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A hybrid knowledge-sharing model for corporate foreign investment in China's construction market

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ABSTRACT

The research proposes a hybrid knowledge-sharing model, which integrates the concepts of the self-organizing feature map optimization, fuzzy logic control, and hyper-rectangular composite neural networks, to provide 32 rules that suggest performing or not performing foreign construction investment. The database is derived from 520 quarterly financial reports of all listed construction companies in Taiwan that have now or in the past five years made foreign investment in China's construction industry. The input variables are set to all 25 financial ratios assessable in public, reducing to 11 ratios after feature deduction using *t*-test. The model yields a high successful classification rate of 90.6% and generates 14 and 18 rules for Taiwan construction companies performing or not performing foreign investment in China, respectively. The valuable rules give user a closer look at what is the appropriate corporate financial status, what knowledge can be shared from the interpretations of the rules, and the impact by investment on corporate finance.

1. Introduction

A booming market, such as China's construction market, inevitably attracts a tremendous amount of investment. The amount of completed residential projects in China exceeded $110 billion US dollars in 2009 (China Investment Consulting, 2010). Thousands of foreign construction and construction related companies have crowded into the market over the last decade. As a matter of course, some have succeeded but some have failed. Although there are numerous reasons for their success or failure, it is believed that the performance of the parent companies affects foreign investment capability (Agmon & Messica, 2009). Nevertheless, how to determine, based on its performance, whether a parent company is able to handle overseas investment remains an unsolved problem.

Studies typically divide features indicative of corporate performance into financial and non-financial aspects. Difficulties of quantification and measurement may be encountered with those corporate features categorized as non-financial. For example, researchers may doubt systematic relationship between the board and corporate financial performance (Ellstrand, Daily, Johnson, & Dalton, 1997). This occurs due to the selection of quantitative methods. Many researchers tend to do quantifiable research with financial data. There are many studies where the financial aspects of corporate performance are scrutinized to obtain solid findings. These findings make us aware of the influence of a firm's financial status on corporate performance (Altman, 1968; Beaver, 1966). In the construction industry, although corporate performance would mean project-level performance, recently there is increased attention being paid to corporate-level performance (Bassioni, Price, & Hassan, 2004, 2005; Chang, 2001; Dai & Wells, 2004; Navon, 2005, 2007; Russell, Jaselskis, & Lawrence, 1997). The financial factors that drive construction firm performance have been found in previous work (Phua, 2006). For example, researchers have found certain financial ratios capable of representing a construction firm's performance in the Egyptian construction industry (Goda, 1999). Yue et al. has utilized financial data mining to explore the relation between corporate governance and firm performance (Yue, Lan, & Jiang, 2008). Financial data from Chinese listed companies have been used to find that corporate performance is positively related to certain financial ratios (Hong, 2009). Knowing whether overseas investment is feasible is an aspect of corporate performance that can be ascertained from financial data. Numerous methods have been used to analyze financial data. Most of these methods can be categorized as statistical models or artificial intelligent expert system (AIES) models. The overall accuracy achieved by AIES is relatively higher than that obtained with statistical models, especially for financial distress prediction (Muller, Steyn-Bruwer, & Hamman, 2009). This suggests that developing an AIES model based on financial data to deal with corporate performance is feasible. It is known that information technology (IT) including AIES generally facilitates knowledge management and sharing (Earl, 2001; Harman & Brelade, 2000); however, it was found in a 2006 survey that knowledge sharing in the construction industry is atypical (Fong & Chu, 2006).

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To deal with these problems, this research proposes a hybrid model, which integrates the concepts of Self-organizing feature map optimization, Fuzzy logic control, and hyper-rectangular composite Neural Networks (SFNN) to provide rules that suggest performing or not performing foreign construction investment. The research only considers the corporate capability of conducting foreign construction investment in China, not including how successful the investment performs. Since the computation of financial ratios requires at least 5 consecutive years of accounting data, the research targets are those listed construction companies in Taiwan, which have conducted construction related investment in Mainland China for the last five years (2005–2009). Due to the accessibility of data, the targeted financial ratios are those revealed in the quarterly financial reports published in the Taiwan Economic Journal (TEJ). The following 25 published financial ratios are included: profit margin, return on assets, after-tax rate of return, operating profit to paid-in capital ratio, pre-tax net profit to paid-in capital ratio, earnings per share, operating margin, operating profit, growth rate, after-tax net profit growth rate, revenue growth rate, growth rate of total assets, growth in the total return on assets, equity ratio, debt to assets ratio, long-term funds to fixed assets ratio, dependence on borrowing, inventory turnover ratio, receivable turnover ratio, total assets turnover ratio, fixed assets turnover ratio, net worth turnover ratio, current ratio, acid-test ratio and times interest earned ratio.

2. Corporate investment in China's construction industry

China's construction industry underwent reform in 1980. It has become one of the fastest developing markets. It is concluded in a study investigating the increase in construction activities that the opportunities for foreign direct investment (FDI) in China's construction industry will keep growing. China has successfully absorbed extensive amounts of FDI over the past two decades (Luo, Whitehead, & Gale, 1998). A survey summarized that the total amount of FDI rose approximately 36.3 times in the period from 2002–2008, especially for China. Since the 1990s, foreign investment from Taiwan has increased tremendously, becoming the second largest source of investors in China (Luo, Gale, & He, 2001). Meanwhile, it has been pointed out that most foreign involvement in construction has been by developers, main contractors, project managers, design consultants, specialist contractors and turnkey contractors. A 1995 survey showed the five most common difficulties encountered by foreign investment: (1) shortage and low quality of local produced materials, (2) delays of delivery of production materials, (3) bureaucracy and insufficient law and regulation, (4) poor quality of local labor, (5) poor management and co-ordination. Investing in China's construction industry via joint ventures is the most highly recommended alternative (Chen, 1997).

3. IT models and knowledge sharing in construction

In recent decades, using IT models inclusive of AIES to assist in knowledge sharing has been encouraged. Koch has pointed out that the joining of IT and human resources could facilitate knowledge management of consulting engineering in corporate management, organization, human resources, design, culture and project processes (Koch, 2003). Internet applications used to share and capture knowledge for construction companies provide a sustainable competitive advantage (Binqunath & Sexton, 2007). Web-based forums integrated with the concepts of knowledge sharing pool improve both education and practical knowledge in the construction field (Obonyo & Wu, 2008). The technique of network knowledge mapping captures and represents construction project knowledge. Construction personnel benefit from an overview of available and missing knowledge maps (Lin, Wang, & Tserng, 2006). The establishment of knowledge sharing models using case-based reasoning (CBR) benefits design processes for residential projects (Liang, Jiang, Chen, Zhen, & Su, 2007), and guides the way to possible resolutions for construction disputes caused by change orders (Chen, 2008). A model combining a knowledge-based expert system with computer-aided design (CAD) feasibly leads housing management to full automation (Al-Hussein, Kumar, Sharma, & Mah, 2006). AIES models are unquestionably capable of dealing with massive amounts of information and knowledge to construct a knowledge-sharing model.

Academics and construction practitioners have been aware of the importance of knowledge management and sharing since 1995 (Nonaka & Takeuchi, 1995). Scholars have proposed the concept of knowledge sharing and reuse for engineering design integration (Chao, Smith, Hills, Florida-James, & Norman, 1998). A concept of live capture and reuse of project knowledge was discussed (Kivrak & Arslan, 2006). One study suggests that there is need in the construction industry for improvement in the sharing of valuable knowledge, dissemination of superior practices, customer response, reduction of reworking, and development of new products and services (El-Gohary & El-Diraby, 2010). Even though there have been numerous studies presenting knowledge-sharing models that can be applied in construction have been established (Carrillo & Chinowsky, 2006; Chen, 2008; Dave & Koskela, 2009; El-Gohary & El-Diraby, 2010; Styhre, 2010), Fong and Chu (2006) have noted that knowledge sharing in practice is still rare (Fong & Chu, 2006). It is not surprising that local firms have not felt the urgency to share knowledge with foreign firms or vice versa. Construction companies investing in foreign markets also require this type of knowledge sharing. This becomes an important determinant of success for entering foreign markets via FDI.

4. Data collection and analysis

Model development is preferably dependent on a well-defined database (Chen, Yang, Chen, & Chang, 2008). This research looks at financial reports published in the TEJ regarding Taiwan construction companies (Chen, 2009; Chen & Lin, 2010; Chen, Yang, Su, & Lin, 2010), and then investigates those listed construction related companies which have conducted construction related business in Mainland China from 2005 to 2009. The financial reports clearly record the amount of foreign investment in China and the values of those 25 financial ratios mentioned in the previous section. The investigation of the research discovers that a total of 26 out of 42 construction companies have invested in the construction market of China. 152 quarterly financial reports of these companies indicate investment activities in China's construction market; the other 368 reports do not record any. These 520 quarterly reports are set as the database. Numerous inapplicable data are found. Once any of missing, incomplete or doubtful data are found, the corresponding ratio(s) are removed. As a result, ten ratios are eliminated and the remaining 15 ratios used as input variables include the following: (1) debt to assets ratio; (2) long-term funds to fixed assets ratio; (3) current ratio; (4) acid-test ratio; (5) times interest earned ratio; (6) receivable turnover ratio; (7) inventory turnover ratio; (8) fixed assets turnover ratio; (9) total assets turnover ratio; (10) return on assets; (11) operating profit to paid-in capital ratio; (12) pre-tax net profit to paid-in capital ratio; (13) profit margin; (14) earnings per share; and (15) net worth turnover ratio. Ratios 3, 4, 6, and 7 are typically classified in the liquidity category. They measure the short-term ability of the corresponding corporation to pay obligations or to satisfy unanticipated requirements. Ratios 2, 8, 9, 10, 11, 12, 13 and 14 belong to the profitability category, quantifying the income or operating success of the corresponding corporation.