 2/3 of Chinese oil companies operated at a loss with poor performance in overseas projects. As can be seen from Figs 3 and 4, China's petrochemical contractor performance and agglomeration value greatly reduced in value in 2011. Since 2012, Chinese contractors' agglomeration level and growth rate have both increased to the point that they are now in the Advantaged group. 70% of the American International Contractors' activity, represented by Bechtel Corporation and Fluor Corporation, is concentrated in the petrochemical industry. The U.S. contractors have strong technical support in this sector and, with their advantages in several areas of expertise, many American contractors are leaders in their "niche markets", such as in the Middle East, Asia-Pacific and Africa. Although, as with Korean contractors, they have regressed to Capable

contractors, their agglomeration performance value is still high. Meanwhile, German contractors have developed from Disadvantaged to Advantaged during the five-year period while the proportion of industrial process/petroleum has also increased in terms of turnover. The competitive position for Turkish contractors on the other hand, despite volatility in agglomeration levels, remains unchanged in the Disadvantaged group.

Competitive position in electric power

Since 2006, the power industry has maintained steady growth in revenue. Its new contracts were close to that of the transportation industry in 2013, but the shaky state of the economic recovery is negatively affecting its development. As indicated in Fig. 5, Chinese power contractors have the highest agglomeration levels and as well as being competitive in the international market.

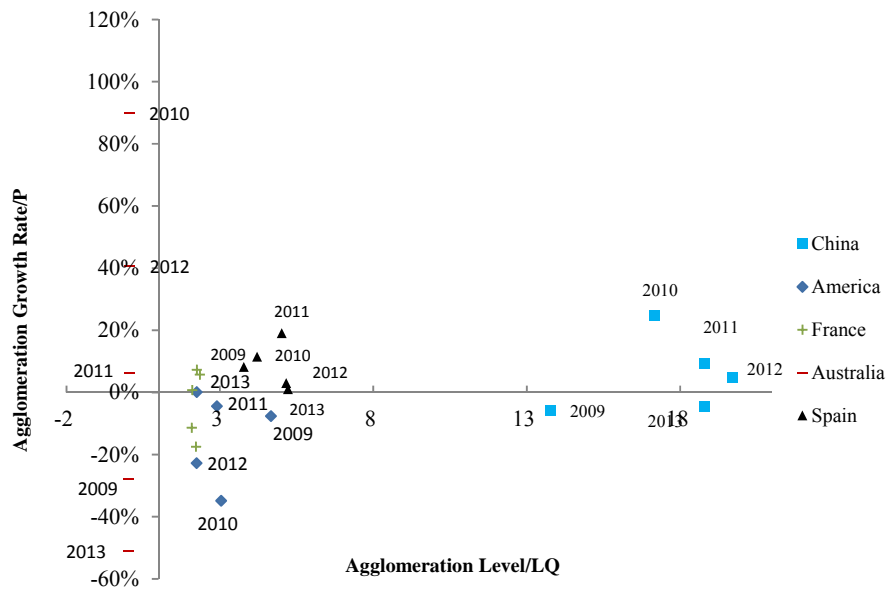


Fig. 5. Competitive position in electric power

According to the 2014 *ENR* list, the top 10 businesses in the power industry accounted for 49.7%, with 4 and 3 being Chinese and Spanish contractors respectively. Based on a report by the China International Contractors Association (CICA 2012), the newly signed contracts in electric power industry amounted to USD 31.07 billion in 2011, accounting for 21.8% of all new contracts. The power sector overtook the general building and transportation sectors for the first time in 2011, having been the first market that China's international contractors chose to enter. The development of American, French and Spanish contractors has progressed steadily in recent years, with Spain's largest electrical contractor, Aberinsa Company, for instance generating 80% to 90% of its revenue from overseas power projects. Australian contractors have also developed in recent years, but are still in a Disadvantaged position compared to other contractors.

Competitive position in telecommunications

Telecommunications is a newly developed sector, with many international contractors having little or no involvement. Here, most business is concentrated in a few contractors — the revenue share of the top 10 accounting for approximately 80% of the total over the 5 year *ENR* period. As shown in Fig. 6, the telecommunication contractors from all 5 countries have been in a shaky state.

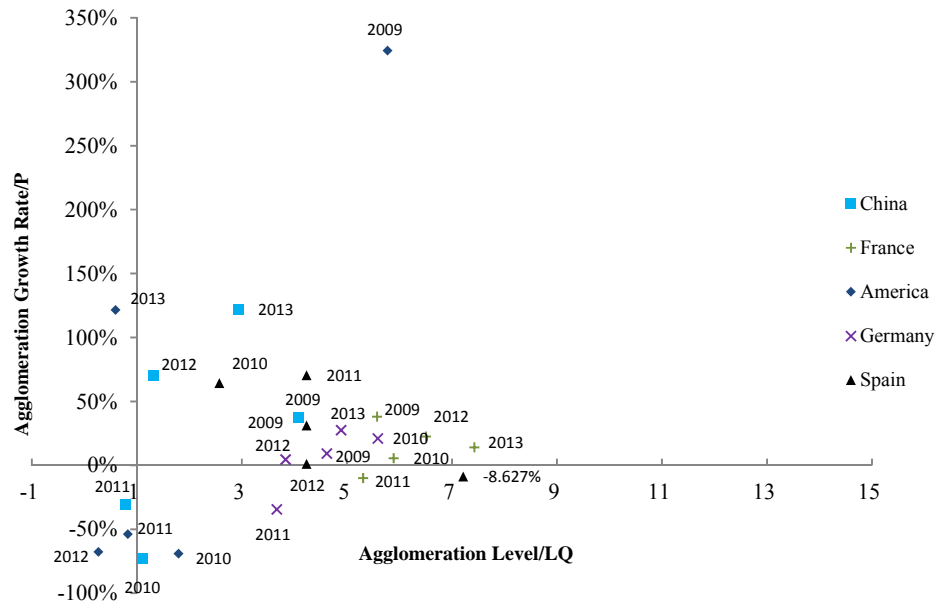


Fig. 6. Competitive position in telecommunications

Over the period in Fig. 6, Chinese contractors have slipped from Advantaged to Disadvantaged only to return to Advantaged again by 2012. The German contractors' position has grown even stronger since 2011, while French contractors have maintained their growth momentum in these years except a small decrease in 2011. French firms, represented by the ACS Company, are leading contractors in the energy and information technology markets, and telecommunication services (telecommunications infrastructure, telecommunications equipment, etc.) comprise a significant part of their energy business. Germany and Britain are their major markets for contractors operating out of France. The ACS company from Spain also stepped into the telecommunications sector in 1999 after doing well in general building. Currently, it is involved in extensive business activities in many areas such as communications and cell phones.

Recently, the China Telecom Company has been actively undertaking a national strategy of “*One Belt and One Road*” (refers to the “New Silk Road Economic Belt”, which will link China with Europe through Central and Western Asia, and the “21st Century Maritime Silk Road”, which will connect China with Southeast Asian countries, Africa and Europe.) (Xinhua Finance Agency 2015) to help make China into a regional center for information gathering and exchange through creating and updating business functions of international import and export, and thus further opening information channels with other nations. For example, the company has joint six global partners (the Chinese mainland, China Taiwan, Korea, Japan and the United States) involved in the new trans-Pacific undersea fiber optic cables project — New Cross Pacific (NCP).

Agglomeration changes during 2010-2013

Over the years, the international construction business has been involved in a variety of sectors, from general building and transportation to manufacturing, water/sewer and waste. Industry structure has simultaneously shifted to being technology-intensive and labor intensive. The market share of contractors in emerging fields has improved and also has its own characteristics. Table 3 shows the movements in the 2010-2013 LQ agglomeration indices of the 13 countries according to the ENR list of top 250/225 international contractors (TICS250) and which may also provide a reference for government policy and contractors interested in developing their international business.

Table 3. Agglomeration changes from 2010-2013

Country	General building	Transportation	Industrial process/petroleum	Power	Manufacturing	Water supply	Water/sewer waste	Hazardous waste	Telecommunication
America	↑	↓	↓	↓	↑	↓	↓	↓	↑
Canada	↓	↓	↓	→	↓	↓	↓	↓	→
Britain	↓	↓	↓	↓	→	↓	↓	→	↓
Germany	↓	↓	↑	↑	↑	↓	↑	→	↑
France	→	↑	↑	→	↓	↑	↑	↓	↑
Italy	↑	↑	↓	↓	→	↓	↓	→	→
Dutch	↓	→	↑	↓	→	→	→	→	→
Spain	↑	↑	↑	↑	↑	↑	↑	→	↑
Australia	↓	↑	↑	↑	→	↓	↑	→	↑
Japan	↑	↑	→	↓	↓	↓	↓	→	↑
China	↓	↓	↑	↑	↓	↑	↑	↓	↓
Korea	↑	→	↑	↑	↓	↑	↑	→	→
Turkey	↑	↑	↓	↑	↓	↓	↓	↓	↓
Sum	→	↑	↓	↑	↓	↑	↑	↓	↑

European contractors have generally been a leading force in the international construction sector, although from Table 3 the agglomeration level of American, Canadian, British and Italian contractors have slightly declined in 9 industries. Dutch contractors have remained stable in most sectors while, with their excellent performance in the world market, the agglomeration level of Spanish contractors has maintained an upward trend in 8 sectors. Contractors from Germany, France and Australia have degenerated in some industries although, taken altogether, they have been developing well.

The agglomeration level of Chinese contractors has declined in emerging industries while Japanese and Korean contractors have developed in the power, water supply and water/sewer and waste sectors. Except for the transportation, general building and power sectors, Turkish contractors have a downward trend. Contractors from America and China, the world's two largest economies and biggest trading nations, have an agglomeration performance that has

slightly declined in some sectors, although they still have significant influence and positions in the international market by virtue of their strength. There is little doubt that general building, industrial processes/petroleum and transportation are three most important sectors for international contractors to obtain revenues, while there is still much room for development in emerging, technology/capital-intensive industries, where contractors still need take actions to enhance their ability of develop new industry areas and improve efficiency of resource allocation.

Conclusion

Agglomeration level and competitive position has a significant impact on international contractors' choice and development of their business activities. By analyzing their agglomeration performance by data collection and BCG Matrix analyses, this paper identifies the different competitive positions of international contractors in different industries. From an overall perspective, all the contractors in the international contracting business have a stable agglomeration performance during 2009 to 2013 but the individual contractor groups from the 13 nations are characterized by recession, stabilization and enhancement.

Comparing their competitive positions, there are obvious contrasts between the international contractors in different sectors. Chinese contractors have an absolute competitive advantage in general building, transportation and electric power. Second only to the Chinese, American contractors in the building construction and transportation sectors have a higher competitive advantage than other contractors and a strong competitive advantage in industrial

processes/petroleum, Although some have declined in performance in recent years, the performance of Korean contractors has been outstanding in general building and industrial processes/petroleum. Spanish contractors are classed as Advantaged in the power industry and with strong experience and ability in the telecommunication industry, where many others still a capacious development space. Fig. 3 also reflects enormous indeterminate growth faced by emerging industries.

In the competitive climate of the global engineering contracting market, international contracting companies need to understand the development trend of international contracting business and consolidate their advantages when identifying their location in the market. The findings of this study provide a valuable reference for international contractors who are interested in developing their business activities in the international construction market. With the guidance of funds and profits, international contractors can adjust their industry structure to promote business growth, and constantly improve their ability, capability and management to achieve sustainable development in the broader global market.

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