INTERNATIONAL MARKET SELECTION OF INFRASTRUCTURE CONSTRUCTION INVESTMENT ALONG 'ONE BELT AND ONE ROAD': THE CASE OF ASEAN COUNTRIES

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Under the active support of the national policy "One Belt and One Road" (OBOR) Initiative, Chinese construction contractors are trying to seize this historic opportunity to accelerate strategic globalization, of which the first step for them is selecting suitable markets that are important to win the fierce market competition brought by the process of internalization. This paper develops a comprehensive international market selection (IMS) approach for infrastructure construction investment along OBOR using the objective information and mathematical algorithm. The objective information consists of 13 factors related to national risk and project reward and builds a market evaluation system. The mathematical algorithm includes Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) based on information entropy theory and cluster analysis with SPSS. Then, the Association of Southeast Asian Nations (ASEAN) countries are taken as research samples to verify the feasibility of the approach. The results show that Brunei is the high-risk and high-reward market; Indonesia and Philippines are low-risk and low-reward markets; Laos, Cambodia and Myanmar are high-risk and low-reward markets; while Singapore, Thailand, Malaysia, and Vietnam are low-risk and high-reward markets. The results may not only help Chinese contractors select better candidate markets to enhance their sustainability in the international market, but also have great theoretical and practical significance.

Keywords: ASEAN, OBOR, information entropy theory, TOPSIS

INTRODUCTION

International expansion is becoming more imperative in today's marketplace (Ozturk *et al.,* 2015), which also happens in the field of infrastructure construction. With the support of the multinational cooperation framework of "One Belt and One Road" (OBOR) Initiative whose main goal is creating an all directional, multi-level, and interconnected infrastructure network (Zhao *et al.,* 2016), the needs for acceleration of infrastructure investment and infrastructure upgrading in 66 related countries provide various market opportunities (Feng 2016). Even though choosing a suitable market could give contractors a competitive advantage in the fierce market competition (Kakol and Twarowska 2013), the international market selection (IMS) is not a

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straightforward task (Magnani *et al.,* 2018). IMS is one of the most complicated and time-consuming problems, due to the large number of alternatives, conflicting objectives, and variety of factors (Aghdaie *et al.,* 2013). This implies that the decision-making process must consider several criteria, which makes IMS a multicriteria decision-making problem, whose objective is to find an optimal alternative among candidate (Dat *et al.,* 2015). China-ASEAN (The Association of Southeast Asian Nations) Free Trade Area is one of the greatest World Federation of Free Trade Zones. Therefore, how Chinese contractors select better candidate country to enter is crucial for achieving project success in ASEAN.

The research aims to develop a comprehensive IMS approach for infrastructure construction investment along OBOR using the objective information and mathematical algorithm. In this paper, 13 factors are selected from two aspects of national risk and project reward based on theories of market selection, and a comprehensive international market evaluation system for infrastructure is established (Lee *et al.,* 2017). By quantifying the influence factors of various objective indexes, the ideal point method based on information entropy theory is used to process the data (Fan and Wang 1998). Finally, two corresponding scores are obtained for each country in ASEAN. The sample scores are clustered by SPSS, and the target markets are classified into four categories: High risk and high reward, high risk and low reward, low risk and high reward and low risk reward (Lee *et al.,* 2017).

Theoretical Frame

The literature varies widely on how to select a suitable international market and the debate focuses on influence factors and market evaluation methods. In the aspect of influence factors, Shi (2012) studied IMS from 3 aspects based on the institutional theory: Institutional distance, cultural distance and trade frequency. Ghemawat (2001) believed four elements of CAGE distance theory (Cultural, Administrative, Geographic and Economic distances) still have influence on market choice. Zhao *et al.,* (2016) hold that market situation and development are key factors and classified 66 OBOR countries according these. At the same time, how to evaluate target markets is also a key problem. Cano (2017) used fuzzy logic for the uncertainty of the variables in the market evaluation. Through Monte Carlo simulation, the market evaluation model measures the stability of international markets for exporting when criteria are fuzzy. Through a multiple case study methodology, Maganani (2018) conducted a comparative analysis and studied the revealing the role of firm-specific strategic objectives as determinants of foreign market.

The study introduces a quantitative approach for diagnosing the multi-dimensional aspects of target countries using both country-level and project-level variables. That is, to evaluate the target from each single point of view, and then integrate the information of each evaluation index to get a comprehensive index that can be judged as a whole and to compare horizontally or vertically on this basis. Through collecting and sorting out the relevant theories of market selection, including Eclectic Theory of International Production (ETIP) (Dunning 2000), Theory of National Overall Attractiveness (TNOA) (Hill 2002) and New Institutionalism Theory (NIT) (North 1981), 13 specific evaluation indexes are selected as follows:

Trade link (C_{11}): Frequent trade links can reduce the risk of uncertainty and encourage contractors to form economies of scale, save costs and increase profit margins. Correspondingly, the larger the total import and export trade volume of two countries, the closer the trade relationship between the two countries and the more frequent the economic ties (He and Zhang 2009).

Geographical distance (C_{12}): The increase of geographical distance will obviously increase transport costs and affect the cost of intangible goods and services trade. The geographical distance takes into account the regional area of two countries, whether they are landlocked countries, population and other factors, which can better explain the geographical distance between the two countries.

Institutional distance (C_{13}): Enterprises entering the international market need to rely on the legal system of the host country and the way of acting by the state organs to maintain business activities, while the differences in the level of institutional development increase obstacles and risks.

Government governance (C_{14}): The level of political governance in developing markets may be a major risk issue. Political stability means that political risks are small, which can reduce the risks and uncertainties faced by contractors. The political stability of the host country will determine the success of foreign investors in the country (Minifie and West 1998).

Judicial justice (C_{15}): As a long-term and complex project, infrastructure construction may involve legal disputes with local suppliers or owners (Kerur and Marshall 2012). Fair judicial procedures can protect the interests of contractors, but also make contradictions and disputes can be reasonably resolved.

Market opportunity (C_{21}): When choosing the market, international engineering enterprises tend to enter the high-growth market (Agarwal and Ramaswami 1992). On the contrary, in the case of low market potential, companies are unlikely to undertake large resource commitments (Brouthers 2013).

Market competition (C_{22}): Strong competition will reduce the level of profits and the average growth rate of sales for specific companies (Harrigan 2010). Once they fail in the competition, they will face huge sunk costs (Jia *et al.,* 2016). Therefore, enterprises are more inclined to enter the less competitive market.

Access to credit (C_{23}): The biggest human risk that contractors may face in the performance of engineering contracts is the breakage of project capital chain. It is very important for contractors to obtain stable and credible sources of loans (Kerur and Marshall 2012). This index analyses two issues: The strength of credit reporting system and the effectiveness of guarantee and bankruptcy law in promoting lending.

Enforcement of contracts (C_{24}): Effective execution of contracts is an important guarantee to ensure that the project is completed on time and to obtain expected profits. The index measures the time and cost of a local primary court in resolving a commercial dispute, as well as the quality of judicial proceedings. Judicial procedural quality indicators measure whether each economy has taken a series of good initiatives to improve the quality and efficiency of the court system.

Protection of minority investment (C_{25}): Protecting minority investment refers to protecting Contractors' rights in overseas project construction and measuring the full protection of minority investors when conflicts of interest occur. This indicator measures the protection of minority shareholders' rights when project investment partners abuse their finances in order to obtain private interests, and measures to reduce the risk of shareholders' interest impairment, including equity, governance and corporate transparency requirements.

Registered property (C_{26}): Based on a standardized case in which an entrepreneur wants to buy a registered land and building without ownership disputes, the registered property index measures the necessary procedures, time and cost for the entrepreneur to register the property.

Taxes (C_{27}): When evaluating the selected scheme, the tax consequences of local tax system and tax jurisdiction should be considered. This indicator records the taxes and mandatory payments that a medium-sized enterprise must pay or withhold in a year, the data show which countries have more efficient post-tax procedures and why the overall cost of tax compliance varies among economies.

Processing construction permits (C_{28}): This indicator records the procedures, time and cost of building a warehouse, including obtaining the necessary permits and approvals, submitting the required notifications, applying for and accepting all necessary inspections and obtaining public facilities. In addition, the construction permit index also inspects the construction quality control index, measures the quality of building laws and regulations, the strength of quality control and safety system, responsibility and insurance system, and the requirements for professional certification.

These factors consist a market evaluation system which contains 1 final “target A”, 2 “B level index” and 13 “C level index”. The national risk factor “B_1” includes 5 indexes and project reward “B_2” contains 8 indexes. Professional data are selected from the annual reports of professional institutions, and each index is processed quantitatively. Since the score of the upper level index is obtained through the treatment of the score of the lower level index, only the “C level index” needs to be quantified. The specific structure and content of the evaluation system are shown in Table 1.

Table 1: Structure and content of the market evaluation system

Target A	Factor B	Index C	Theory	Data Resource	Data Duration	Measurement/Scale
A	B_1	C_{11}	TNOA	China Statistical Yearbook	2014-2018	Total import and export/ million US dollars
		C_{12}	ETIP	CEPLL Database	2014-2018	Geographical Distance/km
		C_{13}	ETIP	World Governance Indicators	2014-2018	Degree of Economic Freedom/score
		C_{14}	TNOA	World Integrity Index	2014-2018	Integrity Index/ranking
		C_{15}	TNOA	World Justice Project Rule of Law Index Report	2014-2018	Rule of Law Index/score
	B_2	C_{21}	TNOA	OBOR National Infrastructure Development Index Report	2014-2018	Infrastructure Development Index/score
		C_{22}	TNOA	Engineering News Records	2014-2018	Number of Overseas Contractors/numbers
		C_{23}	NIT	World Business Index Report	2014-2018	Business index/Ranking
		C_{24}	NIT	World Business Index Report	2014-2018	Business index/Ranking
		C_{25}	NIT	World Business Index Report	2014-2018	Business index/Ranking
		C_{26}	NIT	World Business Index Report	2014-2018	Business index/ranking
		C_{27}	NIT	World Business Index Report	2014-2018	Business index/ranking
		C_{28}	NIT	World Business Index Report	2014-2018	Business index/ranking

RESEARCH METHODOLOGY

The counting and calculating process in this paper includes the following steps:

Step 1: Normalization. In the multi-index evaluation system, the nature of each index varies greatly. There are no similar criteria among the indexes, and the unit dimension is not consistent. The role of data standardization is to eliminate dimensional differences and minimize the impact of extreme values (Zhao *et al.,* 2016). Among the various methods of data standardization, the normalization method is relatively common and typical. It converts each value into the proportion and maps data processing to "$[0,1]$" in the whole sequence.

Step 2: Entropy of information weighting method. The index weight reflects the relative importance of each index and the coordination degree of the whole index system. On the basis of the established index system, the weighted summation method is often used to obtain the evaluation value (Fan 1998). In information theory, Shannon (1948) quoted the concept of entropy in physics and pointed out that any information has its own information entropy, which is an objective value that can be calculated by formula. Comparing with the weight of each index given by expert survey, it is more objective. Entropy "e" is a measure of the degree of uncertainty of the system (Liu and Zhang 2007). When the system is in "n" different states and the probability of occurrence of each state is "p_i", the system's entropy is:

$$e_j = -\frac{1}{\ln(n)} \sum_{i=1}^{n} p_i \ln p_i \ (0 \leq e_j \leq 1)$$

According to the formula of entropy, the definition of entropy weight is as follows:

$$\omega_j = \frac{1 - e_j}{\sum_{j=1}^{n}(1 - e_j)}$$

When the entropy of the system is small and the weight of the entropy is large, it shows that the system contains more information to help decision-making than other systems.

Step 3: Technique for Order Preference by Similarity to an Ideal Solution. Technology for Order Preference by Similarity to an Ideal Solution model (TOPSIS) is an effective method for multi-objective decision-making and improves the accuracy and operability (Hwang and Yoon 1981). Firstly, the data standardization is used to unify the quantified index values, and the ideal solution "C_1^+"and the negative ideal solution "C_1^-"are selected according to the principle of “Take the biggest in the big and the smallest in the small.”

$$C^+ = \{(\max C_i \mid i \in J1), (\min C_i \mid i \in J2) \mid i=1, 2, 3, 4, \cdots m\};$$

$$C^- = \{(\min C_i \mid i \in J1), (\max C_i \mid i \in J2) \mid i=1, 2, 3, 4, \cdots m\}$$

The distance between each corresponding target and the ideal target is calculated by Minkowski distance or Euclidean geometric distance. In theory, the closer the distance is, the better the evaluation is. Finally, a ranking of advantages and disadvantages is obtained. The distance from each solution to a positive ideal solution is"S_J^+"; The distance from each solution to a negative ideal solution is "S_J^-"; The closeness of each corresponding index to the ideal solution is"B". The greater the degree of closeness, the more ideal. By sorting the degree of closeness in B set according to size, the sorting can be obtained.

$$S_J^+ = \sqrt{\sum_{i=1}^{m}(C_i - C^+)^2}, \ j=1,2,3,\cdots,m.$$

$$S_J^- = \sqrt{\sum_{i=1}^{m}(C_i - C^-)^2}, \ j=1,2,3,\cdots,m.$$

$$B_i = \frac{S_j^-}{S_j^+ + S_j^-} \quad (0 \leq B_i \leq 1)$$

Step 4: Cluster analysis. It describes the characteristics of the original object by clustering method, analyses the similarity within the group and proceeds to classify. As the main purpose of data mining in practical application, clustering can provide multi-cluster data with different characteristics for the subsequent analysis process, which facilitates the subsequent analysis of specific characteristics and the decision of processing methods. At the same time, clustering analysis is also a necessary precondition for classification and qualitative induction in practical application. This study uses SPSS to do cluster analysis by taking K-means clustering.

RESULTS AND DISCUSSION

Taking ten ASEAN countries as samples, including Brunei (BN), Indonesia (ID), Kampuchea (KH), Laos (LA), Malaysia (MY), Burma (MM), Philippines (PH), Singapore (SG), Thailand (TH) and Vietnam (VN), this research method is applied to analyse IMS. According to the data sources shown in Table 1, the initial data are sorted out and standardized, and the weight of each index is calculated by entropy of information weighting method. The weights are combined with the standardized data to get the specification values. Table 2 below shows the data panels for weights and specification values

Table 2: Weights and specification values

Index C	ω_j	BN	ID	KH	LA	MY	MM	PH	SG	TH	VN
C_{11}	0.6037	0.0020	0.0783	0.0055	0.0038	0.1282	0.0204	0.0573	0.0999	0.0964	0.1121
C_{12}	0.1630	0.0149	0.0200	0.0128	0.0106	0.0167	0.0383	0.0109	0.0172	0.0126	0.0089
C_{13}	0.0259	0.0029	0.0025	0.0024	0.0021	0.0030	0.0020	0.0026	0.0037	0.0027	0.0022
C_{14}	0.1444	0.0212	0.0127	0.0074	0.0096	0.0175	0.0089	0.0126	0.0298	0.0131	0.0115
C_{15}	0.0630	0.0076	0.0066	0.0041	0.0037	0.0069	0.0053	0.0060	0.0102	0.0064	0.0064
C_{21}	0.0099	0.0008	0.0015	0.0009	0.0009	0.0010	0.0008	0.0009	0.0011	0.0009	0.0011
C_{22}	0.0606	0.0014	0.0092	0.0041	0.0038	0.0096	0.0042	0.0063	0.0076	0.0072	0.0072
C_{23}	0.1761	0.0132	0.0298	0.0493	0.0110	0.0030	0.0201	0.0278	0.0044	0.0119	0.0055
C_{24}	0.2352	0.0008	0.0218	0.0079	0.0305	0.0079	0.0702	0.0563	0.0115	0.0167	0.0115
C_{25}	0.1465	0.0093	0.0220	0.0272	0.0147	0.0067	0.0285	0.0226	0.0003	0.0052	0.0100
C_{26}	0.2338	0.0117	0.0126	0.0317	0.0505	0.0012	0.0537	0.0428	0.0012	0.0047	0.0238
C_{27}	0.0690	0.0108	0.0084	0.0098	0.0052	0.0033	0.0106	0.0090	0.0015	0.0054	0.0050
C_{28}	0.0690	0.0074	0.0081	0.0097	0.0111	0.0052	0.0089	0.0075	0.0005	0.0048	0.0061

The closeness of national risk and project reward to the ideal solution is as follows:

{0.1782, 0.5933, 0.1708, 0.1806, 0.8960, 0.1407, 0.4590, 0.7773, 0.7298, 0.8223}

{0.8150, 0.6038, 0.5117, 0.4854, 0.8765, 0.2408, 0.2707, 0.8850, 0.8041, 0.7424}

Each data is divided into two categories by cluster analysis using SPSS and the evaluation results are shown in Table 3.

Table 3: Evaluation results

	High Reward	Low Reward
High Risk	Brunei	Laos, Cambodia, Myanmar
Low Risk	Singapore, Thailand, Malaysia, Vietnam	Indonesia, Philippines

Compared with other Southeast Asian countries, Singapore, Thailand, Malaysia and Vietnam have better economic conditions, solid foundations, good economic prospects and large room for growth. However, they do not invest enough in infrastructure. Some of the infrastructure is old and even backward, which to some extent restricts the further development of the economy. Therefore, these markets have good prospects, and countries with large market space have the most obvious demand for infrastructure improvement. Brunei is a small country with a small volume of trade with China, and its relations with other countries do not have a great advantage. Moreover, the domestic infrastructure construction is mature, the market demand is small, and the entry risk of enterprises is high. However, once social and economic stability, complete system entered, there will be considerable project rewards. Indonesia and the Philippines have large economic aggregates, and both countries attach importance to infrastructure construction with rapid development. However, due to the long construction cycle and the large national development base, there is an urgent need to constantly update infrastructure, so there are still many construction opportunities. In addition, the two countries have close ties with China, frequent commercial exchanges, and the contractors are familiar with the economic and social conditions of the market, with relatively small risks. By comparison, Laos, Cambodia, Myanmar are the most backward in economic development. Owing to economic and social factors, most of these countries invest less in infrastructure and have lower opportunities and rewards. In addition, the government's inadequate governance and the problems of the social and economic system pose greater risks.

In summary, this approach can be applied successfully and the degree that the result accords with the realistic condition is high. Each of the four types of market has its own characteristics. Chinese international engineering contracting enterprises should screen market opportunities according to the actual situation.

CONCLUSIONS

In order to explore what factors, affect the decision making of Chinese contractors in infrastructure construction market selection along OBOR, this study establishes an objective multi-index IMS approach, uses the ten countries as an example for application and analysis. The results show that Brunei is the high-risk and high-reward market; Indonesia and Philippines are low-risk and low-reward markets; Laos, Cambodia and Myanmar are high-risk and low-reward markets; while Singapore, Thailand, Malaysia and Vietnam are low-risk and high-reward markets. The results may not only help Chinese contractors select better candidate markets to enhance their sustainability in the international market, but also have great theoretical and practical significance.

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