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MODELS FOR PREDICTING SINGAPORE CONTRACTORS' EXTENT OF INTERNATIONALIZATION

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ABSTRACT: Before a contractor embarks on exporting its services, it needs to know if it is likely to succeed. This research developed two prediction models to help contractors in Singapore predict the number of projects (Y1) and the contract values (Y2) that they are likely to secure from overseas. Detailed characteristics of 60 contractors who export their services (exporters) were obtained from the database of registered contractors in Singapore. Multiple linear regression models were developed and tests showed that Y1 is a robust model. A contractor's chance of winning more overseas projects may be predicted by the number of projects it acted as a subcontractor; the variety of projects it undertakes; the total contract value in the domestic market; and the number of countries it exported its services to. It is recommended that contractors who are planning to export their services be flexible instead of adopt a focused policy of undertaking only one or two project types in a few selected countries.

Keywords: Internationalization; Globalization; Singapore; Modeling

1. INTRODUCTION

International construction has seen phenomenal growth [1]. Before contractors jump on the bandwagon, they should assess their capability to internationalize. The aim of this research is to develop and test models to help Singaporean contractors predict the likely number of projects (Y1) and project values (Y2) they could secure from their internationalization efforts. Based on the predicted values, contractors may be able to decide if they should internationalize or not. If they have already decided to export their services, the models help to identify the key variables which need to be controlled in order to win more overseas projects.

The scope of this study was confined to Singapore-owned construction firms. Only objectively measurable and firm-specific variables as shown in Table 1 were investigated. This study made use of static/historical information relating to characteristics of firms in a given period, though in reality, internationalization is a dynamic affair. A firm is deemed to have internationalized when it offered products and services outside the country of incorporation (home country). An international project or overseas project is one located in the host country, which is outside the contractor's home country.

2. LITERATURE REVIEW

There are several differences between exporters and non exporters. Exporters record better performance in areas such as market share and return on investment [20]. Exporters also have higher sales turnovers and higher number of staff (employment size) [21]. Exporters are more likely to be manufacturers, while those in the services sector are more likely to be non exporters [21].

Table 1. Factors investigated in the study

Code	Description of variable
	Dependent variables
Y1	Number of overseas projects
Y2	Total contract value of overseas projects
	Independent variables
x1=	Age of firm (in years)
x2=	Type of firm (1= public listed; 2= private limited)
x3=	Paid up capital (in Singapore dollars)
x4=	Number of projects in domestic market
x5=	Total contract value of works in domestic market
x6=	Number of contracts as main contractor
x7=	Number of contracts as subcontractor
x8=	Number of project types
x9=	Number of overseas countries ventured into

Note: with the exception of x1 to x3, all the variables above were measured in a 6-year period (between 1999 and 2004).

In the construction industry, the concept of exporting applies to export of construction services [9]. Unlike in manufacturing, the nature of the construction industry is characterized by the immobility and uniqueness of its output [10]. In such a business model, firms provide a customized service rather than a readily exportable mass-produced unit. As a result of the inherent differences between the two industries, construction firms have had to sift through the numerous export strategies originally conceptualized for the manufacturing industry and select the ones applicable for construction export. Manufacturing export techniques have to be modified to cater to the export of construction services [11, 12]. By using these modified strategies, some construction firms have managed to surmount the many barriers to exporting their services globally. However, many obstacles exist despite the ever-increasing integration of national markets – which is a result of globalization [13].

Firms that plan to export their products and services need good corporate strategies to meet the opportunities and overcome the threats in the organization's external environment. The strategies can be developed using Porter's [14] Five Forces model. According to Porter [14], a competitive strategy involves weakening suppliers' and customers' bargaining power, reducing the threat of new entrants and substitutes, and reducing the competition between existing players by avoiding price competition and product differentiation. Porter's [14] Five Forces model is important to help firms develop strategies to penetrate foreign markets.

However, before an organization can strategize regarding its external environment, Mintzberg and Quinn [15] emphasized that besides external competition, firms need to tackle internal weaknesses. Low moral, high wastage, reworking, returns, high overheads, machine downtime and rejects are all internal weaknesses of the organization. While it is important to identify key characteristics and strategies to help contractors internationalize and export their services, this study focused on objectively measurable firm-specific variables that help firms to internationalize their services.

Ofori [16] argued that a firm can attain international competitiveness by focusing on firm-specific advantages. The size of a firm is an important aspect as it is closely related to its resource capabilities. Larger firms may have higher chance of securing more international projects because they tend to have larger number of employees and thus would have better management capabilities than smaller firms [4].

Closely related to firm size is a firm's financial strength. When a firm sets out to venture overseas, having strong funding support is important. The firm will be disadvantaged in the international market if it has limited capital [4]. British construction firms that venture overseas have been found to have extensive and competitive financial sector back home in UK to 'back them up' [17]. This gives British firms competitive advantage over construction firms from countries that do not have strong backing of their home financial institutions.

In international markets, Cuervo and Low [4] found that good reputation allows firms to compete based on quality of services/products and not just on price alone. Good company reputation instils confidence in clients [5].

To be successful in international markets, construction firms should have good track record both in the domestic and international markets [18]. This is because past performance is a valid predictor of future performance [19].

Ling [18] found that firms that want to export should have excellent quality in terms of product quality, service quality and high quality professional and technical staff. In addition, firms should possess financial resources, technological supremacy and capabilities in management and strategic planning [18].

Ling and Kwok [2] identified variables that are significantly correlated to Y1 and Y2. They found that the number (Y1) and value (Y2) of overseas projects are significantly correlated with: firm's paid up capital; contract value in domestic market; number of contracts as main contractor and subcontractor; number of project types and number of countries ventured into.

However, that study did not construct models to help contractors predict how many projects they could win and the project values based on their individual characteristics. This research is a continuation of Ling and Kwok's [2] study, aimed at developing and testing prediction models to fill the gap identified.

To investigate whether a firm has the capability to export, two dependent variables were adopted: 'number of overseas projects' (Y1); and 'total contract value of overseas projects' (Y2). By definition, an exporter is a firm that had won at least one overseas contract during the period of study. Nine firm-specific and measurable factors (independent variables) were also identified from the literature review (see Table 1).

3. RESEARCH METHOD

The research used data from the Singapore Building and Construction Authority's (BCA) database to identify characteristics of Singapore-owned construction firms that enabled them to secure overseas contracts. The database comprised the entire population of registered contractors that had been awarded projects in Singapore and international markets. It contained details of construction firms, value and type of contracts awarded in Singapore and overseas. The data were based on the information provided by contractors at the time of registration, renewal of registration and periodic surveys by the BCA. The periodic surveys had return rates of between 70% and 95%.

The population for this study was all Singapore

owned BCA registered contractors which had been awarded construction contracts outside Singapore valued at more than S$1 million during the period of study (January 1999 to December 2004). The database contained 60 exporters, who were all included for detailed analysis. The contractors were randomly divided into two groups; ⅔ of the sample to develop the model (n_1) and ⅓ to test the model ($n_2 = 20$). Within the first group of 40 cases, two outliers were removed, thus leaving $n_1 = 38$. No outliers were found in the second group.

4. CHARACTERISTICS OF THE SAMPLE

Between 1999 and 2004, the 60 exporters had clinched 330 overseas contracts, valued at S$4.82 billion in 40 countries. The mean is 5.5 overseas projects per firm. 37 (62%) of the exporters had also won contracts in the domestic market during the period that the firm ventured overseas. The majority of the firms were 20 years or older.

5. MODEL DEVELOPMENT

In this study, multivariate regression analysis was used to develop two models to determine the statistical relationship between contractors' exporting capability (Y1 and Y2) and the explanatory variables (x1 to x9). The models were developed using traditional regression techniques with the help of the Statistical Package for Social Sciences software (SPSS). The predictive models are shown in Equations 1 and 2, and details given in Table 2.

$$Y1 = -0.884 + 0.870\bullet(x7) + 0.712\bullet(x9) + 0.650\bullet(x8) + 3.925x10^{-9}\bullet(x5) \quad \text{(Eq. 1)}$$

$$Y2 = 2843427.28 + 10232770.056\bullet(x7) + 0.183\bullet(x5) - 2936274.642\bullet(x4) \quad \text{(Eq. 2)}$$

Where:
Y1= number of overseas projects
Y2= total contract value of overseas projects
x4= number of projects in domestic market

x5= total contract value in domestic market
x7= number of contracts as subcontractor
x8= number of project types
x9= number of overseas countries ventured into.

6. MODEL VALIDATION

Besides R^2 and adjusted R^2, four relative measures of accuracy were used to validate the models (see Table 3). The models were validated by substituting the relevant values of x from the 20 sets of data put aside earlier (n_2) into Eqs. 1 and 2. The calculated values for predicted Y1 and Y2 were then compared to the actual Y1 and Y2 values obtained from the 20 sets of data.

Table 3. Results of model validation

Measures	Y1	Y2
R^2	0.987	0.952
Adjusted R^2	0.985	0.948
Mean Percentage Error	-9.0%	214%
Mean Absolute Percentage Error	34%	756%
Mean square error	47.94	1.72×10^{17}
Root Mean Square Error	6.92	4.15×10^{8}

The relatively low mean percentage error and root mean square error for Y1 suggests that the model is able to predict relatively accurately. The results show model Y2 is unable to predict with any accuracy indicating that this model is not useful for forecasting the total contract value of overseas projects. This may be because total contract value of overseas projects depends on some others variables which are outside the scope of this study.

7. DISCUSSION

Eq. 1 shows four variables that can be used to predict the number of overseas projects a Singapore contractor is likely to win: x5, x7, x8 and x9. These are now discussed.

7.1 Value of domestic projects (x5)

The prediction model (Eq. 1) shows 'total contract value in domestic market' (x5) can be used to predict the 'number of overseas projects' (Y1). The positive but small β coefficient suggests the need to maintain some work in the home country while a firm exports its services. This is consistent with Low et al.'s [3] finding that successful exporters continue to carry out projects in their home countries while they concurrently export their services.

The advantages of being active in the domestic market include: preserving credibility [5]; providing the necessary funds to finance overseas ventures [2]; and maintaining a pool of experienced staff in the home country for possible deployment abroad [5].

7.2 Role as a subcontractor (x7)

The prediction model shows that the number of projects a contractor has acted as a subcontractor (x7) is the most significant variable to predict the number of overseas projects a contractor may win (Y1). As some international projects are complex and mega sized, Singapore contractors may not be able to take on the role of main contractors due to lack of financial capacity, resources and expertise. Some countries may also have protectionist policies that prevent foreigners from being main contractors. The alternative is to participate in the overseas project as a subcontractor. To do so, contractors need to offer specialty or niche product/service so that they can differentiate themselves from their competitors [6].

There are several advantages of being involved in international projects as subcontractors. Singaporean contractors are able to showcase their expertise, management skills and quality of work; and at the same time build up networks. These put them in good stead to be invited to participate in future projects.

7.3 Project types (x8)

The prediction model shows that 'number of project types' (x8) can be used to predict the 'number of overseas projects' (Y1). The positive β coefficient suggests the need to develop capability in handling a variety of project types, instead of focusing only on one or two types. For example, firms should try to undertake more complex project types (eg. hazardous waste, petroleum, industrial process) than the less complex general building and manufacturing facilities, to earn higher levels of profit [7].

7.4 Countries ventured into (x9)

The optimum model (Eq 1) shows that the second most significant factor to predict number of overseas projects (Y1) is the number of countries the exporters venture into (x9). Geographical diversification has several advantages. It increases a firm's reach and provides more opportunities. By operating in different countries, firms may be able to minimize foreign exchange risk from portfolio management [8]. There is however a need to overcome the competition from indigenous contractors who are familiar with their own turf, and forming project joint ventures with them is recommended [6]. The disadvantage of focusing on many countries is that firms may spread their resources too thin.

8. CONCLUSION

The essence of this study is that a robust model that may be used to predict the likely number of projects a Singaporean contractor can secure from overseas has been developed and tested (see Eq. 1). It is recommended that contractors who wish to secure many overseas projects adopt the following: maintain a healthy construction volume in the domestic market (x5); undertake some projects as a subcontractor (x7); increase capability to handle many project types (x8); and diversify geographically to several markets (x9). It is suggested that those who need to decide on whether to venture overseas or not use Y1 as an initial assessment tool to help them gauge the number of projects they are likely to secure overseas.

REFERENCES

[1] Bon, R. and Crosthwaite, D., *The future of International Construction,* Thomas Telford, London, 2000.

[2] Ling, F.Y.Y. and Kwok, D.H.Y., "Enablers for Singapore contractors to internationalize construction services", *Construction Management and Economics*, Vol. 25, pp. 267-275, 2007.

[3] Low, S.P, Jiang, H. and Leong, C.H.Y., "A comparative study of top British and Chinese international contractors in the global market", *Construction Management and Economics,* Vol. 22, pp. 717-731, 2004.

[4] Cuervo J. C. and Low S. P., "Ownership advantages/ disadvantages of Singapore transnational construction corporations", *Construction Management and Economics*, Vol. 21, pp. 80-94, 2003.

[5] Jennings, P., and Holt, G.D., "Pre-qualification and multi-criteria selection: a measure of contractors' opinions", *Construction Management and Economics*, Vol. 16, pp. 651-660, 1998.

[6] Ling, F.Y.Y., Ibbs, C.W. and Cuervo, J.C., "Entry and business strategies used by international architectural, engineering and construction firms in China", *Construction Management and Economics*, Vol. 23, pp. 509-520, 2005.

[7] Ling, F.Y.Y., Ibbs, C.W. and Hoo, W.Y., "Determinants of international architectural, engineering and construction firms' project success in China", *Journal of Construction Engineering and Management*, Vol. 132(2), pp. 206-214, 2006.

[8] Han, S.H. and Diekmann, J.E., "Approaches for making risk-based go/ no-go decision for international projects", *Journal of Construction Engineering and Management*, Vol. 127(4), pp. 300-308, 2001.

[9] Moore, A. B., *Marketing Management in Construction: A Guide for Contractors*, Butterworth, London, 1984.

[10] Job D.H., Hans, V. and Geert-Jan, J., "Market strategies and core capabilities in the building industry", *Construction Management and Economics*, Vol. 20(10), pp. 109-118, 2002.

[11] Hindley B. and Smith A., "Comparative advantage and trade in services", *The World Economy*, Vol. 7(11), pp. 369-390, 1984.

[12] Boddewyn J. J., Halbrich M. B. and Perry A. C.,

"Service multinational: conceptualisation, measurement and theory", *Journal of International Business Studies*, Vol. 29(3), pp. 41-57, 1986.
[13] Douglas S.P. and Wind Y., The myth of globalization", *Columbia Journal of World Business*, Vol. 21(10), pp. 19-29, 1987.
[14] Porter, M., *Competitive Strategy: Techniques for Analyzing Industries and Competitors*, The Free Press, New York, 1980.
[15] Mintzberg, H. and Quinn, J.B., *The strategy process: concepts, contexts and cases*, 3rd ed., Prentice Hall, Upper Saddle River, N.J., 1996.
[16] Ofori, G., "Frameworks for analyzing international construction", *Construction Management and Economics*, Vol. 21, pp. 379-391, 2003.
[17] Hillebrandt, P.M., Cannon, J. and Lansley, P., *Construction Company in and out of Recession*, Macmillan, London, 1995.
[18] Ling, F.Y. Y., "Benefits that foreigner AEC firms derive when undertaking construction projects in China", *Management Decisions*, Vol. 43(4), pp. 501-515, 2005.
[19] Epstein, S., "The stability of behavior: on predicting the most of the people much of the time", *Psychological Bulletin*, Vol. 37, pp. 1097-1126, 1979.
[20] McDougall, P. P. and Oviatt, B. M., "New venture internationalization, strategic change, and performance: a follow-up study", *Journal of Business Venturing*, Vol. 11(1), pp. 23-40, 1996.
[21] Westhead, P., "Exporting and non-exporting small firms in Great Britain: a matched pairs comparison", *International Journal of Entreprenuerial Behaviour and Research*, Vol. 1(2), pp. 6-36, 1995.
[22]

Table 2 Regression results

	β	σ	b	t value	*p* value
Model for Y1					
Constant	-0.884	0.416		-2.126	0.041
x7	0.870	0.049	0.769	17.803	0.000
x9	0.712	0.145	0.206	4.918	0.000
x8	0.650	0.206	0.074	3.160	0.003
x5	3.925×10^{-9}	0.000	0.052	2.550	0.016
Model for Y2					
Constant	2843427.28	4327518		0.657	0.516
x7	10232770.056	412968.9	1.014	24.779	0.000
x5	0.183	0.049	0.269	3.700	0.001
x4	-2936274.642	1200974	-0.180	-2.445	0.020

Notes:

1. Regression coefficient (β), calculated using ordinary least square method.
2. Standard error (σ) of variable regression coefficient, measures the dispersion of regression coefficient over sampling distribution.
3. Standardized regression coefficient (b), allows for equal comparison of coefficient weights, when the constant is removed.
4. Value of t-statistic, to be compared to the theoretical t-distribution for accuracy.
5. Significance of t-statistic. For significance < 0.05, the null hypothesis that $\beta = 0$ is rejected. There is less than 5% chance that t-statistic is wrong due to random occurrence.