Niche Comparisons: toward a new approach for analyzing competition and organizational performance in the international construction market

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Abstract

Over the past few decades, studies on competition and organizational performance in the international construction market have been prolific. Construction companies are founded, then grow, compete, evolve, and die in the international landscape, a common process from an ecological perspective. However, few studies have considered the international construction market from this perspective. Using niche theory, which was initially populated in the field of natural bio-ecology and then introduced to business management and economics, a NW/O-L (niche width/overlap and location) framework is established in this study. With this framework, the niche evolution of the top 225 international contractors are explored along two dimensions - product and geography. The effects of a proper niche on an international construction company's performance are also investigated using the cluster analysis method. It was discovered that, despite fluctuations over time, the contractor' niche is highly related to its performance in the international construction market. The most appropriate niche for the international construction contractors is a wide niche width, with a small niche overlap and with its location near to the market centre that with comparatively more market resources. However, only a few contractors can survive in this niche, as the majority of contractors are in a narrow niche width, with a comparatively large niche overlap and far from the market centre. Contractors which do not fit either of these two niches have proved to be poor performers in this study.

Keywords: international contractor, international construction, niche theory, organizational ecology,

Introduction

With the globalization of the world economy, today's construction business is fast becoming an internationally interdependent marketplace. Engineering News Record (ENR) (Reina and Tulacz 2011) show that their top 225 international contractors (TIC 225) in 2010 logged US$383.7 billion from construction projects outside their home countries. This represents a three-fold increase over the US$106.5 billion in 2001. Advanced technology, fast transportation, convenient communications, effective knowledge transfer, integrated markets, and trade liberalization have all helped to lower traditional barriers and transform construction into a fiercely competitive international marketplace where construction companies rise and fall. A clearer understanding of the competition and performance involved in this market would be helpful to all stakeholders, especially to international contractors.

International construction has been defined as when a company, resident in one country, performs work in another country (Ngowi *et al.* 2005). Similarly, ENR defines international construction as the part of construction business that is undertaken by companies working on projects outside their home country. Although nowadays most big construction companies conduct both domestic and overseas business, the concept of international construction encourages to investigate construction business from an international perspective by focusing on the business and competition in overseas markets (Lu *et al.* 2009).

Due to the flourishing international construction market, research on various aspects of international construction has been prolific. By and large, these studies can be classified into two categories. The first category is the analysis of the trend and framework of the international construction market from a macro perspective. An example is Bon and Crosthwaite's work (2001), which investigated future market trends based on their annual worldwide surveys conducted during the period from 1992 to 1999. Also, based on ENR data from the TIC225, Ye et al. (2009) investigated the international construction competition trend over the period 1981 to 2008. Ofori (2003) and Ngowi et al. (2005) reviewed the trajectory of the international construction industry as well as the methods for analyzing and comparing performance of international construction contractors. The second category of studies is the analysis from a micro perspective by comparing companies' strategies in international construction markets across different jurisdictions. This was done using a SWOT (strengths, weaknesses, opportunities and threats) analysis based on interviews and case studies (Zhao and Shen 2008, Lu *et al.* 2009, Lu 2010), by using Dunning's eclectic paradigm that emphasizes ownership, location and internalization advantages of international construction companies (Low and Jiang 2004, Low, Jiang and Leong 2004), and by using Porter's competition theories - Öz's (2001) survey of the competitive advantages of Turkish international construction companies. Kale and Arditi (2002), Korkmaz and Messner (2008) study the competitive positions of construction firms mainly based on Porter's competition theories. Although it is

heavily dependent on theories from mainstream management, international construction is a research discipline in its own right that has helped to significantly improve the understanding of competition in the international construction market over the past twenty years.

Moore (1996) saw an economic environment as an ecosystem and claimed that new understandings of company management could be gleaned by studying it from an ecological perspective. However, such studies have rarely been applied to international construction. Organizational ecology, which focuses on organizations and populations from an ecological perspective, was established more than 30 years ago (Baum and Shipilov 2006). Compared with other mainstream management theories, organizational ecology places more emphasis on evolution and natural selection, which considers the environment as the primary mechanism for explaining the performance of an organization (Whittington 2001).

The organizational ecology theory is sometimes criticized as being passive, as it places an emphasis on the natural selection process but neglects an organization's innovativeness. However, a clearer understanding of the relationship between organizations and the competitive environment in which they operate is necessary, especially in a risky international market. By establishing a proper relationship with the environment, international construction companies are more likely to achieve better performance. Since international construction is complicated, it is difficult to

describe the international status of a company in a holistic sense; hence the introduction of the niche theory. As one of the most important sub-theories in organizational ecology, the niche theory was initially populated in the natural bio-ecology field as the multidimensional spaces in which organism or species persist (Tisdell and Seidl 2004). With its empirical and quantitative characters, niche analysis may enable a more accurate understanding of success or failure of an organization by considering its interactions with the environment.

The aim of the research was therefore to demystify the disciplines necessary for contractors to survive in the international construction market by using niche theory as a new perspective. The remainder of this paper is structured into three sections. Firstly, a NW/O-L (niche width, niche overlap and location) framework is proposed to transfer the conceptual niche to specific constructs. In this section niche theory is reviewed in conjunction with other theories to identify their similarities and distinctions. Secondly, the specific parameters included in the NW/O-L framework - niche width (***NW***), niche overlap (***NO***), and location (***L***) - are elaborated upon. Thirdly, the ***NW, NO,*** and ***L*** of the top international contractors are calculated. Using cluster analysis, they are divided into groups according to their niche. The context and performance of the difference groups is then illustrated and compared. The final part of the paper provides conclusions and suggestions for further research.

Niche theory and the NW/O-L framework

Niche theory

The term niche was initially defined in the bio-ecology field and first introduced into economics as a concept by Hannan and Freeman (1977). Niche in economics is taken as an N-dimensional environment, with each dimension characterised by different environmental conditions. Tisdell and Seidl (2004) specified that a niche for a firm is associated with the its ability to stave off competition from other firms and, consequently, gain a degree of security or comfort. Dimmick et al. (2004) suggested that niche theory explains how a company competes and coexists in a limited resource environment. A proper niche in the environment may enable a company to gain a stronger competitive advantage and avoid threats from both rivals and the environment. In order to help understand the niche of an organization the niche concept is translated into the following specific and meaningful constructs: niche width, niche overlap, and location.

NW/O-L framework

Organizational niche width (***NW***) has been defined as the variance in resource utilization in the N-dimensional environment (Hannan and Freeman 1989). In line with this concept, organizations pursuing strategies based on a wide range of environmental resources possess a wide niche width, and would be classified as generalists, whereas organizations following strategies based on a tight band of resources hold a narrow niche width, and are considered to be specialists. ***NW*** and its implications to organizational performance is a traditional issue in organizational

studies (Boone, Carroll and Van Witteloostuijn 2002, Dobrev, Kim and Carroll 2002, Sorenson *et al.* 2006, Ramirez Jr *et al.* 2008). It is generally considered that a specialist will always outperform a generalist in any stable environment because the generalist must carry 'extra capacity' that sustains its ability to perform in different environments (Hannan and Freeman 1989). In contrast, in a variable environment, specialists have trouble surviving long unfavorable periods whereas generalists do not (Baum and Shipilov 2006). Hannan and Freeman (1977) argued that the specialist maximizes its exploitation of the environment and accepts the risk of facing an environmental change, while the generalists accept a lower level of exploitation in return for greater security.

Niche overlap (***NO***) is defined as the fraction of the focal organization's niche covered by the other organizations' niches(Hannan, Carroll and Polos 2003). In general, organizations in two different niches have the potential for competition that is directly proportional to the extent that their organizational niches overlap (Baum and Singh 1994). High overlap indicates that companies are substitutes or they serve the same needs and the differentiation is small, whereas low overlap indicates that different needs are served and the differentiation is great (Ramirez Jr *et al.* 2008). ***NO*** is thus often served as an indicator to reflect the competition among organizations. Small ***NO*** implies fewer threats from the competition among organizations and is seen as a positive indicator for organizational performance. The reverse is true of a large ***NO***.

Carroll and Dobrev (2002) considered that organizational viability depends on not only ***NW*** and ***NO*** but also location (***L***) within an environmental space. This location is not the geographic location in the new economic geography (Fujita, Krugman and Venables 2001), but the niche location in the multidimensional resource space. It assumes that resources are unevenly distributed in a multidimensional environment. The joint distribution of each dimension displays a unimodal peak representing what is called 'the market centre', where resources are more bountiful or lucrative than in other areas. The relatively infertile areas distributed around the market centre are designated as the peripheral area. The ***L,*** relative to the market centre, is critical to an organization (Dobrev, Kim and Carroll 2002). Companies located near to the centre usually gain more market resources and opportunities. However, fierce competition in the market centre results in a high exit rate from this area. With an evolution process, only a few large companies reside in the centre of the market, while most companies are distributed around the periphery. Carroll (1985) has demonstrated that generalists are more likely to locate in the centre of the market, since a position in this resource-rich area provides them with the potential to reap scale advantages, to grow and expand further. In contrast, specialists seem to face a greater threat and risks from the competition than their generalist competitors as their assets may be fully exposed to the intense competition in this location.

By integrating niche width (***NW***), niche overlap (***NO***), and location of an organization (***L***), an **NW/O-L** analytical framework is established in this study. As shown in Figure

1, with ***NW*** and ***L***, it is easier for contractors to understand their niche in a multidimensional international construction environment, such as their market resource utilizations and distance from the market centre. Furthermore, contractors can see whether they are in an appropriate niche. As generalists are supposed to be at the centre of the market and the peripheral areas are more appropriate for specialists (Dobrev, Kim and Carroll 2002), Area Ⅰ and Area Ⅳ seem to be more suitable niches for contractors. ***NO*** is another indicator allowing contractors recognize their rivals and the possibilities of sustaining their current niche. According to the definition of ***NO***, contractors with a large ***NO*** indicate high competition threats, while contractors with a small ***NO*** face less competition and gain a degree of 'comfort' that they are in the proper niche. As a whole, this **NW/O-L** framework can help contractors distinguish their niche and improve the likelihood of them sustaining it (See Figure 1).

Insert Figure 1 here: The NW/O-L framework

Similarities and differences with other theories in international construction

Strictly speaking, the niche concept is not entirely new to international construction researchers. Porter's (1980) generic strategies theory, which emphasized cost leadership, differentiation and focus, is a widely adopted theory in international construction studies. In particular, differentiation is concerned with creating something that is perceived by consumers and the market as special, which is similar

to the concept of the ***NO*** in niche theory. The focus in Porter's theory implies that a company would compete in limited market segments, which is related to the idea of ***NW***. However, the essence of niche theory is different from Porter's theory. Niche theory, belongs to organizational ecology theory and is in favor of environmentally-driven structures for the survival of organizations. It emphasizes the natural selection process, arguing that a proper niche or environment is the primary mechanism for explaining the performance of an organization (Hannan and Freeman 1989). In contrast, Porter's generic strategies focus on strategic analysis, strategic plan and strategic choice and their effects on the performance of organizations (Korkmaz and Messner 2008). Whittington (2001) concluded the main difference between these two theories is the process hey use: Porter's generic strategies follows the strategic choice discipline, highlighting deliberate processes, and demonstrating how the performance of the companies s determined by endogenous factors, such as the organizational structure, product categories, managers' decisions etc. While the niche theory is concerned more with the emergent process of natural selection, recognizing the exogenous factors (environment and the fit with the environment) as the main impact when analyzing a company's performance.

Dunning's eclectic paradigm is one of the most important classic theories in internationalization frameworks. It can be represented by an OLI model, suggesting that the determinants of internationalization rely on the ownership (O), internalization (I) and locational (L) advantages that may be exploited by firms (Dunning 2000). It

serves as a platform for explaining international activities, including international construction activities. Based on Dunning's eclectic paradigm, Low and Jiang (2004) developed a OLI+S model and applied it to the international construction industry. The specialized field in which a firm is involved (S), and the particular country in which they are located (L) are highly relevant to the concept of ***NW***. However, Dunning's eclectic paradigm emphasizes comparative advantages. It concentrates more on the added value that a particular field or country may offer to multinational corporations, instead of the various resources utilized by them. It explains the extent and pattern of the foreign value-added activities of firms in a globalized sense, but not the position of organizations in a multidimensional resource space.

SWOT analysis investigates both an organization's internal and external conditions (Weihrich 1982). Enterprises' strengths and weaknesses are usually considered as business internal factors, which are formed in a long development process, while opportunities and threats are external factors over which enterprises have no direct control. The philosophy behind a SWOT analysis is that an organization should establish a fit between its internal strengths and weaknesses and the opportunities and threats posed by its external environment (Lu 2010). This is similar to niche theory implications. However, with an emphasis more on resource based principles (internal and external resources), the outcome of a SWOT analysis can be complex as it involves such things as competition abilities and sustainable abilities. Furthermore, as it is mainly based on questionnaires and interviews, SWOT analyses are usually

subjective evaluations.

According the four generic approaches to strategies suggested by Whittington (2001) the differences between niche theory and traditional frameworks are summarized in Figure 2.

Insert Figure 2 here: Distinguishing between the niche theory and others

The niche theory has many similarities with other traditional theories. However, since the it highlights the “natural selection” process, the niche and the distribution of contractors in the international construction environment are the main research target of this study, thus distinguishing it from other studies. Using a further analysis of the relationship between a company’s niche and its performance, the proper niche or the international contractor is sought in this study.

Data and Methods

Data

Ye et al. (2009) claimed it was difficult to collect data on business competition and to identify those contractors who have international businesses, while Ruddock (2002) found that data on construction activities are usually poor and erratic, both in a domestic and international context. In such circumstances, ENR is valuable since it provides a comprehensive historical database of international construction activities and the major actors involved (Drewer 2001). The ENR annual survey started in 1979

following the expansion of international demand for construction. It collects data from the top 225 international contractors (TIC 225), including each firm's revenue and details of their sub-markets, thereby offering a relatively objective and comprehensive longitudinal database for studies on international construction. Although some researchers might question the validity of the ENR data since it is self-reported, it can be supplemented by data derived from other public sources such as company annual reports. As most international contractors are listed companies, they are required by law to reveal data to their shareholders and maintain its integrity. Based on the ENR database and by comparing datasets from other sources to achieve concurrent validity, this paper identifies the niche of international contractors and the influence of this niche on their performance. To produce a time axis, six years of data, reflecting the performance of organizations from 2004 to 2009, were gathered for this study.

Zoning the international construction markets and organizations

Markets

The international construction market represents the competitive environment in which international contractors operate. When applying niche theory, the environment should be defined from the outset by using an N-dimensional approach (Hutchinson 1978, Hannan and Freeman 1989). In this study, the two dimensions of product and geography are selected to conduct a two-dimensional approach for describing the international environment. According to ENR, international construction can be

divided into nine sub-markets in terms of its product dispersion: general building, manufacturing, power, water supply, sewer waste, industrial process/petroleum, transportation, hazardous waste, and telecommunication. From another perspective of geographic dispersion, international construction can also be divided into six regional market segments: North America, Europe, Latin America, Asia, the Middle East, and Africa.

Product dimension

According to ENR statistics, general building, industrial process/petroleum and transportation are the three most important sub-markets with tremendous resources for international contractors (Reina and Tulacz 2005, Reina, Tulacz and Schexnayder 2006, Reina and Tulacz 2007, 2008, 2009, 2010)

General building is a traditional market in international construction. Its revenue reached US$86 billion in 2009, ranking third amongst all the nine sub-production markets in international construction. Chiang et al. (2001) considered that the traditional building sector to be labor intensive and not requiring proprietary or advanced technology. The low entry barrier means that competition in this sector is more intensive than in other segments.

Owing to a rapid increase in oil prices and subsequent oil and gas projects, **industrial process/petroleum** began to soar in 2002. Newly emerged oil-rich countries in North

Africa also began to promote themselves in the international market. Although there is great potential for further development, entry barriers for this market are relatively high, due to the technical complexity and capital requirements associated with projects of this type (Chiang, Tang and Leung 2001).

The **Transportation** market has expanded fast. According to ENR statistics, its revenue soared from US$22.04 billion in 1992 to US$112.3 billion in 2009, making it the largest sub-market in 2009. This growth is ascribed to the bustling economies in developing countries and investment from both the public and private sectors. The former creates a huge demand for transportation projects and the latter fosters this potential demand into reality. Stimulus packages in many countries after the sub-prime crisis in 2008 further reinforced the transportation market.

Geography Dimension

The main regional markets for international construction activities are Europe, Asia and the Middle East. The African market has also witnessed a dramatic expansion since 2007 (Reina and Tulacz 2005, Reina, Tulacz and Schexnayder 2006, Reina and Tulacz 2007, 2008, 2009, 2010).

The Middle East market fluctuates in terms of its oil production and related construction projects. As a result of a rise in oil prices and following huge expansion

plans in the oil, gas and petrochemical sector, there is huge potential in this market for transportation, infrastructure, petrochemicals and water related projects (Reina and Tulacz 2005)

Asia contains over 50% of the world's population. With many developing countries with relatively high population densities, Asia has long been recognized as a market with the greatest potential for international construction activities (Raftery *et al.* 1998). The Asian market continues to play an important role in international construction, though the financial crisis in 1997 depressed this market for a number of years. Following an international construction boom worldwide, Asia rebounded in 2003. Revenue in this region reached US$73.2 billion in 2009 (Reina and Tulacz 2010), making it the second largest market in international construction.

Europe is the world's biggest regional market, which can be generally divided into Western Europe and Eastern Europe (Flanagan *et al.* 2007). Western Europe is a vast and stable market with modest cross border activity, while emerging countries in Eastern Europe offer more opportunities. Eastern Europe has been fueled by building and urban infrastructure needs and foreign investment.

Africa shows huge potential construction demand yet economic difficulties prevent this demand from being translated into projects. African international revenue began to rise in 2001, driven by North Africa (Egypt, Algeria, Nigeria, and Libya). An influx

of oil revenue into Africa has driven this market, making it the fastest growing region in the world.

Organizations

Ngowi et al. (2005) explained that international construction has a pattern whereby companies from advanced industrialized countries (AIC) carry out work in newly industrialized countries (NIC) or developing countries (LDC). This was supported by ENR in the 1980s, as contractors from advanced industrialized countries (European, American and Japanese) dominated the international construction market. With better technology, management capacity, and financial skills, these contractors are well placed to compete in the global market place. However, more and more developing countries, generally belonging to the NIC group, have joined this market. Compared to the contractors from AIC, the advantages of these new competitors include lower workforce cost, construction materials and equipment price, advancement in certain technologies, and good relationships with developing countries (Zhao and Shen 2008, Lu *et al.* 2009, Zhao, Shen and Zuo 2009). However, usually with lower and aggressive bidding prices, they make the competition in the international construction market fiercer than ever. International contractors therefore need a proper niche in order for their business to be sustainable.

Modeling the NW/O-L Framework

Based on the organizational niche definition, the elements in the *NW/O-L* analytic

framework are further elaborated in the next section, including the environment resource utilization (NW), the relationship with other competitors (NO), and the relative location in the environment (L).

*Niche Width (**NW**)*

Niche width is an important indicator that reflects an organization's resource utilization. Both dimensions of product and geography are considered in the **NW** calculation for this study. For the product **NW** of organization i ***(NW$_{ip}$)***, the following definition of niche width proposed by Hannan and Freeman (1989) is adopted in this study:

$$NW_{ip} = -\sum_{r=1}^{R} u_r \log u_r \qquad (\text{I})$$

Where u_r stands for the international revenue of product r within the total international revenues of organization i. R is total number of products, including general building, manufacturing, power, water, sewer waste, industrial process/petroleum, transportation, hazardous waste, and telecommunication. When the contractor is only concerned with one product, the niche width is at its minimum value of 0. When the contractor's revenue is equally distributed across all the product categories, its niche width will achieve the maximum value of logR.

Owing to a data limitation of ENR where revenue data on geography dimension

cannot be collected, the formula (I) for $\boldsymbol{NW_{ip}}$ cannot be simply applied to geography $\boldsymbol{NW}$ of organization i ($\boldsymbol{NW_{ig}}$). However, the $\boldsymbol{NW}_{\mathrm{g}}$ is identified as an important indicator to reflect the contractors' resource utilization in a geographical dimension. In order to overcome the data limitation, some researchers use the span covered by the niche to reflect the resource utilization of the company. For example, Baum and Singh (1994) defined the niches of day care centres as the span of ages that they are authorized to enroll. Dobrev et al. (2001) characterized the technology niche of an automobile manufacturer as the difference in sizes between the largest and smallest engines that they produce. This study defined the NW_{ig} as geographical span of organization i that they have engaged in:

$$NW_{ig} = n / N \qquad (\text{II})$$

Where n is the number of countries in which organization *i* has a presence, *N* is the total number of countries with international construction activities.

Niche Overlap (NO)

Baum and Singh (1994) considered that **NO** among two organizations are, in general, asymmetric, i.e., $\mathrm{NO}_{\mathrm{ij}} \neq \mathrm{NO}_{\mathrm{ji}}$. A large company will exert greater pressure on a small company. Based on this hypothesis, $\boldsymbol{NO_{ij}}$ is defined as the organization i's **NO** with organization j, indicating the amount of competition threat that the organization i has received from organization *j* (Sohn 2001). It is calculated as:

$$NO_{ij} = \frac{\sum_{r=1}^{R} w_{ir} w_{jr}}{\sum_{r=1}^{R} w_{ir}^2} \qquad (\text{III})$$

Where w_{ir} indicates the intensity of resource r used by organization i. For the product dimension, w_{ir} stands for the ratio of organization i's international revenue for product r within the total international revenue of TIC 225 for product r. Where the geography dimension is concerned, resource r denotes total project numbers[1] of TIC 225 in region r. R (r=1,…, 6) that comprise North America, Europe, Latin America, Asia, the Middle East, and Africa. In order to estimate the ***NO*** of an organization comprehensively, the niche overlap of organization i (***NO$_i$***) is defined as:

$$NO_i = \sum_{j=1}^{N} NO_{ij} \qquad (\text{IV})$$

Where N=224, and ***NO$_i$*** represents the whole competitive threat that organization i has received from other companies.

Location (L)

Since the market environment is assumed to be unevenly distributed, location to the market centre (the environment with more resources) becomes important to the company. ***L*** in this study is defined as the distance away from the centre of the market. The market centre must be described first. As the centre of the market is difficult to describe quantitatively, this study followed Dobrev et al.'s (2001) definition that

[1] As the exact project numbers cannot be obtained, one company in one country are supposed as one project in this study.

assumes the largest organizations form the market centre. Thus, it can be defined as:

$$Centre_r = E4_r^{\min} + (E4_r^{\max} - E4_r^{\min})/2 \qquad (\text{V})$$

Where $Centre_r$ represents centre for product/geography r. For product analysis, $E4_r^{\min}$ is the minimum revenue of product r among the top four international construction firms, while $E4_r^{\max}$ is the maximum revenue of product r among the top four firms. For geographical analysis, $E4_r^{\min}$ is the minimum project numbers in region r among the top four, and $E4_r^{\max}$ is the maximum project number in region r among the top four. As Figure 3 and Figure 4 show that, although it fluctuates, these centres coincide with the main markets analysed above, demonstrating an asymmetric distribution of the environment resources. General building, industrial process/petroleum and transportation in the product dimension, and Europe, Asia and Africa in the geography dimension are the centre of the international construction market.

Insert Figure 3 here: Centre of product dimension (2004-2009)

Insert Figure 4 here: Centre of geography dimension (2004-2009)

$\boldsymbol{L}$ of organization i ($\boldsymbol{L_i}$) is then calculated with Euclidean distance.

$$L_i = \sqrt{\sum_{r=1}^{R} (U_r - Centre_r)} \qquad (\text{VI})$$

For company i's L_{ip} in product dimension, U_r is international revenue of product r (r=1,…, 9), while for L_{ig} in geographical dimension, U_r is numbers of projects in the region r (r=1,…,6).

Application and results

NW/O-L and top contractors

Using the equations (I) to (VI), average niche width, niche overlap, and location of all TIC 225 have been calculated based on ENR data from 2004 to 2009. The evolution of the competitive position for the international contractors was reflected in Figures 5, 6 and 7.

Insert Figure 5 here: Average niche width of product and geography (2004-2009)

It can be seen from Figure 5 that the average $\boldsymbol{NW_p}$ for TIC 225 firstly decreases in 2005 and 2006 and then shows an increasing trend. At the same time, $\boldsymbol{NW_g}$ shows a stable increasing trend since 2004. The average $\boldsymbol{NW_g}$ only decreased somewhat in 2009 because of the unstable global economic environment. This indicates that international contractors are generally expanding their resource occupations in both the product and geography dimensions.

Insert Figure 6 here: Average niche overlap of product and geography (2004-2009)

The $\boldsymbol{NO_p}$ of TIC 225 mainly shows a decreasing trend, as shown in Figure 6. Since $\boldsymbol{NO}$ reflects the competition among organizations, it can be concluded that the

competition among TIC 225 is not as notoriously fierce as it used to be. To some extent, this research finding resonates with Ye et al. (2009), who refuted the popular view that international construction competition has been intensifying. However, in contrast to the trend of NO_p, NO_g shows an increasing trend since 2005. Following the expansion of transnational construction activities worldwide, international contractors now encounter more competition threats in the geography dimension than ever before.

Insert Figure 7 here: Average lLocation of product and geography (2004-2009)

As shown in Figure 7, the average distance to the market centre presents an increasing trend for the TIC225 in both the product and geography dimensions. Because of either fierce competition or high entry barriers in the market centre, most international contractors seem to extend their activities far from the market centre, which expands market boundaries and, at the same time, diminishes the competition.

NW/O-L and performance

In order to test the availability of the NW/O-L framework and achieve a better understanding of the contractor's niche, an analysis of NW/O-L and its relationship with performance has been conducted in this study. .

Good performance of an organization is usually associated with more profits,

additional growth, and improved market position. However, most of these indicators often lack integrity and the standardization across different countries needed for evaluating a contractor's actual performance. Since this study focused on the performance of international contractors, a project-oriented international revenue approach was chosen to measure performance. To diminish the influence of inflation, fluctuation and exchange rates on revenue of international contractors, the ranking of TIC 225 was introduced as a proxy. Though this indicator may not comprehensively reflect the performance of international contractors, it is an available and trusted indicator since ENR is one of the most important historical databases in international construction studies. For example, based on ENR's ranking data, Han et al. (2010) investigated strategies for contractors to sustain growth in the global construction market, and Low and Jiang (2004) compared the international construction performance at country level.

International contractors may choose different competitive strategies. Figure 1 showed that there are specialists or generalists locate in the peripheral area or market centre. The question remains as to whether the contractors with different niches will show different levels of performance. In order to prove the contractors' niche is related to their performance, a cluster analysis was used in this study. According to the niche of different companies, international contractors have been divided into groups. The performance differences are expected to be detected among these groups.

The basic principle of the cluster analysis is to classify a set of values or variables into an appropriate number of groups or clusters (Harrign 1985). Since the appropriate number of clusters was initially unknown, a hierarchical cluster process was chosen for this study utilizing the Ward method (Ward 1963) to estimate the numbers of clusters and their centroids for group classifications. Based on the equations (I) to (VI), NW/O-L of the TIC225 in 2009 was introduced into this model. The dendrograms for both product and geography dimensions have been calculated separately. With a further analysis of the two dendrograms, the TIC 225 have been classified into 3 groups based on their niche within the product dimension while in the geography dimension, there are two clusters. Table 1 and Table 2 show the cluster analysis results. It can be concluded that different niche groups generally show distinguished performances (ranking), indicating that contractors' niche are highly related to their performance in the international construction market.

Insert Table 1 here: Cluster results in the product dimension

Insert Table 2 here: Cluster results in the geography dimension

In the product dimension, all 17 of the contractors concentrated in Cluster 1 belonged to the top 50 contractors in 2009. According to Table 1, these contractors controlled nearly half of the international revenue of the TIC225 in 2009, indicating their superior power and performance in the international construction market. Referring to their niche, it can be seen from Table 1 that they generally have a wide niche width

(generalists), distribute near to the market centre and have a small niche overlap, which mainly fall into area Ⅳ as Figure 1 shows. According to Table 3, more than 40% of their revenue comes from transportation, which was the largest market centre in 2009 (See Figure 3). This indicates that contractors from cluster 1 tend to be located in the prolific resource space. Most contractors in cluster 1 belong to AIC countries, such as the USA, Germany, France and Spain, which supports the argument by Ngowi et al. (2005) that, with experience of the international market, contractors from AIC countries are more likely to occupy more market resources than competitors from other countries.

Most of the TIC 225 belongs to Cluster 2, contributing 53.5% internatioanl revenue to international construction in 2009. This differs from Cluster 1 contractors, as they present a narrow niche width, are located in the pheripheral area of the international construction maket and show a relatively large niche overlap. It can be concluded that most Cluster 2 contractors have the characteristics of area Ⅰ of in Figure 1. According to Table 3, the greatest proportion of revenue of these contractors comes from industrial process/petroleum, which was the second richest resource space in 2009 as Figure 3 shows. Cluster 2 is mostly composed of contractors from China and Turkey. As new players in the international construction market, most of the contractors from NIC countries are still specialists resident in the peripheral area. The high entry barriers in the market centre still prevent most NIC contractors from entering.

There are 18 contractors in Cluster 3, all ranked between 151and 225 in the TIC 225. They contributed less than 1% to international construction revenue in 2009, suggesting a relatively poor performance in the internatinal construction market. Compared with the other two clusters, contractors in Cluster 3 show a mean niche width of 0.33, which is between that of Cluster 1 and Cluster 2. However, its average niche overlap and distance from the market centre are much larger than the other two groups, implying that they encounter greater competition threats than contractors in the other two groups. Most contractors in Cluster 3 belong to the area Ⅱ in figure 1. Table 3 indicates that general building accounts for a significant portion of revenue for these contractors. Since the competition is more fierce in the traditional general building market (Chiang, Tang and Leung 2001), it is understandable that the niche overlap of Cluster 3 is large.

Insert Table 3 here: Revenue share of different clusters (product dimension)

In order to provide an intuitive understanding of international contractors' niches, the distribution of the TIC 225 for different clusters has been drawn. The horizontal axis represents the niche width of contractors, while the vertical axis shows the location in relation to the market centre. The proportion of the bubbles demonstrates the niche overlap.

Insert Figure 8 here: *NW/O-L* of TIC 225 in 2009 (product dimension)

As Figure 8 shows, the contractors in Cluster 1 stay within a particular niche compared with the other two clusters. As mentioned above, contractors in Cluster 1 mainly fall in Area Ⅳ of Figure 1. It seems that contractors within this area have relatively little competition and good performance, highlighting the proper niche for contractors. Contractors in Cluster 2 are very different compared to those in Cluster 1. Although they do not exactly fit into Area I of Figure 1 as assumed above, the general distribution of most contractors shows that they cannot enter into the market centre via the product dimension. Most contractors live in peripheral areas with a narrow niche width. As most bubbles in Cluster 2 are larger than those in Cluster 1, it indicates that they encounter more competition threatens than their competitors in the market centre. Contractors in Cluster 3 are mainly generalists living in peripheral areas. The barren resources in the market periphery cannot offer generous returns. However, generalists in this area have to face more competition than their specialists competitors, indicating the improper niche for the international construction contractors.

Contractors are divided into two clusters in the geography dimension. As presented in Table 2, 40 out of the 78 contractors in Cluster a belonged to the top 50 contractors in 2009. Contractors from Cluster a occupied nearly 80 percent of international construction revenue, illustrating their superior performance over companies in Cluster b. Similar to contractors in Cluster 1 of the product dimension, contractors in

Cluster a of the geography dimension also drop into area Ⅳ of Figure 1, suggesting this area to be the most appropriate niche for the international contractors in both the product and geography dimensions. As shown in Table 4, the European revenue share of contractors in Cluster a accounts for a large portion of their total revenue, and the proportion is much higher than their counterparts in Cluster b. As Europe was the richest market centre in 2009 (Figure 4), their dominant position in this market meant that they had a superior performance in the international construction market. Most contractors in Cluster a are come from AIC countries, such as the USA, Japan and European countries. The relatively similar culture environment and geography proximity to the European market have offered contractors in Cluster a more advantages than their competitors, which further raises the entry barriers to this market. Meanwhile, there are 16 Chinese contractors in this group, suggesting that some contractors from NIC countries have benefited from the worldwide expansion process.

Contrary to Cluster a, contractors from Cluster b mainly have a narrow niche width, a large niche overlap, and locate themselves far away from the market centre, which coincides with area Ⅰ of figure 1. The majority of the members in Cluster b come from China and Turkey, implying that most contractors in NIC countries with a narrow niche width in the geography dimension still focus on regional work rather than exploring the worldwide market. The Middle East, Asia and Africa are the main targets for Cluster b (See Table 4).

Insert Table 4 here: Revenue share of different clusters (geography dimension)

Insert Figure 9 here: *NW/O-L* of TIC 225 in 2009 (geography dimension)

It can be concluded from Figure 9 that contractors in Cluster a generally show a small niche overlap, indicating their sustained ability in this competitive environment. By contrast, most contractors in Cluster b suffer from high competition in the peripheral area. Compared with the distribution of TIC 225 in the product dimension, the contractors' niche in the geography dimension is more regular. There is a significant relationship between $\boldsymbol{NW}_{\mathrm{g}}$ and $\boldsymbol{L_g}$. Most of the contractors near the market centre are generalists, while specialists are mainly scattered in the peripheral area. Most contractors carefully choose their niche, and keep within the appropriate niche bounds as shown in Figure 1.

It can be concluded from the cluster analysis that a contractor's niche is highly related to its performance. Contractors with different niche types are usually associated with different performances. Generalists in the market center do better than the specialists in the peripheral area, suggesting that the niche within the area Ⅳ of Figure 1 (wide niche width and located centrally) is the ideal choice for the international contractors. However, not all the contractors can enter the market centre. The best choice for the contractors which can only survive in the peripheral area is to be a specialist, making the niche within the area Ⅰ of Figure 1 the second proper niche for international

contractors. Compared with areas Ⅳ and Ⅰ, areas Ⅱ and Ⅲ of Figure 1 are obviously improper niche for international contractors. From the analysis above, it can be seen that most contractors in area Ⅱ do not perform well, while hardly any contractors adopt the niche in area Ⅲ.

Conclusions

There have been many studies devoted to devising competitive strategies for improving the performance of international contractors. However, few of them have examined the dyads from an organizational ecology perspective. Based on niche theory, a NW/O-L analysis framework was established in this study. With this framework, the niches of the main contractors of TIC 225 over the past six consecutive years were investigated. It is found out that niche width in both product and geography dimensions generally show an increasing trend, indicating most contractors are expanding their resource occupations in the international construction market. It also transpires that competition in the international construction market is not as intense as some assume it to be since the niche overlap in the product dimension shows that there has been a declining trend since 2004. However, following the expansion of transnational construction activities worldwide, the niche overlap in the geography dimension increased. Furthermore, the distribution of contractors in the international construction environment has shown a scattered trend, as most contractors move far away from the market centre in both the product and geography dimensions.

A contractor’s niche is also related to its performance. By using a cluster analysis, contractors have been divided into groups according to their niche. Contractors with superior performance are usually associated with a wide niche width, small niche overlap and a location near to the market centre. These contractors mostly come from AIC countries with advanced technology and rich experience. The appropriate niche for the contractors that cannot enter into the market center is a narrow niche width, a comparatively large niche overlap and a locality far away from the market centre. Contractors from the NIC countries usually choose this niche. These are the proper niche for the international construction companies.

Compared with traditional analytical methods, niche theory succinctly situates international construction companies into their macro resource environment. This is done by examining their organizational abilities to occupy various resources, taking account of their relationship with other organizations, and positioning them in the resource environment. Although this study focused solely on international construction, the research method adopted could be replicated for other industries, thus helping to understand the relationship between organizations and their global environment.

Cluster analysis revealed a link between organization niche and performance. However, as cluster analysis is approximate, the specific mechanism through which a

niche can be translated into organizational performance needs empirical evidence from further studies. Niche theory can be thought of as negative since it emphasizes natural selection without considering the activities of companies. Although a clear understanding of a contractor's status in the environment is important for the sustainable development of the organization, organizational performance is complicated and any isolated theory framework is incomprehensive. Cheah and Wong (2004) have suggested that the different theoretical fields should be viewed as complementary rather than mutually exclusive. Therefore, further studies should focus on a more combined view to investigate the niche and performance of international contractors.

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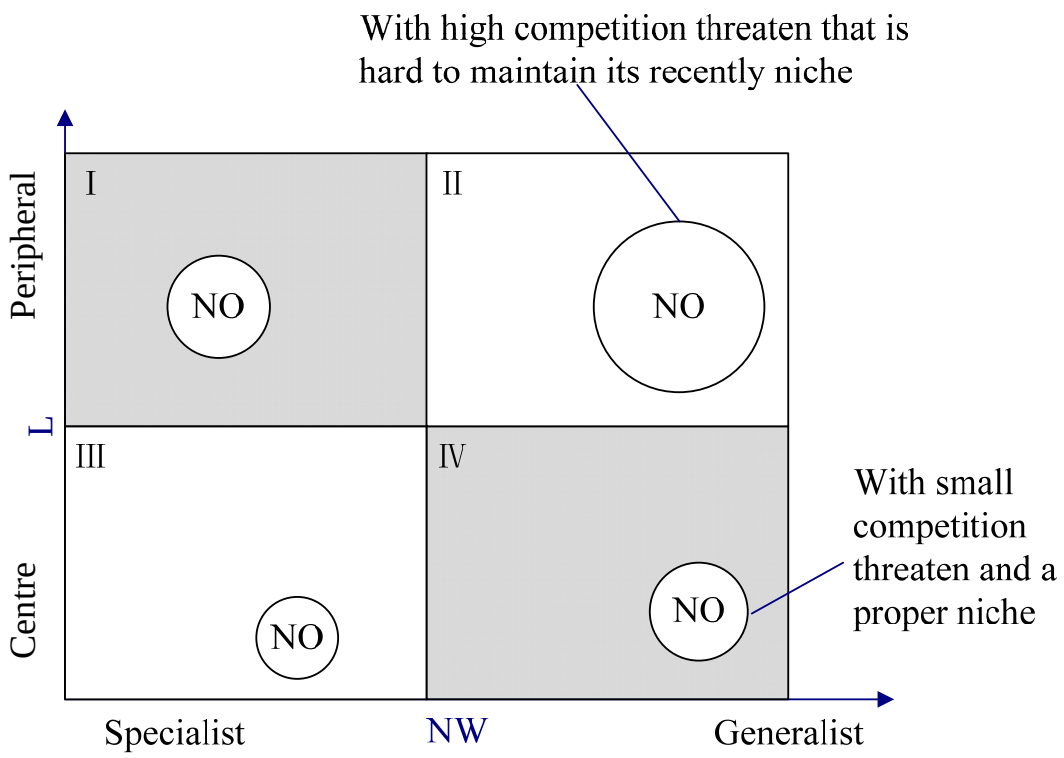

Figure 1 The NW/O-L framework

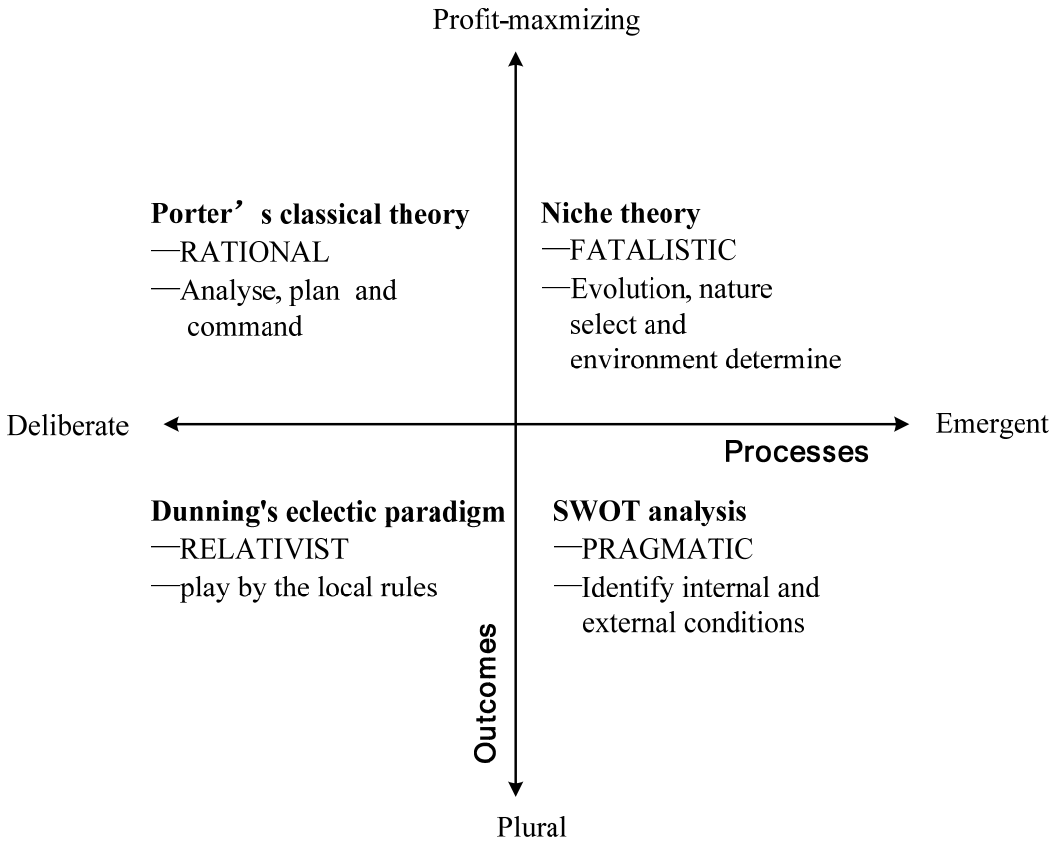

Figure 2 Differences between niche theory and traditional frameworks

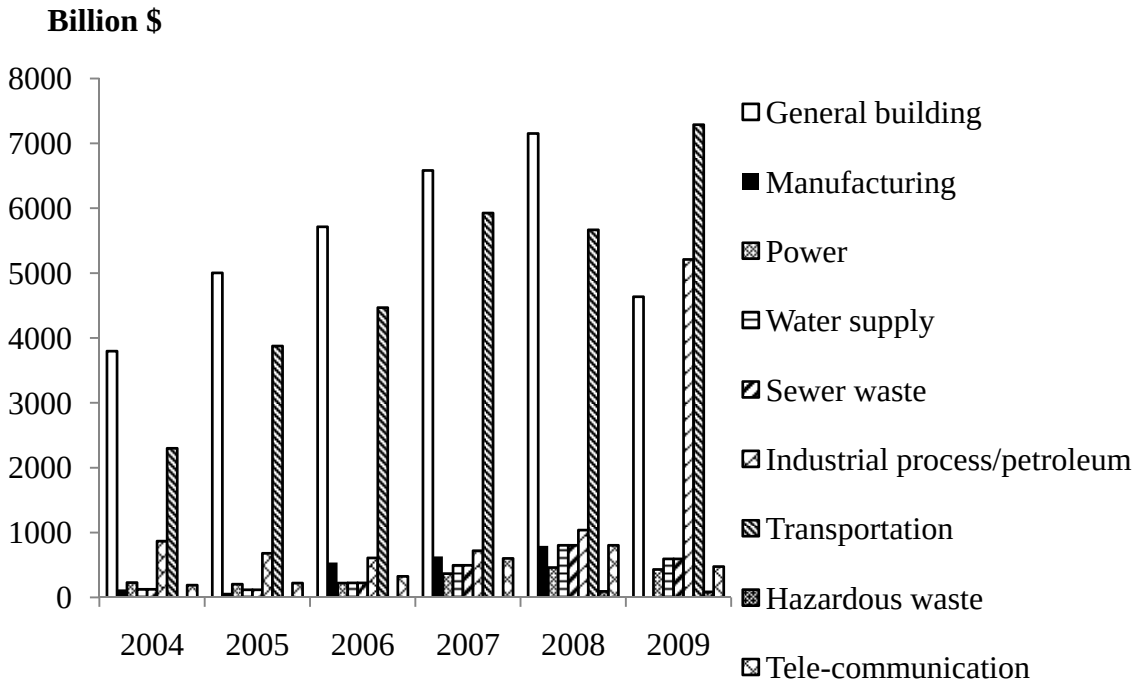

Figure 3 Centre of product dimension (2004-2009)

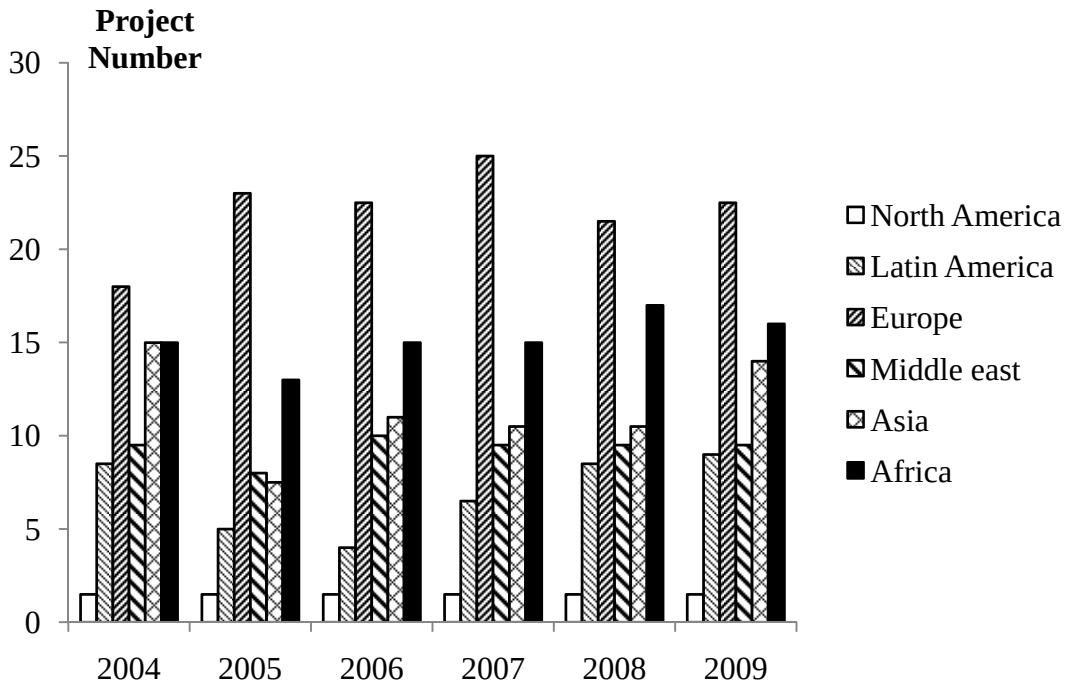

Figure 4 Centre of geography dimension (2004-2009)

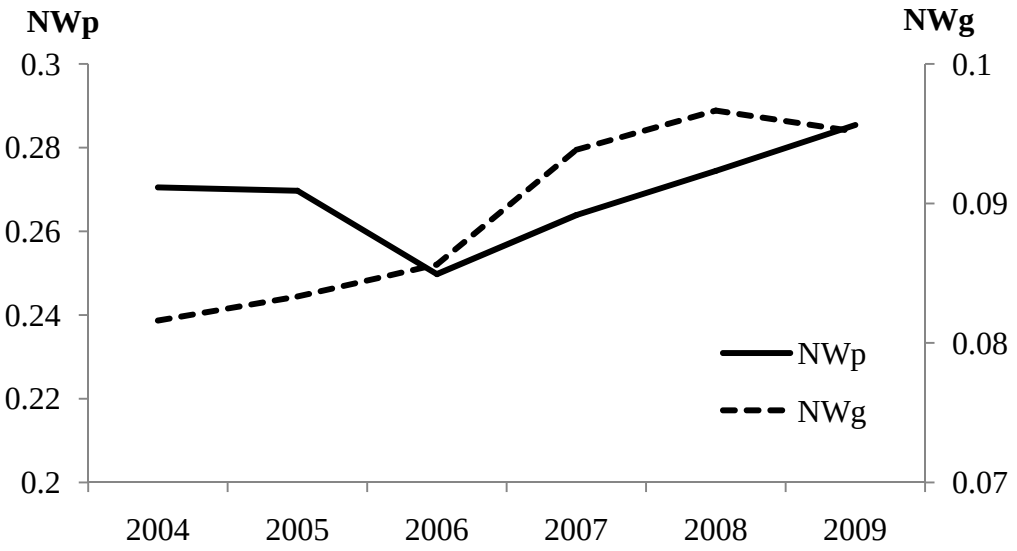

Figure 5 Average niche width of product and geography (2004-2009)

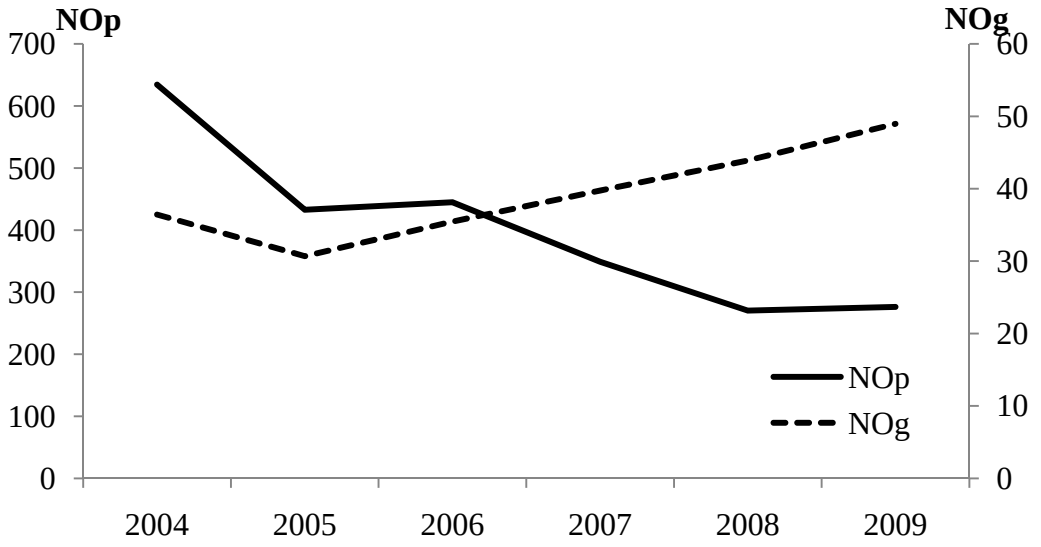

Figure 6 Average niche overlap of product and geography (2004-2009)

Figure 7 Average location of product and geography (2004-2009)

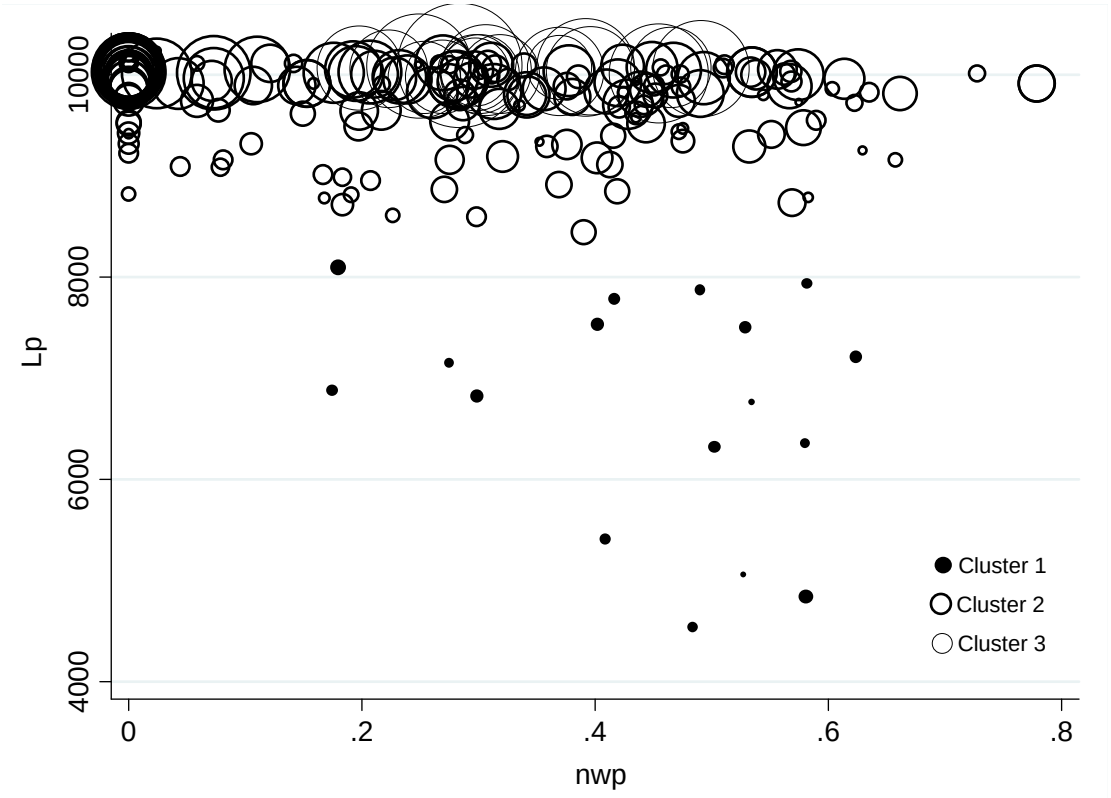

Figure 8 *NW/O-L* of TIC 225 in 2009 (product dimension)

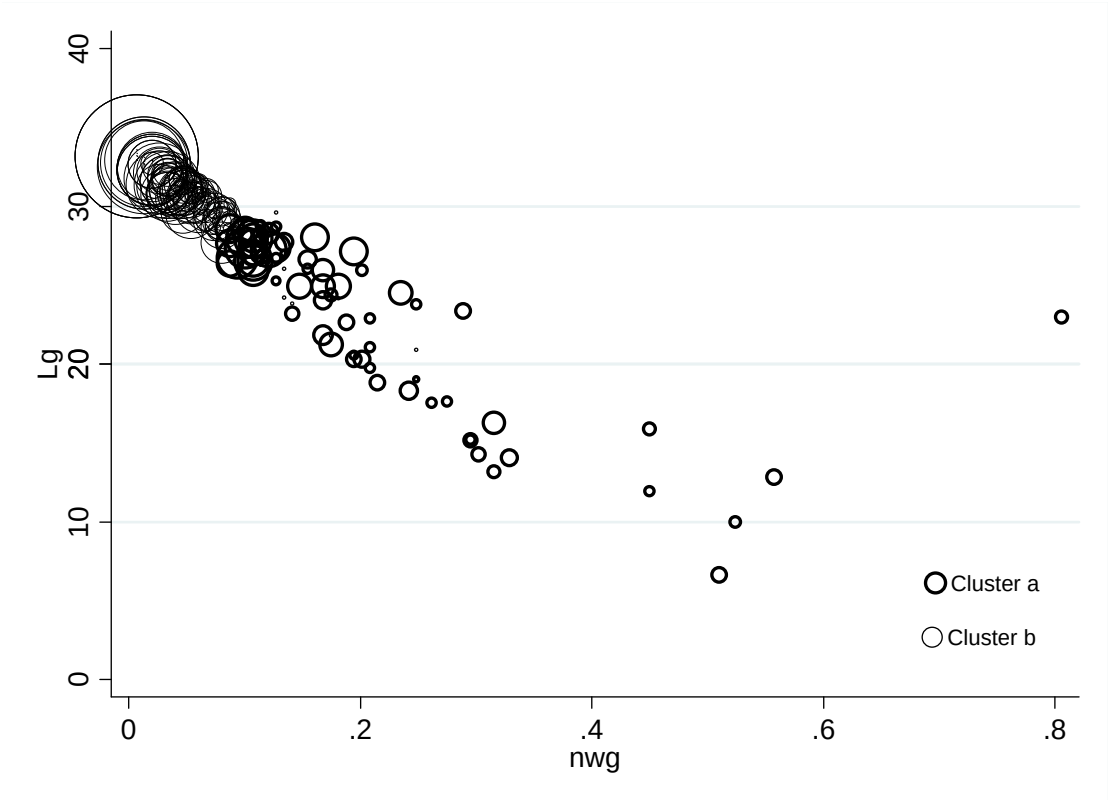

Figure 9 *NW/O-L* of TIC 225 in 2009 (geography dimension)

Table 1 Cluster results in the product dimension

	No. of contractors	Number Share (%)	Revenue Share (%)	Mean NWp	Mean NOp	Mean Lp	Top 1-50	Top 51-150	Top 151-225
Cluster1	17	7.589	45.628	0.446	20.755	6712.568	17	0	0
Cluster2	189	84.375	53.515	0.267	216.740	9757.269	33	100	56
Cluster3	18	8.036	0.857	0.330	1142.321	10041.815	0	0	18
Total	224	100	100						

Table 1 Cluster results in the product dimension (continued)

	No. of contractors	US	Japan	Korea	China	Turkey	UK	Germany	France	Italy	Spain	Others
Cluster1	17	3	0	0	1	0	1	2	2	0	2	6
Cluster 2	189	16	13	12	47	29	2	2	2	19	8	39
Cluster3	18	1	0	0	5	4	1	0	1	3	1	2
Total	224	20	13	12	53	33	4	4	5	22	11	47

Table 2 Cluster results in the geography dimension

	No. of contractors	Number Share (%)	Revenue Share (%)	Mean NWg	Mean NOg	Mean Lg	Top 1-50	Top 51-150	Top 151-225
Cluster a	78	35.455	76.318	0.197	14.744	23.330	40	33	5
Cluster b	142	64.545	23.682	0.043	55.139	31.231	9	66	67
Total	220	100	100						

Table 2 Cluster results in the geography dimension (continued)

	No. of contractors	US	Japan	Korea	China	Turkey	UK	Germany	France	Italy	Spain	Others
Cluster a	78	13	7	1	16	1	3	4	5	8	7	13
Cluster b	142	7	6	11	37	32	1	0	0	14	4	30
Total	220	20	13	12	53	33	4	4	5	22	11	43

Table 3 Revenue share of different clusters (product dimension) (%)

	General building	Manufacturing	Power	Water supply	Sewer waste	Industrial process/petroleum	Transportation	Hazardous waste	tele-communication
Cluster 1	25.88	0.27	4.59	2.84	1.85	20.33	42.74	0.10	1.39
Cluster 2	20.83	1.62	13.91	3.18	1.43	38.84	19.86	0.09	0.25
Cluster 3	34.34	0.00	8.40	0.32	0.14	28.08	28.62	0.00	0.10

Table 4 Revenue share of different clusters (geography dimension) (%)

	North America	Latin America	Europe	Middle East	Asia	Africa
Cluster a	2.75	12.20	28.68	14.39	22.74	19.24
Cluster b	2.66	8.64	14.17	25.25	25.58	23.70