Characteristics of regional international engineering contracting market of the Belt and Road

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Abstract. With the implementation of the Belt and Road, international contractors face more opportunities and challenges. Based on the Engineering News-Record data, this paper analyzes the current situation of the international engineering contracting market in the region of the Belt and Road and uses the cluster analysis to conduct research on the leading international contractors in the region of the Belt and Road. Then the differences of the industry and contractors characteristics in different regional markets are confirmed. Finally, proposals are put forward for the contractors to develop regional market of the Belt and Road.

1. Introduction
Implementing the Going Global strategy of enterprises is a major measure for the country to open up to the outside world. It is of great significance for promoting foreign investment, foreign trade, foreign economic cooperation, optimizing resource allocation, enhancing international competitiveness and building an open and mutually beneficial economy [1]. In 2013, Chairman Xi proposed to build “the Silk Road Economic Belt and the 21st-Century Maritime Silk Road” during his visit to Central Asia and Southeast Asia. The Belt and Road is the maximum spanning economic corridor and the most potential economic belt in the world. It runs through Eurasia, with the thriving Asia-Pacific economic circle connected to the east and the developed European economy to the west. Most of the middle are emerging economies and developing countries, with a total population of about 4.4 billion and a total economic output of about $21 trillion, accounting for 63% and 29% of the world respectively[2].

According to the data of 2017, Chinese contractors signed 7,217 new contracts for foreign contracted projects in 61 countries along the Belt and Road, with a new contract value of $144.32 billion, increased by 14.5% year-on-year, accounting for 54.4% of the newly signed contracts for foreign contracted projects in China during the same period. Turnover of $85.53 billion was completed in this year, increased by 12.6% year-on-year, accounting for 50.7% of the total quantity for the same period [3]. Although prospects for the future development are broad, most of contractors face defects such as insufficient competition experience, weak competitive strength and so on with the profound changes in the international engineering contracting market environment. Therefore, it is particularly important to study the characteristics of the international engineering contracting market of the Belt and Road.

2. Background
At present, the development of the international engineering contracting market is increasingly showing a trend of globalization and the overall market scale is developing rapidly. According to Engineering News-Record (ENR), the international engineering contracting revenue of the world's major contractors
was $115.9 billion in 2000 and it reached $574 billion in 2013. Then, due to the continuous decline in commodity metals and oil prices, the international engineering contracting market has ushered in three years of continuous pressure. From the overall trend, the international engineering contracting market from 2000 to 2016 has developed rapidly and the market revenue has maintained an average annual growth rate of 9.1%[4]. The international engineering contracting market still has a lot of room for development, but the market competition is more intense and complicated. The leading international contractors are closely related to the advantageous industries and market areas[5].

The regional market of the Belt and Road covers Middle East, Europe and Southeast Asia[6], while Asia Pacific, Europe and Middle East markets are also the three largest markets in the international engineering contracting market, accounting for more than 15% of turnover over the years. Among them, Asia-Pacific market accounted for 24.8% of total share in 2011, making it the world's largest contracted market. Therefore, it is necessary to study the industry and contractors characteristics of the engineering contracting market in Asia Pacific, Europe and Middle East.

3. Methodology and Results

Asia-Pacific, Europe and Middle East are regional markets with different degrees of monopoly for international engineering contract. European region has a high degree of monopoly, mainly engaged in general building, sewer/waste, hazardous waste and telecom. Asia-Pacific has a middle degree of monopoly, mostly engaged in general building, transportation and indus./petroleum. Middle East has a low degree of monopoly, almost concentrated on the infrastructure construction [7].

In recent years, the industry and contractors characteristics of different regional markets have undergone significant changes. This paper selects the leading international contractors from ENR’s top 250 international contractors in 2016 and uses cluster analysis to analyze the industry and contractors characteristics of different regional markets from the regional market turnover and business type. Finally, a conjecture on the dynamic development of the industry and contractors characteristics is proposed in the regional market.

There are two screening criteria for contractors. One is the rank of comprehensive strength, and the other is whether the collected data is analyzable. The list of 25 sample contractors and related data are shown in table 1 and table 2 below.

In table 1, overseas revenue does not include domestic revenue and the unit is $100 million. In each regional market, each value represents the rank of market share. The contractor labeled 1 has the largest market share in the corresponding market. As the number increases, its market share decreases. In the column of business type of table 2, each value represents the proportion of each business type in the contractor revenue, unit of which is %.

Cluster analysis is the basic methodology for studying the classification in multivariate statistics. It is used to classify the individuals (variables or cases) according to their multiple characteristics so as to obtain a variety of classification results [8]. In this paper, SPSS 22.0 is used for classification with Euclidean square to measure the distance between individuals. The results of cluster analysis reflect the similarities and differences of the industry and contractors characteristics in the respective market.

3.1. Europe

Through the above steps, results of European regional market are shown in table 3 and table 4 below. From the results, it can be found that European regional market has the following characteristics:

1. Business type: mainly for general building, transportation, indus./petroleum and telecom, not involved in manufacturing.
2. Business hierarchy:
   (1) level-1: Strabag, Bouygues, Ferrovial and Vinci
   These contractors have a high proportion of transportation business and partially carry out the general building business. At the same time, they conduct business in the fields of power, indus./petroleum, water supply, telecom, sewer/waste and hazardous waste, thus belong to the contractors of comprehensive development type.
level-2: Skanska and ACS

These contractors attach great importance to the market in the fields of general building and transportation and partly involve indus./petroleum and power business. Therefore, they are prominent contractors in the professional field.

level-3: Fluor and Bechtel

At this level, contractors only increase their market share in the indus./petroleum. So, they are contractors of specialized indus./petroleum type.

3. Nation attribute: The market monopoly of this region is relatively high. Thus, the leading contractors are all from Europe and America.

4. Correlation analysis: Leading contractors in the European regional market choose to conduct business in the United States, Asia and Latin America, hardly in the Middle East and Africa.

3.2. Asia

Results of Asian regional market are shown in table 5 and table 6 below. From the results, it can be concluded that Asian regional market has the following characteristics:

1. Business type: mainly for general building, transportation, indus./petroleum and power, not involved in sewer/waste and hazardous waste.

2. Business hierarchy:

level-1: Hochtief, China State Construction and ACS

These contractors focus on general building, indus./petroleum and transportation while taking the power and telecom into account. They have strong comprehensive competitiveness, thus belong to comprehensive development contractors.

Table 1. Rank of regional market share for the sample contractors.

| Company Name | Country  | INT’L Revenue | ASIA | EUROPE | MIDDLE EAST | AMERICA | LAT.AMER | AFRICA |
|--------------|----------|---------------|------|--------|-------------|---------|----------|--------|
| ACS          | Spain    | 320.7         | 2    | 9      | 1           | 2       |          |        |
| Hochtief     | Germany  | 245.2         | 1    |        | 2           |         |          |        |
| CCC          | China    | 192.6         | 4    | 5      |             |         | 1        |        |
| Vanci        | France   | 179.6         | 2    |        |             |         |          |        |
| Bechtel      | U.S.A.   | 168.8         | 3    | 8      |             |         | 6        |        |
| Odebrecht    | Brazil   | 149.4         |      |        |             | 1       | 7        |        |
| Techinip     | France   | 134.4         |      |        |             |         |          |        |
| Strabag      | Austria  | 133.8         |      |        |             | 1       |          |        |
| Bouygues     | France   | 133.7         |      | 4      |             | 6       |          |        |
| Skanska      | Sweden   | 126.9         | 3    | 3      |             |         |          |        |
| Power China  | China    | 113.5         | 6    |        |             | 10      | 2        |        |
| Saipem       | Italy    | 102           |      |        |             | 10      | 4        |        |
| Hyundai      | Korea    | 100.3         | 9    | 2      |             | 7       |          |        |
| CSCEC        | China    | 87.3          | 7    |        |             | 9       | 5        |        |
| Fluor        | U.S.A.   | 80.5          |      |        |             | 6       | 4        |        |
| Ferroval     | Spain    | 75.8          |      | 5      |             |         |          |        |
| Samsung      | Korea    | 70.2          | 5    |        |             | 6       |          |        |
| JGC          | Japan    | 61.8          |      | 8      |             |         |          |        |
| China Railway| China    | 60.4          |      |        |             |         |          | 3      |
| Consolidated | Greece   | 60.2          |      |        |             |         |          | 1      |
| Salini       | Italy    | 45.7          |      |        |             |         |          |        |
| Daelim       | Japan    | 37.5          |      |        |             |         |          | 5      |
| Abeinsa      | Spain    | 33.7          |      |        |             |         |          | 3      |
| M+W          | Germany  | 29.2          |      |        |             |         |          |        |
| Jacobs       | U.S.A.   | 24.2          |      |        |             |         |          |        |
Table 2. Proportion of each business type for the sample contractors.

| Company Name   | G.B. | Man. | Power | W.S. | S.W. | I.P. | Transp. | H.W. | Tele. |
|----------------|------|------|-------|------|------|------|---------|------|-------|
| ACS            | 36   | 1    | 8     | 2    | 3    | 12   | 25      | 0    | 2     |
| Hochtief       | 49   | 1    | 1     | 1    | 0    | 10   | 20      | 0    | 2     |
| CCC            | 6    | 0    | 1     | 4    | 1    | 1    | 87      | 0    | 1     |
| Vanci          | 8    | 0    | 15    | 1    | 0    | 5    | 47      | 1    | 10    |
| Bechtel        | 0    | 2    | 0     | 0    | 1    | 0    | 73      | 26   | 0     |
| Odebrecht      | 2    | 0    | 26    | 8    | 1    | 0    | 26      | 38   | 0     |
| Technip        | 0    | 0    | 0     | 0    | 0    | 0    | 76      | 0    | 0     |
| Strabag        | 37   | 0    | 0     | 5    | 3    | 6    | 48      | 0    | 0     |
| Bouygues       | 28   | 0    | 8     | 1    | 0    | 1    | 57      | 1    | 0     |
| Skanska        | 48   | 2    | 4     | 1    | 2    | 5    | 36      | 0    | 1     |
| Power China    | 11   | 0    | 59    | 6    | 1    | 3    | 17      | 0    | 0     |
| Saipem         | 0    | 0    | 0     | 0    | 0    | 0    | 98      | 2    | 0     |
| Hyundai        | 13   | 8    | 37    | 0    | 1    | 29   | 13      | 0    | 0     |
| CSCEC          | 55   | 0    | 2     | 0    | 0    | 0    | 27      | 0    | 0     |
| Fluor          | 11   | 0    | 1     | 0    | 0    | 0    | 82      | 0    | 0     |
| Ferroval       | 16   | 0    | 8     | 4    | 1    | 0    | 71      | 0    | 0     |
| Samsung        | 12   | 22   | 16    | 1    | 0    | 3    | 35      | 0    | 1     |
| JGC            | 0    | 0    | 0     | 0    | 0    | 0    | 100     | 0    | 0     |
| China Railway  | 15   | 2    | 0     | 0    | 0    | 0    | 60      | 0    | 0     |
| Consolidated   | 22   | 0    | 1     | 0    | 0    | 0    | 47      | 29   | 0     |
| Salini         | 5    | 0    | 0     | 42   | 4    | 0    | 44      | 0    | 0     |
| Daelim         | 7    | 0    | 15    | 18   | 5    | 0    | 55      | 0    | 0     |
| Abeinsa        | 4    | 0    | 89    | 3    | 1    | 1    | 3       | 0    | 0     |
| M+W            | 0    | 62   | 23    | 0    | 0    | 0    | 13      | 0    | 0     |
| Jacobs         | 4    | 2    | 2     | 2    | 1    | 81   | 2       | 5    | 0     |

Note: G.B. for general building, Man. for manufacturing, W.S. for water supply, S.W. for sewer/waste, I.P. for indus./petroleum, Transp. for Transportation, H.W. for hazardous waste and Tele. for telecom.

(2) level-2: Samsung and Vanci

These contractors have relatively high market share in the fields of transportation, power and general building. The difference with the level-1 lies in the different areas of focus. So, they also belong to comprehensive development contractors.

(3) level-3: Power China and Hyundai

Contractors of this level conduct business in the key areas of power, transportation, general building and indus./petroleum and almost have no other focus. They are professional and prominent contractors.

(4) level-4: China Communications Construction

The CCCC Group only develops transportation business and some other business in the transportation auxiliary field. It is a professional transportation contractor.

(5) level-5: Bechtel and JGC

At this level, contractors only develop indus./petroleum. Bechtel also develops some businesses in the transportation sector, but in general, these contractors belong to professional contractors of indus./petroleum.

3. Nation attribute: The level-1 and level-2 are three European and two Asian contractors while the level-3, level-4 and level-5 are almost from Asia. From this, we can see the internationalization of the strategic vision of Asian contractors.

4. Correlation analysis: It can be concluded that the level-1 contractors occupy a large proportion in the American regional market while the other can hardly enter the European and American regional markets and only choose to conduct business in the Middle East and Africa.
Table 3. Cluster analysis results for European regional market share.

| Company Name | Country | INT’L Revenue | ASIA | EUROPE | MIDDLE EAST | AMERICA | LAT.AMER | AFRICA |
|--------------|---------|----------------|------|--------|-------------|---------|----------|--------|
| Strabag      | Austria | 133.8          | 1    |        |             |         |          |        |
| Bouygues     | France  | 133.7          | 4    | 6      |             |         |          |        |
| Ferroval     | Spain   | 75.8           | 5    |        |             |         |          |        |
| Vanci        | France  | 179.6          | 2    |        |             |         | 8        |        |
| Skanska      | Sweden  | 126.9          | 3    | 3      |             |         |          |        |
| ACS          | Spain   | 320.7          | 2    | 9      |             | 1       | 2        |        |
| Fluor        | U.S.A.  | 80.5           | 6    |        |             |         |          | 4      |
| Bechtel      | U.S.A.  | 168.8          | 3    | 8      |             |         |          | 6      |

Table 4. Cluster analysis results for European regional business type.

| Company Name | G.B. | MAN. | Power | W.S. | S.W. | I.P. | Transp. | H.W. | Tele. |
|--------------|------|------|-------|------|------|------|---------|------|-------|
| Strabag      | 37   | 0    | 0     | 5    | 3    | 6    | 48      | 0    | 0     |
| Bouygues     | 28   | 0    | 8     | 1    | 0    | 1    | 57      | 1    | 0     |
| Ferroval     | 16   | 0    | 8     | 4    | 1    | 0    | 71      | 0    | 0     |
| Vanci        | 8    | 0    | 15    | 1    | 0    | 5    | 47      | 1    | 10    |
| Skanska      | 48   | 2    | 4     | 1    | 2    | 5    | 36      | 0    | 1     |
| ACS          | 36   | 1    | 8     | 2    | 3    | 12   | 25      | 0    | 2     |
| Fluor        | 11   | 0    | 1     | 0    | 0    | 82   | 2       | 3    | 1     |
| Bechtel      | 0    | 0    | 0     | 1    | 0    | 73   | 26      | 0    | 0     |

Table 5. Cluster analysis results for Asian regional market share.

| Company Name | Country | INT’L Revenue | ASIA | EUROPE | MIDDLE EAST | AMERICA | LAT.AMER | AFRICA |
|--------------|---------|----------------|------|--------|-------------|---------|----------|--------|
| Hochtief     | Germany | 245.2          | 1    | 2      |             |         |          |        |
| CSCEC        | China   | 87.3           | 7    | 9      |             |         |          |        |
| ACS          | Spain   | 320.7          | 2    | 9      |             | 1       | 2        |        |
| Samsung      | Korea   | 70.2           | 5    | 6      |             |         |          |        |
| Vanci        | France  | 179.6          | 2    | 8      |             |         |          |        |
| Power China  | China   | 113.5          | 6    | 10     |             |         |          |        |
| Hyundai      | Korea   | 100.3          | 9    | 2      |             | 7       |          |        |
| CCCC         | China   | 192.6          | 4    | 5      |             |         |          |        |
| Bechtel      | U.S.A.  | 168.8          | 3    | 8      |             |         |          | 6      |
| JGC          | Japan   | 61.8           | 8    |        |             |         |          |        |

Table 6. Cluster analysis results for Asian regional business type.

| Company Name | G.B. | MAN. | Power | W.S. | S.W. | I.P. | Transp. | H.W. | Tele. |
|--------------|------|------|-------|------|------|------|---------|------|-------|
| Hochtief     | 49   | 1    | 1     | 1    | 0    | 10   | 20      | 0    | 2     |
| CSCEC        | 55   | 0    | 2     | 0    | 0    | 0    | 27      | 0    | 0     |
| ACS          | 36   | 1    | 8     | 2    | 3    | 12   | 25      | 0    | 2     |
| Samsung      | 12   | 22   | 16    | 1    | 0    | 3    | 35      | 0    | 1     |
| Vanci        | 8    | 0    | 15    | 1    | 0    | 5    | 47      | 1    | 10    |
| Power China  | 11   | 0    | 59    | 6    | 1    | 3    | 17      | 0    | 0     |
| Hyundai      | 13   | 8    | 37    | 0    | 1    | 1    | 29      | 13   | 0     |
| CCCC         | 6    | 0    | 1     | 4    | 1    | 1    | 87      | 0    | 1     |
| Bechtel      | 0    | 0    | 0     | 1    | 0    | 73   | 26      | 0    | 0     |
| JGC          | 0    | 0    | 0     | 0    | 0    | 100  | 0       | 0    | 0     |
3.3. Middle East

Results of the Middle East regional market are shown in table 7 and table 8 below. From the results, it can be concluded that the Middle East regional market has the following characteristics:

1. Business type: mainly for manufacturing, power, indus./petroleum, general building and transportation, lacking business of water supply, sewer/waste, hazardous waste and telecom.

2. Business hierarchy:
   (1) level-1: Hyundai, Samsung and Consolidated Contractors International Company
   These contractors mainly carry out business in the fields of general building, indus./petroleum, transportation, manufacturing, and power. They have a relatively balanced business share, thus belong to balanced development contractors.
   (2) level-2: China Communications Construction
   The CCCC Group only develops transportation business and some other business in the transportation auxiliary field. It is a professional contractor in transportation.
   (3) level-3: Saipem
   Saipem only develops indus./petroleum business and some indus./petroleum auxiliary business. It is a professional contractor in indus./petroleum.

3. Nation attribute: In the Middle East regional market, Korean contractors have obvious advantages, followed by China and Europe. The market in this region has higher requirements on the capacity of capital operation.

4. Correlation analysis: Leading contractors in the Middle East carry out a small proportion of businesses in the Asian, African and Latin American, not in the US and Europe.

Table 7. Cluster analysis results for Middle East regional market share.

| Company Name | Country | INT'L Revenue | ASIA | EUROPE | MIDDLE EAST | AMERICA | LAT.AMER | AFRICA |
|--------------|---------|---------------|------|--------|-------------|---------|----------|--------|
| Hyundai      | Korea   | 100.3         | 9    | 2      | 7           |         |          |        |
| Samsung      | Korea   | 70.2          | 5    | 6      |             |         |          |        |
| Consolidated | Greece  | 60.2          | 60   | 1      |             |         |          |        |
| CCCC         | China   | 192.6         | 4    | 5      | 1           |         |          |        |
| Saipem       | Italy   | 102           | 10   | 4      |             |         |          |        |

Table 8. Cluster analysis results for Middle East regional business type.

| Company Name | G.B. | MAN. | Power | W.S. | S.W. | I.P. | Transp. | H.W. | Tele. |
|--------------|------|------|-------|------|------|------|---------|------|-------|
| Hyundai      | 13   | 8    | 37    | 0    | 1    | 29   | 13      | 0    | 0     |
| Samsung      | 12   | 22   | 16    | 1    | 0    | 3    | 35      | 0    | 1     |
| Consolidated | 22   | 0    | 1     | 0    | 0    | 47   | 29      | 0    | 0     |
| CCCC         | 6    | 0    | 1     | 4    | 1    | 1    | 87      | 0    | 1     |
| Saipem       | 0    | 0    | 0     | 0    | 0    | 98   | 2       | 0    | 0     |

3.4. Comparison of results from different regional market

From table 9, we can conclude that there are significant differences in the industry and contractors characteristics of the three different regional markets along the Belt and Road. At the same time, it can be confirmed that the hierarchy of contractors in the different regional market are also different, which is manifested in different business types engaged by contractors at three levels.

Table 9. Comparison of industry type and hierarchy of The Belt and Road regional market.

| Industry               | Europe                  | Asia                    | Middle East             |
|------------------------|-------------------------|-------------------------|-------------------------|
|                        | G.B., Trans., I.P. and Power. | G.B., Trans., I.P. and Power. | Man., Power and I.P.    |
| Hierarchy              | Level-1 comprehensive development | comprehensive development | G.B., I.P. and Trans.   |
4. Conclusion

4.1. Different business type
From the results of business type, it can be observed that the industry characteristics of different regional markets are quite different. Businesses in the Europe and Asia-Pacific are mainly concentrated on the general building, transportation, indus./petroleum and power, which require higher capabilities of innovative technologies and research and development. In the Middle East, demands for manufacturing, power and indus./petroleum are so strong because the region is rich in resources and requires a large amount of basic investment. The contractors in this region have strong capability of capital operation. So, contractors in different regions have different competitive advantages and need to selectively enter relevant markets according to the industry characteristics of different regions and their own competitive advantages.

4.2. Hierarchical contractors characteristics
From the results of business hierarchy, it can be concluded that contractors are clearly layered even in the same regional market. For example, the contractors in the Asian and European regional markets are divided into three similar levels. The level-1 are comprehensive development contractors and the level-2 are prominent contractors in key areas. These contractors have outstanding capabilities in general building and transportation. The level-3 are almost contractors in the indus./petroleum.

This law enlightens us that if we want to develop and grow in a certain area, there are several competition modes. One is to specialize in indus./petroleum industry, the other is to focus on the mixed development of general building and other fields, and the third is comprehensive development. Therefore, contractors should develop a competitive strategy that meets their own conditions and should not blindly follow suit.

4.3. Develop a diversified and integrated business
The hierarchical characteristics of contractors in the Middle East, Asia and Europe reflect the dynamic trend of development. The contractors gradually transition from domain-specific type to key areas (taking other fields into account) and eventually transform into comprehensive development type. The reason for this trend is that the integrated development business spans multiple areas and has diversified sources of revenue and profit and strong ability to withstand market cycles, so they usually maintain sustained profitability. It suggests that if contractors are already established and pursue long-term development in the region, they should develop a diversified and comprehensive development strategy.

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