



國立高雄應用科技大學
企業管理系碩士班
碩士論文

台灣耐火材料業供應鏈彈性之探討

A Study of Supply Chain Flexibility for Refractory Industry in Taiwan

研究生：林麗娟

指導教授：余銘忠 博士

中華民國 100 年 6 月

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**A Thesis
Submitted to
Department of Business Administration
National Kaohsiung University of Applied Sciences
In Partial Fulfillment of Requirements
For the Degree of Master of Business Administration**

**June 2011
Kaohsiung, Taiwan, Republic of China**

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摘要

近年來彈性已被業界視為市場最主要的競爭力要素之一。學者專家也對彈性議題提出許多文獻探討。在進階供應鏈管理觀念中，業界也知道光談生產彈性是不夠的。彈性應從公司對公司的彈性，擴大至供應鏈對供應鏈的系統。

耐火材料業是一個獨特且重要的基本工業，主要服務鋼鐵、水泥、石化業等所有需要耐高溫產業。由於產能小，長久以來一直不受政府的重視。導致業者面對國內廠商打價格戰的競爭，或國際知名品牌以高技術或豐富資源的雙面夾攻。

本研究目標在找出該產業主要之供應鏈彈性的構面，含產品、數量、採購、交貨、回應與開始等共六個彈性構面，每一個彈性構面下又包含了數個相關屬性。經訪談耐火材料業供應鏈上中下游專家意見與層級程序分析法計算權重後，發現交貨、開始與回應三個彈性在供應鏈彈性中最为重要。

最後根據計算後之權重排序，提出五項建議改善方向供業界高階主管做為公司營運改善的目標，或者列為公司策略設定的考量指標之一。

關鍵詞：耐火材料業，供應鏈彈性，AHP（分析層級程序法）

A Study of Supply Chain Flexibility for Refractory Industry in Taiwan

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ABSTRACT

Flexibility has been considered a major determinant of competitiveness in the face of increasingly intense market competition. A number of literatures have considered various issues of flexibility in recent years. In line with the advent of the supply chain management concepts, enterprises have been realizing that being flexible only in regard to their production system is not enough. Thus, flexibility concepts should be broadened from the perspective of enterprise to enterprise to take into account a supply chain to supply chain system.

The refractory industry in Taiwan holds a unique and indispensable position among essential and heavy industries, like Iron and Steel, or Cement and Petro-Chemical, which require intense heat. However, the production capacity of the refractory industry is too small to attract the concern and support of the government. As a result, refractory enterprises must compete unaided with local competitors on pricing, while also facing strong competition from high technology and international resources firms.

This study first aims to define the flexibility dimension and its sub-criterion of a supply chain. Six flexibilities identified including those of the product, volume, sourcing, delivery, responsiveness, and launch. In each of these dimensions, a number of sub-criteria assessed. Interviews conducted with experts from the upstream and downstream of the supplier chain, answers to the questionnaires analyzed, and the weight

of the variables computed using AHP methodology. This study verified that delivery, launch, and responsiveness flexibility are the most significant flexibilities in the supply chain of Taiwan's refractory industry. Five suggestions were provided to top management of refractory enterprises in Taiwan to examine the theoretical and managerial implications of these flexibilities.

Keywords: Refractory industry, Supply chain flexibility, AHP



Chapter 1 Introduction

1.1 Background

Taiwan is a tiny island holding a key transportation position in the Pan Pacific zone, but China has politically isolated it from the rest of the world over the decades. Taiwan has no natural resources, and has to import all its raw materials from overseas. Therefore, reliable and stable on-time resource deliveries are crucial concerns, though not easy to control in practical terms. However, Taiwan is still wins a certain place in the world economy. How is such an amazing achievement possible?

The Taiwan economic miracle was created by diligent, devoted entrepreneurs working in small and medium-sized firms to compete in the international market, since the 1970s. The achievement of the Taiwan economic miracle was due to the devotion of small and medium enterprises (SMEs). SMEs possess flexibility. (陳湘詒, 2009) Such companies are renowned for flexibility, and quickly adapt to changes in the highly volatile and uncertain international market.

The basic industrial structure of Taiwan is made up of small and medium enterprises, in which respect it radically differs from other societies of East Asia (Hamilton and Biggart, 1988). SMEs respond to market demand, which rises and falls greatly with outsourcing. As a result, Taiwan enterprises have become among the most popular and favorable upstream companies operating in the international market.

Taiwan went through the Asian economic crisis in 1996, as well as financial turbulence in 2008–2009; it dropped from its position at the top of the four Asian dragons, which it held in 2000, to bottom position in 2008, because of the political isolation policy pursued by the ruling party from 2000 to 2008. In today's world, no country can be insulated from others, since the global political and economic environment has an impact on all countries. The global economic crisis poses great challenges for all governments, particularly that of Taiwan, given its heavy dependence on exports. The Ma administration responded quickly, though the magnitude and complexity of the crisis.

According to a statement in a 2009 White Paper report released by the American Chamber of Commerce in Taipei, the Taiwan government has become increasingly aware of the difficulties many Taiwanese exporters will face if they are excluded from the enlarged regional trade bloc that is emerging, as the 10 ASEAN nations begin implementing Free Trade Agreements (FTAs) with China, South Korea, and Japan, respectively. From 2005, ASEAN and China had already started tariff reductions, and on January 1, 2010, a large proportion of the products traded among ASEAN, China, Korea, and Japan became duty free. If Taiwan does not achieve a trade agreement with China, Taiwan will be at a considerable duty disadvantage in its trade with China compared to the 10 ASEAN countries, South Korea, and Japan. For industry and other commodity-based businesses, as well as downstream industries and other important manufacturing sectors, that gap would potentially have a huge impact on Taiwan's international competitiveness. The absence of such a breakthrough means its impact would likely include substantial loss in export revenues and in profitability for manufacturing industries.

Globalization is a trend that is inevitable for a member of the global society. The Ma administration opened Taiwan's business, politics, and economy to the world, attracting increasing foreign investment to Taiwan. The future of Taiwan thus looks brighter. However, as an open and free market, there are still many obstacles that need to be resolved. For example, Taiwan faces competitive pressure from the low labor costs of South East Asian countries (i.e., Thailand, Indonesia, Vietnam etc.) and China, as well as from the high quality of goods from government leading strategy countries like South Korea, Singapore. How can it survive in today's severely competitive business world? Survival requires enterprises to develop strategies.

At the same time, Taiwan's enterprises are also aware of the trend of rapid market growth and evolution, because of which it increasingly faces unpredictable demands, and is required to make a greater variety of products while shortening the lead time for doing so. Creating high-value added products and increasing the flexibility of enterprises is a

way to deal with such challenges in a cost-effective way in the face of global competition, rapidly changing technology, and shorter product life cycles.

Enterprises are facing a highly volatile and uncertain environment, and traditional independent operating patterns are no longer suitable for the current environment. Instead, close cooperation and integration between companies to create mutual benefits are the tendency nowadays.

Flexibility is “the ability to change or react to environmental uncertainty with little penalty in time, effort, cost or performance” (Upton, 1995). In recent decades, there has been a considerable amount of research on manufacturing flexibility (Upton, 1995), and a growing trend to extend this approach to business within the supply chain. Considering that supply chains are connecting firms and that the focus is on internal (i.e., manufacturing flexibility, routing flexibility, product flexibility, volume flexibility, product mix, finance), and external (i.e., outsourcing, transportation, information).

Understanding supply chain flexibility (SCF) is crucial for many reasons. First of all, the global trend of customization requires supply chains to meet individual customer requirements without adding significant cost (Gilmore and Pine 1997). Second, certain industries, particularly high-tech ones, require upside and downside flexibility (Hausman 2004). Third, the uncertainty of demand is a fact of life and creating a responsive supply chain is one method of coping with uncertainty (Fisher 1997). Last, companies require rapid new product introduction, as well as quick response to consumer requirements and orders. In line with competition in the supply chain and its time consuming nature, the flexibility of the supply chain has become a critical issue in modern organizations.

There are many studies on the relation between supply chain flexibility and the firm’s performance. One of the key performance indices of competitiveness is the capability to meet customers’ demands in timely fashion, and cost effectively.

The refractory industry in Taiwan established in 1918 during the Japanese colonial period. With their characteristics of intense heat, refractory became essential materials for basic heavy industry, such as Iron & Steel, Cement, Alumina, Thermal, Incinerator,

Petrochemical, and Power plants. (陳新上, 2006)

As demand grew over time for refractories, the industry moved from basic products for essential industry to iron & steel, cement, and the petro-chemical industry, among others. One special characteristic of the refractory industry is that their key customers are big enterprises that dominate the market in terms of product performance, price, delivery, and after-sales service. In others words, the refractory industry is a user's orientation industry, and the supplier has to provide and satisfy whatever customers need, or drop out of the market. Moreover, with high-tech developments and utilization of new materials, high-end refractory products are being continually developed. The refractory industry spearheads new product development and existing product revolution more often the industry. (陳新上, 2006)

Hence, this research mainly focuses on assessing the dimensions of supply chain flexibility. It weights the dimensions of supply chain flexibility and provides better solutions for the refractory industry in Taiwan.

1.2 Research Motivation

Taiwan is a tiny island lacking natural resources, with exporting being its most important source of national revenue. Though isolated from the rest of the world because of the political issue with its neighbor across the Taiwan Straits, Taiwan's industry still relies heavily on yearly exports to China. According to statistics of the Ministry of Finance, exports/imports with China in recent years (from 2009 to the first half of 2011) amount to 54,284,679 KUSD/24,423,470 KUSD, 76,935,144 KUSD/35,945,949 KUSD and 42,816,907 KUSD/22,024,462 KUSD, respectively. These figures prove that China is Taiwan's largest trading partner.

The problems that the refractory industry face today, first of all, is a lack of reliable and stable resource materials in Taiwan. The refractory industry relies on raw materials imported from overseas, especially the main aggregates imported from China; hence, a punctual delivery at short notice is considered as the top difficulty needing resolution.

Second, the operation cost for manpower, land, and facilities keeps soaring, but with the severe price competition in the market, it is not easy for customers to accept companies raising prices. Third, the local market is small and conservative, and focuses only on the local market, so that production cost is uneconomical. If local firms try to access the foreign market to maximize their economic production scale, with no political and economic support policy like a Free Trade Agreement (FTA) with other countries to guarantee tariff free access, the refractory industry in Taiwan will be unable to compete successfully in the international market. The last problem is lack of research and development competence, as well as the lack of a budget and team to do product evolution. The industry requires a variety of specialist knowledge from metallurgy, chemicals, and mechanics, in addition to practical experience cultivated over years. If there is no incentive to attract new blood, human resources might become another serious problem in the future.

Those difficulties encountered now may well last into the future if no solution is found. In order to strengthen firms, a strategy must be adopted to prevent potential threats from materializing and to lessen future problems. This study focuses mainly on finding solutions to improve the performance of supply chain flexibility, to ensure reliable and stable on-time resource delivery that is cost effective, and to ensure the quality of manufactured products meets with customers' expectations.

1.3 Research objectives

This study aims to select and define primary flexibility dimensions for a supply chain, weight the priority of flexibility and its key sub-criteria, provide valid viewpoints from upstream to downstream of the supply chain to guide management's decision making, in order to enhance the competitiveness of Taiwan's refractory industry on the world market.

To achieve its objective, this research will do the following:

- (1) Determine key dimensions of supply chain flexibility

- (2) Assess the selected dimension of supply chain flexibility
- (3) Compute the relative importance of flexibility in each dimension
- (4) Compute the relative importance of sub-criteria for each flexibility dimension
- (5) Provide the findings to management of refractory enterprises.

1.4 Research Scope and Limitation

This research mainly targets the impact of supply chain flexibility on the manufacturing industry, in the context of a conventional industry, the refractory industry. There are diverse factors influencing this industry, but not all factors can be assessed in detail. Further, the regulator of this industry offered limited information, and perception, resources, time, and money constraints also affected this study. These limitations may lead to bias in this study; however, it can hopefully provide a solution despite the restrictions of this research.

1.5 Research Process

A research process was designed in order to achieve the purpose of the research. Figure 1.1 illustrates the research process. First, we have our research motivation. According to the research motivation, we collect data to define the topic and purpose. Then, we review the relative literature and establish a framework for supply chain flexibility to evaluate the study's research dimensions. Following content analysis by means of expert interviews, we design an AHP questionnaire. We compute the weight of the flexibility dimensions and the sub-criteria to finalize their priority. We analyze the findings and provide conclusions with regard to managing the refractory industry.

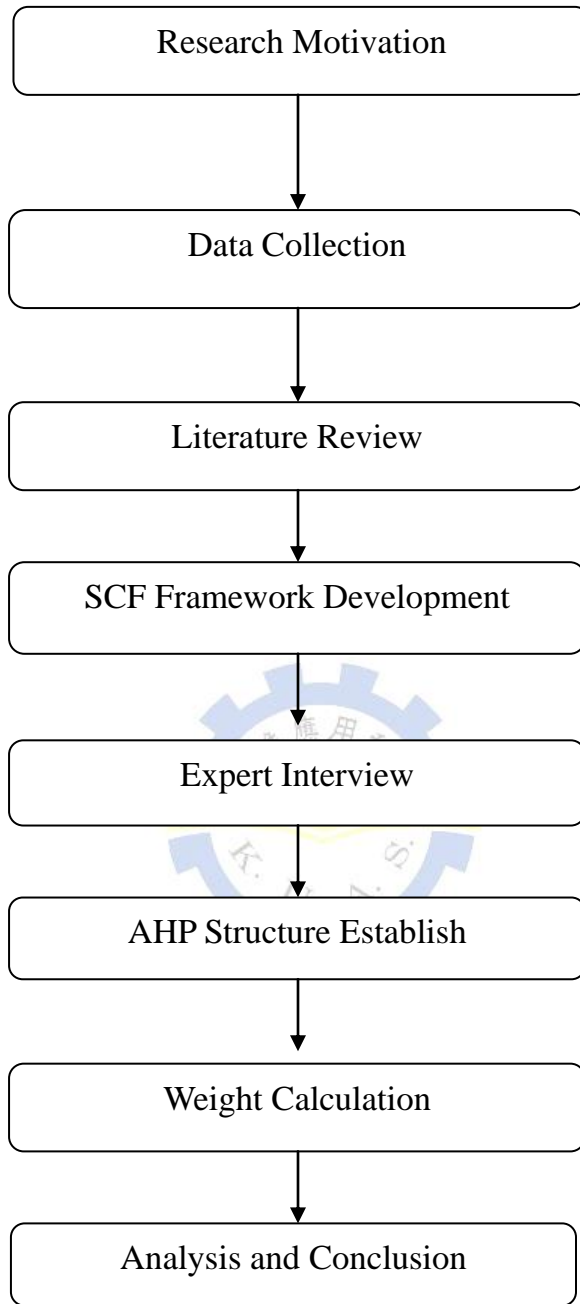


Figure 1- 1 Research Process

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