ISCTE IUL

Instituto Universitário de Lisboa

Supply Base Structure and Company Performance

QIAO Shiping

Thesis submitted as partial requirement for the conferral of the degree of

Doctor of Management

Supervisor:

Professor Álvaro Rosa, Professor, ISCTE University Institute of Lisbon

Co-supervisor:

Professor Ai Xingzheng, Professor, University of Electronic Science and Technology of China, School of Management and Economics

March, 2017

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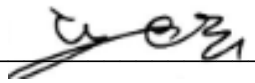

Abstract

One important decision in supply base management is the structure of supply base. Since the supply base has become the core competence in global competition, the supply base structure, which largely determines reliability and sustainability of supply base, attracts more and more attention in business practice. Gaining a suitable supply base structure could not only improve the purchasing effectiveness, but also contribute to a better profitability of whole company.

Unfortunately, very little literature deals directly with how supply base structure determines the company performance with the empirical method. Thus, the supply chain managers are confused about the correlations between supply base structure and performance, and they lack conceptual support while adjusting to the supply base structure. Drawing on literature streams in supply base structure and purchasing portfolio management, along with structured interviews with practitioners, this research attempts to fill this void by validating a framework and tests many conceptual ideas from existing literatures.

Using data from 219 supply chain managers, we test the relationship between supply base structure and company performance. Additionally, we test how three dimensions of supply base structure, including supplier heterogeneous, supplier development and asset-specific investment affect both the operational and financial performance. Furthermore, the moderation effect of purchasing portfolio management on the relationship between supply base structure and performance are tested.

Our empirical results show that heterogeneity of the same type of suppliers has a negative impact on company financial performance but an inconspicuous influence on operational performance. Supplier development and relation at specific investments are both beneficial to the improvement of enterprise performance. As a moderation factor, supply risk in purchase portfolio management plays a role in regulating the relationship between supplier development and enterprise performance.

Key words: Supply Base Structure, Purchasing Portfolio Management, Performance, Supply Chain Management

JEL: M11 Production management; M10 General administration; M20 General; M21 Business economics

Resumo

Um pilar essencial na gestão baseada em fornecedores («*supply base management*») é a estrutura da base de fornecedores. Desde que a base de fornecedores se transformou em uma capacidade organizacional fundamental no mundo globalizado, a estrutura da base de fornecedores, determinante na fiabilidade e na sustentabilidade da base de fornecedores, tornou-se, hoje em dia, o foco de atenção de todo o mundo empresarial. O estabelecimento de uma adequada estrutura da base de fornecedores não só melhora a eficácia de todo o processo de aprovisionamento como também contribui para uma melhoria da rendibilidade da empresa.

Atualmente, ainda existe uma relativa falta de debate de como a estrutura da base de fornecedores pode influenciar diretamente o desempenho empresarial, sobretudo no âmbito da investigação empírica. Deste modo, os gestores da cadeia de fornecimento sentem-se confusos acerca da correlação entre a estrutura da base de fornecedores e o desempenho financeiro bem como o modo de ajustar essa mesma estrutura por falta de fundamentos teóricos. Este presente trabalho procura, através de uma síntese da literatura académica existente no que concerne à estrutura de base de fornecedores e à gestão do portefólio de aprovisionamento e através de entrevistas com agentes do mundo empresarial, contribuir para colmatar essa lacuna de conhecimento.

Usando uma amostra de 219 observações, nós testámos a relação entre a estrutura da base de fornecedores e o desempenho financeiro. Adicionalmente, testámos o modo como três dimensões da estrutura da base de fornecedores, a saber, heterogeneidade de fornecedores, grau de desenvolvimento da base de fornecedores e investimentos específicos de ativos influenciam os resultados operacionais e financeiros. Incluímos, ainda, no nosso estudo, várias variáveis da gestão de portefólio de aprovisionamento como fatores de moderação.

Os nossos resultados demonstram que a heterogeneidade de fornecedores de um mesmo tipo de bens tem um impacto negativo no desempenho financeiro, ainda assim, exerce uma pequena influência positiva nos resultados operacionais. O grau de desenvolvimento da base de fornecedores e o investimento específico de ativos são fatores que contribuem positivamente para a melhoria de resultados. Como fator de moderação, o risco de fornecimento na gestão de portefólio de aprovisionamento desempenha um papel regulador de

desenvolvimento da base de fornecedores bem como do desempenho empresarial.

Palavras chaves: estrutura de base de fornecimento, gestão de portefólio de aprovisionamento, desempenho, gestão da cadeia de fornecimento

JEL: M11 Production management; M10 General Administration; M20 General; M21 Business economics

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Chapter 1: Introduction

1.1 Research Background and Significance

1.1.1 Research Background

In the fierce competitive global market, with the increasing force the companies have to downsize and focus on the core competencies to achieve comparable advantage, thus the competition between different companies or even for the same group companies but at their different locations is not only the pure competition of product quality and product character itself, but also it has evolved to competition of the supply base performance including its cost, quality and efficiency (Tan et al., 1998). Supply base management has become significant strategic tools for firms to achieve competitive success and more attention is paid to the optimization of supply base structure.

In order to enhance the overall competitive strength, most enterprises extend the focus from the internal product operations to the external supplier operations. They not only reduce the price of purchasing products and materials, but also put more attention on the management of suppliers. Adjusting the supplier structure and optimizing the supplier groups gradually become the key factors to improve their core competitiveness. The following example could help us understand the influences of supplier based on company operational performance.

A home appliance enterprise attaches great importance to purchase price and the purchasing manager is eager to reduce the cost of procurement products to achieve the purpose of reducing production costs in a highly competitive environment. Therefore, the manager lowers purchasing price as much as possible during procurement. After three years, the cost of the company's product indeed gets reduced. However, the only way to focus on pricing has changed the supplier base structure which switches into some suppliers very likely with small scale and low quality. The enterprise lowers the purchase price as far as possible, it

means the compression of supplier's profit space as much as possible. It is not a win-win relationship between the enterprise and the suppliers, eventually will lead to a decline in supplier group quality and substandard products supply situation inevitably, directly affect the production and bring about the significant loss to the enterprise finally.

The competitive market environment puts forward higher requirements for the procurement of enterprises and suppliers, optimizing supplier groups becomes the key of enterprise purchasing. Only when taking all the common interest of both sides into account and working together for win-win cooperation, the cooperative relationship will endure. The company not only chooses the product but also selects the cooperative partners, therefore, more factors should be considered at choosing suppliers such as the service capabilities, business trends, the company's development prospects and other comprehensive strength factors. At the same time, in the supplier management process, enterprises should establish and improve the assessment mechanism of suppliers, especially for the 20% suppliers which could occupy 80% of the total purchase value according to the 20/80 principle, through market research, data /information collection and analysis for suppliers including product quality, price level, comprehensive evaluation, supply flexibilities and service capabilities.

A supply base is defined as a portion of a supply network that is actively managed by a buying company. The buying company, referred to as the focal company, manages the suppliers in the supply base through contracts and buying of parts, materials and services (Choi and Krause, 2006). To better manage the supply base, the supply base structure is usually conceptualized into several dimensions such as the number/size of suppliers (Rudberg and Olhager, 2003; Choi and Krause, 2006; Ateş et al., 2015), the heterogeneous of suppliers (Choi and Krause, 2006; Vereecke and Dierdonck, 2006; Ateş et al., 2015) and buyer-supplier interaction (Choi and Krause, 2006; Ateş et al., 2015; Ziggers and Henseler, 2016).

And in most manufacturers, the cost of purchasing takes account for nearly 50% to 70% of each sales dollar (Van Weele 2005), so their success in purchasing management plays an important role in company performance. Another important way to optimize the supply chain is about the purchasing portfolio management. Since Kraljic (1983), the Kraljic's matrix globally and widely used in practice though there are many critiques (Olsen and Ellram, 1997;

Dubois and Pedersen, 2002; Kamann, 2000). Facing hundreds and thousands of kinds of purchasing materials, categorizing them with reasonable dimensions and applying corresponding strategy are the main tasks for purchasing staffs. Several dimensions are used in different portfolio models, such as the strategic importance of purchasing (Kraljic, 1983; Luzzini et al., 2012), supply risk (Kraljic, 1983; Lee and Drake, 2010), and complexity of buyer's market (Kamann, 2000; Lilliecreutz and Ydreskog, 2001).

In order to survive in the long run, based on my work experience in CommScope, the supply base structure and the purchasing portfolio management not only influence the performance of purchasing, but also the whole company. Little research focuses on this issue, and for supply chain managers, there are still puzzles about which dimensions or factors of supply base structure influence the performance most, and how dimensions of purchasing portfolio management, such as the supply risk, complexity of buyer's market and purchase impact, affect the relationship between supply base structure and company performance.

1.1.2 Research Significance

Establishing a framework linking supply base structure and company performance outcomes could provide valuable information to the supply base management field. The empirical test of this framework should assist firms that are in the process of selecting suppliers or those firms who have already owned specific supply base but yet done performance comparisons to other structures of supply base. The results of this research should also substantiate the proposed correlations between purchasing portfolio dimensions to influence the supply base structure and performance outcomes. Finally, this framework should provide firms with a starting point to step back and understand the supply base structure so that some certain adjustment can then be tackled specifically to improve performance.

Up to now, scholars have provided a series of strategies for betterment of supply base structure. The reduction of suppliers is as the method applied widely to bring the size of a supply base to a rational level (Shin et al.2000, Ogden 2006). A small supply base gives rise to the risk of supply disruption, while a large supply base increases the fixed cost. The rationalization of supplier's number is the tradeoff between the supply risk and the cost, so it

is the heterogeneous of suppliers. The heterogeneous in organizational culture, operational practices, technical capabilities, and geographical separation makes it harder to coordinate activities with suppliers and may further determine the relationship of the focal company and suppliers (Rudberg and Olhager, 2003). A supplier with bigger size has more bargaining power and in response, manufacturer would be likely to choose partner model, which results in information sharing and relation-specific investment.

Although there is little doubt that supply base structure is critical for supply chain and company performance, the underlying drivers of supply base structure are not fully understood, and the existing literature mostly focus on the factors determining the supply base structure (Beil, 2014; Rudberg and Olhager, 2003) and supply base strategies (Monczka et al.,1993; Bygballe and Persson, 2015). The further study on the relationship of supply base structure and company performance is needed not only in academic research, but also in practical operation.

This study will look specifically at which dimensions of supply base structure are associated with company performance, and how purchasing portfolio management may moderate the relationship between supply base structure and company performance. This study will therefore provide additional insight not only in the academic environment, but also for purchasing practitioners and firms in general. Practitioners could be able to further understand the impact of suppliers' heterogeneity, supplier development and asset-specific investment on company performance, so that managers could apply targeted strategies that will support the objectives of the firm and improve company performance.

1.2 Research Content and Research Method

1.2.1 Research Content

As mentioned earlier, a growing body of literature has suggested that an optimized supply base structure leads to the betterment of the firm performance. Furthermore, literatures suggest that purchasing portfolio management capability facilitate supply base structure for improving company performance. In other words, a firm would optimize the supply base

structure better if the firm is equipped with better purchasing portfolio management capabilities (i.e. better categorizing the materials) across the supply chain. However, empirical evidence is still very limited and hence, the key research question is to identify the relationship between supply base structure and performance, and to study which purchasing portfolio management capability variables play an important role in supply base structure for improved company performance.

The objectives of this research are (1) to develop a theoretical framework that can be used to evaluate any correlations between supply base structure, purchasing portfolio management and company performance and (2) to test this framework by analyzing the supply base structure and company performance through statistical analysis of data collected from a mailing of a survey instrument.

Developing from these research objectives, based on the grounded theory and using rigorous statistical methods, this thesis addresses the following Research Questions (RQ):

RQ1: How does supply base structure influence on company performance?

RQ2: How does purchasing portfolio influence on company performance?

RQ3: How does purchasing portfolio influence the relationship between supply base structure and company performance?

1.2.2 Research Method

Our research methodology will include both qualitative and quantitative approaches. The qualitative part consists of verifying the dimensions identified in the supply base structure literature through semi-structured interviews with purchasing and supply chain practitioners. We invited twenty enterprise employees to participate this interview which include eleven purchasing directors and above and nine managers of purchasing department. And we designed these key questions to explore the relationship between supply base structure and company performance, the relationship between purchasing portfolio management and company performance, and make a further exploration about whether purchasing materials management is a moderator variable.

The quantitative part consists of a survey instrument and quantitative analysis of the relationship between the identified purchasing portfolio dimensions, supply base structure variables, and company performance. We collect data from the purchasing or supply chain executives listed in the directory of China Supply Chain & Operations Management Club (SCOM) and Council of Supply Chain Management Professionals (CSCMP) and some personally invited purchasing or SCM practitioners (invited respondents).Through an analysis of the data above, the results will then be interpreted, and conclusions regarding possible relationships between supply base structure, purchasing portfolio management and company performance will be discussed.

1.3 Main Innovations and Technical Approach

1.3.1 Main Innovations

As stated earlier, the purpose of this research is to further understand the correlation between supply base structure and company performance. Extensive but fragmented research has been developed on ways to measure performance of the purchasing organizations, and some attempt has been made to identify the dimensions of performance. There are also some researches on recent development in the supply base structure and the benefits of structure adjustment that encompass a better company performance. However, little empirical testing has been done to analyze possible connections between supply base structure and performance. Using a survey instrument, t-test for difference, correlation matrices and multiple regressions will be evaluated to determine if company performance is associated with supply base structure established.

There is not much research that has dealt directly with supply base structure. Some article discusses the dimensions of supply base structure, other article discusses factors affecting the supply base structure, and these articles mention the needs for supply base optimization. Once an organization has decided to utilize supply base structure, there is very little literature to help these organizations decide on what kind of supply base structure to utilize or how to make the adjustment about the size, heterogeneous, and buyer-supplier

relationship. The literature related to supply base management does not answer these questions either. Thus, there appears to be a void in the literature concerning supply base reduction.

This research attempts to fill that void by providing answers to the research questions mentioned earlier. Specifically, this research should help organizations gain a greater understanding of 1) the drivers of supply base structure adjustment, 2) product or market conditions that encourage or facilitate supply base structure adjustment, 3) how to effectively adjust supply base structure, 4) the barrier and critical success factors of such supply base structure.

Besides the general benefit of filling a void in the literature, there are several specific benefits derived from this research, first, organizations will be provided with a better understanding of the situations in which supply base structure may be appropriate. Specifically, organizations will be provided a better understanding of the relationship between elements of purchasing portfolio management and supply base structure. Organizations will be able to examine their current situations and determine whether supply base structure would be beneficial in their given situations.

Second, once the decision to adjust their supply base has been made, this research will provide organizations with a greater understanding of the implementation process, critical success factors, and barriers of such an implementation.

Third, this knowledge will help organizations have a better sense of the potential benefits of supply base structure adjustment and ways to measure those benefits. Fourth, this research develops a framework to analyze the connection between supply base structure and company performance.

1.3.2 Technical Approach

The following chapter discusses the literature on supply base structure, purchasing portfolio management and company performance evaluation.

Chapter 3 describes the design of the research project and the data collection method that

will be used.

Chapter 4 describes the research methodology and the data collection method that will be used. Both qualitative and quantitative methods are used to gather data. Reasons for the selection of the China Supply Chain & Operations Management Club (SCOM) are explained and the design of analysis is described.

Chapter 5 tests the validation of measurement scales through item analysis and common factor analysis.

Chapter 6 introduces the revised research model and research hypotheses.

Chapter 7 entails an analysis of the data collected from returned survey instruments. An analysis of the research questions is detailed, with a summary of the conclusion of the research.

Chapter 8 summarizes the research results and implications of this research for purchasing managers. An analysis of possible linkage between supply base structure and company performance is presented. Contributions and limitations of the research are discussed. And the next is to indicate the shortcomings and future research direction of this thesis.

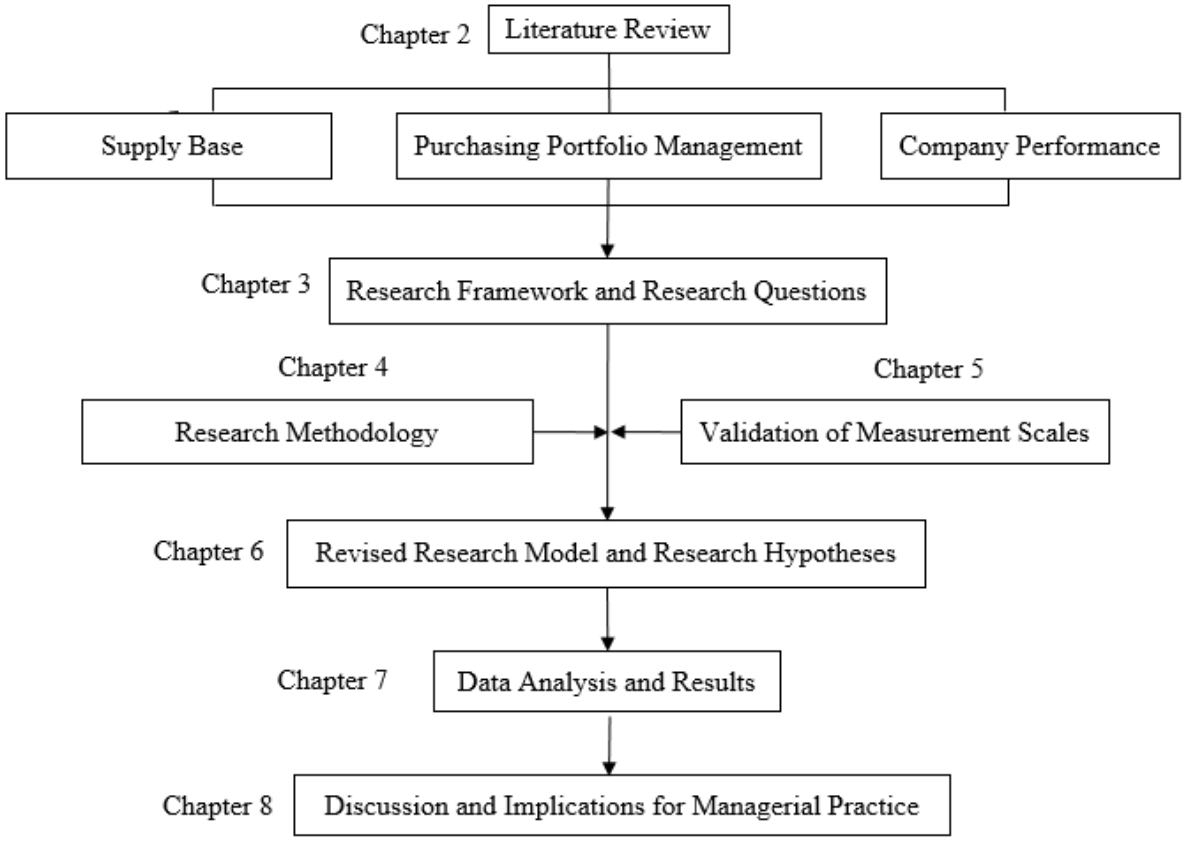

Figure 1-1 Technical Approach

Chapter 2: Literature Review

2.1 Literature Review of Supply Base Structure

All enterprises engaged in value-adding activities purchase goods and services from a group of suppliers. Choi and Krause (2006) defined the focal firm's supply base as only those suppliers that are actively managed through contracts and the purchase of parts, materials and services. Academic researches generally pay more attention on the complexity of the supply base. And the supply base structure mainly contains four facets: (1) the size of suppliers, (2) the differentiation among suppliers, (3) the relationship among suppliers, and (4) the relationship between supplier and buyer (Ates et al., 2015).

2.1.1 The Size of Supply Base

For a long time, the appropriate size of supply base is important for firms. Reducing the size of supply base is thought as a prerequisite for building a strong supplier partnership and developing an effective supply chain. Assuming that the yield delivered from each supplier is stochastic, Agrawal and Nahmias (1997) developed a model to determine the optimal lot size and the number of suppliers. This paper shows that trade-off between supplier's number and cost, wherein the more suppliers, the smaller the uncertainty of yield, but resulting in more fixed costs.

Kauffman and Leszczyc (2005) indicate that in many new or repeat purchasing situations, business buyers must decide how many suppliers to consider (a "choice set") for actually buying from or contract with. This paper develops an optimization method to determine the size of the choice set on basis of considering the buyer's utility and the cost of search and evaluation under one-time and repeat purchase situations. The model is tested by using empirical data on the price and delivery time of the steel tube received from the procurement auction.

Weber et al. (2000) holds that the biggest motivation to own multiple suppliers is to prevent unforeseeable natural disasters (such as earthquakes, tornado, tsunami, floods) and/or man-made disasters (such as grid fault, strikes and community violence). To determine the optimal size of supplier base, the above two modeling approaches are considered inadequate.

Berger et al. (2004) believes that the supply chain relies on supplier more and more heavily, once the supply chain is disrupted, there will be a serious damage of the entire supply chain. In order to determine the optimal size of suppliers, supply risk of catastrophic events can be classified as (1) "super events", all suppliers are affected and all supply is disrupted, exhibiting total effect (2) "semi-super events", the subset of suppliers are affected, exhibiting regional effects, and (3)"unique event", affected the specific supplier, exhibiting local effect. Distinguish the risk as super, semi-super, or unique event by the purchasing environment. For example, a cyclone in the coastal region leads all the supplies to break off, especially all suppliers are in this area. If only a part of the supply is interrupted, it may be called as semi-super event. It is taken into account the occurrence probability of super and unique events to find the financial losses and operating costs of the firm when working with multiple suppliers.

Ruiz-Torres and Mahmoodi (2007) extended the research of Berger et al. (2004), also considered that there is possible loss associated with failure of individual suppliers. They specifically considered two cases. That is, the probability of failure of each supplier for unique event is equal or unequal.

Considering the risks of supply disruption due to super, semi-super and unique events, Sarkar and Mohapatra (2009) formulate a decision-tree like structure to determine the optimal size of supply base. The illustrative examples and sensitivity analysis show that the probabilities of semi-super events and unique-events determine the choice of locations and it is always a better strategy to have suppliers from as many locations as possible.

Since the limitation of present supplier sorting methods, Sarkar and Mohapatra (2006) developed a systematic framework for carrying out the supply base reduction process. Two important dimensions, which are performance and capability, are estimated in the ‘performance-capability matrix’ to help a decision maker arrange the suppliers in decreasing

order of preference.

Nam et al. (2011) established a model incorporating the perspectives of both demand uncertainty and supply base management costs in order to investigate the dynamics between demand uncertainty and coordination. Their model reveals that forecasts' accuracy and the supply chain's expected total profits can be measured with information on the coordination level and the coefficient of the speed of adjusting to a forecasting error.

2.1.2 The Differentiation Among Suppliers

Choi and Krause (2006) argue that the size of supply base is determined by the ability of bearing the operational load of the focal company, while the heterogeneity among suppliers will increase the load and complexity. They differ suppliers as "different characteristics, such as organizational culture, business practices, technical capabilities, and supplier geographic separation". The research shows that the stronger heterogeneity of suppliers, the higher costs, because managing different suppliers will bring additional coordination costs and operational burden. On the other hand, homogeneous suppliers own similar capabilities and lack of diverse knowledge in similar industries what are needed by innovation.

Gao et al. (2015) finds that the technical diversity of suppliers is helpful to create the new products for buying firm. The suppliers' different locations are also considered to be one of the factors of the heterogeneity affects innovation. Schiele (2007) believe that the closer is between suppliers and the buyer's business facility, the more advantages in easy communication and sharing of sticky knowledge.

Melek et al. (2015) believes that, especially the interaction among the global suppliers helps to innovate in different backgrounds. Supplier's relative size and type are also the factors that affect the supply base's heterogeneity. Some companies prefer to large suppliers to benefit from their technical capabilities and infrastructures, there are also some small businesses to help companies develop cutting-edge products. However, firms may have a heterogeneous coordination and control problem. Different companies in the supply base own different culture and work norms, which may also affect the success of innovation.

While buyer periodically auctioning off short-term supply contracts among her supply base, Wan and Beil (2014) find that the buyer's decision to diversify depends on her bid-taker power, which represents her ability to choose the auction mechanism. Two extremes of bid-taker power are investigated and the conclusions indicate that the more bid-taker power the buyer has to control price escalation from cost-advantaged suppliers the more she prefers a diversified supply base.

2.1.3 The Relationship Among Suppliers

Wynstra et al. (2003) considers that the relationship between the suppliers is not isolated. The interaction relationship between suppliers is cooperative or competitive. Gadde and Hakansson (1994) points out a high level of competition among suppliers would result in lower prices. Thus, the competition between suppliers would bring the benefits to the company both in reducing the finance cost and increasing the technology innovation. Cabral et al. (2007) considers that if there is a strong competition between suppliers and if there exists the lead supplier, it will further intensify competition and reduce the innovative motivation of other suppliers. Competition is not the only choice between suppliers.

One concern if more and more suppliers collaborate each other or not with the buying firm's intervention, Sobrero and Roberts (2002) argue that if two suppliers provide the service for the same company, exchange technical information and share resources with each other, the possibility of innovation would be increased. However, Choi and Krause (2006) point out that if the focal company does not interfere with the relationship between suppliers, it may lead to confusion of the relationship between suppliers and is not beneficial to innovation.

Li (2013) investigated how supplier competition affects the buyer's sourcing strategy. Three possible sourcing structures, sole sourcing, symmetric dual sourcing and asymmetric dual sourcing are investigated. The study finds that supplier competition could be fostered by symmetric capacity investment in suppliers and low price commitments, thus the buyer can take advantage of both supplier competition and cooperation.

2.1.4 The Relationship Between Supplier and Buyer

One of the indicators to measure the relationship between the focal company and the supplier is the duration of the contract. Poppo and Zenger (2002) believe that the long-term contract has stability and continuity. Cousins (2002) believes that short-term contract has the flexibility and the effect of price and cost reduction. Corsten and Felde (2005), Handfield et al. (1999), Sobrero and Roberts (2002) hold that the company should develop long-term relations of cooperation with suppliers through establishing the trust and commitment.

Wagner and Bode (2014) argue that the long-term contract can not only ease the holdup problem in the investment, but also make suppliers willing to share product innovation with the buying firm. But there are different points of view, Handfield et al. (1999) thinks that once the supplier having been "inside" the company will lose the incentives to innovation, therefore the buying firm need to attract the new supplier in to promote the innovation, especially the radical innovation methods can be obtained. On the other hand, it can also promote the innovation at the short-term contracts based on price-driven negotiations.

The other indicator to measure the relationship between the focal company and the supplier is about the transparency. Awaysheh and Klassen (2010) argue that transparency is an important supply chain structure dimension, and can be defined as the extent to which information is readily available to the parties in the supply chain. Supplier information sharing is defined as "the extent to which the supplier openly shares information about the future that may be useful to the customer relationship" (Homburg and Kuester 2001). Swink et al. (2007) consider three types of supplier information sharing: financial, operational, and technical. Cannon and Homburg (2001) predict that more information sharing of the suppliers would decrease the costs of the focal firm, but they fail to find empirical support for this proposition in their study. Kamath and Liker (1994) argue that in joint innovations with suppliers, the buying firms should encourage two-way information sharing.

Finally, trust is the foundation of positive and productive buyer–supplier relationships. A recent study by Peterson, Handfield, and Ragatz (2003) of successful versus unsuccessful new product development initiatives that involved suppliers found that successful initiatives involved a detailed formal valuation and selection of potential suppliers prior to consideration for involvement. Only trusted suppliers with a proven track record were approached (at least

initially) to participate in these projects. Some of the important selection criteria considered by executives included the suppliers' relative level of experience and capability in new product development, as well as their relative level of expertise with a given technology. In addition, sharing of project outcome objectives by all parties involved was critical. Although a number of barriers exist at the project team level when it comes to acceptance of suppliers in the process, direct supplier participation in team meetings (whether through simple consultation on design issues or via a detailed design proposal) effectively explained the difference between a successful or an unsuccessful outcome. Finally, supplier involvement on project teams seems to be even more important when the technology is complex or when the buying company does not have a high level of internal expertise in the area. Project teams that approached suppliers with whom a solid relationship existed were better able to include these suppliers on teams, share technology information, and thus better utilize suppliers' expertise earlier in the process.

2.2 Literature Review of Purchasing Portfolio Management

In most manufacturers, the cost of purchasing takes account for nearly 50% to 70% of each sales dollar (Van Weele 2005), so their success in purchasing management plays an important role in company performance. Since Kraljic (1983), the purchasing portfolio has become a well-accepted and important part of purchasing management (Gelderman and Van Weele 2003).

2.2.1 Existing Purchasing Portfolio Model

Kraljic (1983) historically defines the four groups of purchasing category depends on the two factors: the strategic importance of purchasing and the complexity of the supply market. And each of four categories requires different purchasing strategy, such as purchasing management, materials management, supply management and sourcing management respectively, based on the category characteristics.

To help purchasing staffs understand and focus sourcing, Hadeler and Evans (1994) built a strategic framework called Supply Strategy Square, with product complexity and value

potential as the two dimensions. Four sourcing strategies, Simple contract, Close relationship, Global trading, and Strategic partnership are then applied to the corresponding category respectively. Bensaou (1999) developed a new portfolio model with buyer's specific investments and supplier's specific investments as the key classification dimensions, and it further classifies the buyer-supplier relationship into four categories: strategic partnership, market exchange, captive buyer and captive supplier.

Stemming from Kraljic's matrix and considering competitive priorities, Lee and Drake (2010) justified and developed Kraljic's purchasing portfolio model into the pragmatic 'component value' and 'risk in the supply market' dimensions. The component value is consisted of four factors: quality, availability, cost and time, and the risk in market are measured by the monopoly conditions and the size of supplier. Different from the previous literature which mostly cited the Kraljic's matrix, Luzzini et al. (2012) consider both the Kraljic's (1983) and the transaction cost economies dimension, which enable us to grasp several important characteristics of the goods and services involved in both the transaction (i.e. strategic importance, customization, and technological uncertainty) and the supply market (i.e. supplier power and market volatility).

Not only used in purchasing management, with the advantage of simplification for a complex problem, the portfolio approach is also used for other management. Based on case study, Gelderman and Semeijn (2006) studied the global sourcing problem for multinational companies. Their study shows the purchasing portfolio tool is useful for developing effective purchasing strategies, which improves the internal coordination within business units, and further could be used for managing a global supply base. Wagner and Johnson (2004) advanced and extended portfolio approaches and recognize the contribution of supplier portfolio management to the firm's value creation and competitive advantage. The strategic supplier portfolio mainly includes the development and integration of suppliers in supply base, and the paper explores a series of processes that firms use to plan, implement, and monitor strategic supplier portfolios. To investigate how knowledge and skills vary across a portfolio of purchases, Knight et al. (2014) proposes a novel approach to profiling purchasing skills to investigate how knowledge and skills vary across a portfolio of purchases, which are

categorized by the importance to the organization and to the supply market.

2.2.2 The Critique and Update of Purchasing Portfolio Models

Although the Kraljic portfolio approach dramatically develops the traditional purchasing, there are several important criticisms with respect to several measurements of the purchasing portfolio approach.

One main critique of Kraljic portfolio approach is the difficulty in measurement of dimensions and variables. To make the variables be more easily measured in practice, Olsen and Ellram (1997) classified categories with two key classification dimensions, the strategic importance of the purchasing and the difficulty in managing the purchase situation, which describes factors internal and external respectively. Gelderman and Van Weele (2003) tested and refined the concept of Kraljic matrix to solve the unanswered problems about the measurement issue and portfolio-based strategies. The paper found additional portfolio strategies with additional information about the overall business strategy, the specific situations on supply market, and the capabilities and the intentions of individual suppliers and additional strategic movements of commodities within the matrix.

Another critique is the limited and deterministic character of the strategic recommendations. Dubois and Pedersen (2002) provided a critique of Kraljic and suggests that the Kraljic approach has weakness since some important types of relationships are not directly addressed in any of the four quadrants. They discovered the importance of recognizing interaction and networking aspect of purchasing, which are not included in the Kraljic approach. Kamann (2000) and Lilliecreutz and Ydreskog (2001) propose the critique of the disregarding of the supplier's side, which reflects the suppliers' view of buyer-supplier relationship.

There are other critiques in the actual use of portfolio approach. Gelderman and Van Weele (2002) think the purchasing portfolio approach fails to provide guidelines for strategic movement of commodities and/or suppliers within the matrix. And according to a survey on the leaders on sustainable sourcing, Pagell et al. (2010) finds that the purchasing practice usually applied for strategic supplier (i.e. long-term relationship and trust) are more

appropriate for the leverage goods which has low risk but high purchase impact. The reason of the unexpected observation may be resulted by the overall important of sustainability in global sourcing, and the observation suggests the need of portfolio update for practitioners in practice. Gelderman and Van Weele (2005) made a literature review about the critiques of antecede purchasing portfolio model and provided a new insight that the purchasing portfolio usage should be associated with purchasing sophistication, especially with the skills and position in the company.

2.2.3 The Impact of Purchasing Portfolio Management on Performance

Based on the Kraljic's matrix and adopting the critique of Kamann (2000) and Lilliecreutz and Ydreskog (2001) about the disregarding of the supplier's side, we extend the portfolio approach into a three-dimensional model, which is categorized by the supply risk, the profit impact and the complexity of buyer's market. The three dimensions above are widely accepted in literatures because of their significant impact on the performance of purchasing performance (Zsidisin, 2003; Zhao et al., 2013).

Supply risk is always thought as the external dimension which describes the complexity of supply market and the empirical study shows the contingent relationships between supply risks and company performance (Zhao et al., 2013). In Kraljic (1983), supply risks include supply, monopoly or oligopoly conditions, pace of technological advance, entry barrier, logistic costs and complexity, and so on. Mitchell (1995) illustrated the supply risk with the buyer's behavior (i.e. buyer demographics, job function, decision-making unit, personality and customer/supplier interaction) and suggests risk-reduction strategies in organizational purchasing such as information gathering, approved supplier list, partnering and alliances which are widely applied in practical purchasing management. Different form Kraljic (1983) and Steele and Court (1996)'s classification of supply risk with complexity and impact, Zsidisin (2003) suggests that supply risk is classified by the effect that purchased items and services have on corporate profitability, market factors, and supplier characteristics.

The profit impact mainly includes the value added by product line, the percentage of raw materials in total costs and their impact on profitability. The percentage of purchasing raw

materials in total costs takes account for nearly 50% to 70% of each sales dollar (Van Weele 2005), so the cost reduction in purchasing is the main task for manufacturers. And the value added by product line largely depends on productivity and innovation. Úbeda et al. (2015) concludes that the new frontier of purchasing function is the management of suppliers to obtain value and innovation while reducing costs.

The complexity of buyer's market, which describes the degree of customization of the purchasing goods, is one facet of market complexity from the view of suppliers. While the buyers categorizing their purchasing material and further selecting the strategical suppliers, the suppliers do the same assessment of their buyer, which determines the willingness and initiative of cooperation in the exchange. Abundant literatures study the impact of market complexity from the supplier's view on the business performance. Rosenzweig (2009) shows the relationship between the environmental complexity and the business performance. Not only the direct impact on business performance, but also the moderation effect of market complexity is also discovered. Wong et al. (2015) finds the moderation effect of product and market complexity on the relationship between supply chain information integration and performance outcomes. Less product complex and higher market complex lead to greater impact of supply chain information integration on performance improvement. Based on the discussion on the relationship between market orientation and innovation, Pérez-Luño and Cambra (2013) find that higher environmental complexity enhances the introduction of radical and incremental innovation.

2.3 Literature Review of Company Performance

Performance is understood as achievement of the organization in relation with its set goals. It includes outcomes achieved, or accomplished through contribution of individuals or teams to the organization's strategic goals. Performance appraisals have become an increasingly important tool for organization to manage and improve the performance of the firm's services and products. Also, many business activities such as supply chain management have strategic implications for company performance (Rajat Bhagwat and Milind Kumar Sharma, 2007). Abundant researches have focused on the impact of supply base complexity

on performance. Aligned with Choi and Krause (2006)'s definition of supply base complexity, Brandon-Jones et al. (2015) investigate the impact of four dimensions of supply base complexity on the frequency of disruption and performance. They further test the moderating effects of slack resources as a means to absorb the effects of disruptions and supply visibility as a means to improve the ability to handle disruptions. Ziggers and Henseler (2016) both consider the customer orientation and supply-base orientation and utilize the dynamic capability theory to examine how these strategic orientations affect the performance. Their research extended the sole structure with only customer orientation or supply-base orientation to the complementary structure where customer and supply-base simultaneously contribute to the superior performance.

Many methods have been suggested over the years for the performance measurement and evaluation. To align with the research purposes, this part consists of four sections that report on previous studies pertaining to company performance and supply chain performance, performance measurements, performance evaluations, SCM and company performance relations.

2.3.1 Company Performance and Supply Chain Performance

Most of the enterprises that participated in the supply chain integration are mainly motivated by the strategic combination with supply chain partners. Integrating internal and external processes to efficiently manage the product flow, service flow, information flow and capital flow and achieve superior performance ultimately (Vickery et al., 2003). Therefore, how to understand the concept of performance is particularly important. Based on the literature analysis, scholars often divided the performance into company performance and supply chain performance. Generally, company performance includes operational performance, innovation performance, customer service performance, market performance, financial performance, and so on (Beamon, 1999; Flynn et al., 2010) and studies will be based on the actual objects to define and measure different performance, and there is no uniform definition about company performance. For instance, company operation performance is the performance of the enterprise in terms of cost, quality, flexibility, delivery time, customer

service, speed, new product development and so on.

Operational performance and financial performance are widely used to measure company performance in recent literature. Operational performance refers to the strategic dimensions from which a company chooses to compete. It can be considered as the ability of serving the customers at the aspects of quality, flexibility and on time delivery. Financial performance refers to evaluate the company efficiency and utility with the help of measuring data about finance and market. We adopted operational performance and financial performance as the dependent variable in this research model.

For the definition of supply chain performance, there are many different views, in general, it can be defined from the customer oriented, internal operation, future development, financial value and so on (Beamon, 1999; Stank et al., 2001; Frohlich and Westbrook, 2001). Flynn et al. (2010) defined and measured the supply chain performance from the aspects of supply chain flexibility, delivery, inventory, efficiency and the speed of new product introduction. Supply chain is a net structure which is composed of a number of participating nodes. The supply chain performance is the common behavior and results of all the participants in the net chain structure, also refers to the unity of efficiency and effectiveness in operation process of the supply chain.

2.3.2 Performance Measurement

Companies have different ways to measure performance depending on firm's goals. From the managerial focus, the performance measurement can be defined as the information regarding the process and product results that allows the evaluation and the cost price comparison in relation to goals, patterns, past results and with other processes and products (Pires, Sílvio R. I., 2001). Beamon and Ware (1998) affirm that the adoption of performance indicators have three prerequisites, that confirm which aspects should be measured, how to measure these aspects and how to use the measures to analyze, improve and control the productive chain quality. As we can see, measuring company performance is not an easy task. Hence, it is very important to establish a connection between the company strategic objectives and the performance measures (Maskell, 1991).

There is a common categorization to divide performance into financial and non-financial performance (Ittner, 2008). The traditional financial performance indices include sales growth, return on equity (ROE), earnings before interest and taxes (EBIT), and return on investment (ROI), among others (Eldenburg et al., 2010; Orlitzky, 2011). These financial measurements usually are used to measure a firm's profitability. On the other hand, in most researches, the market shares and other operational key performance indicators (KPIs) are usually applied to measure non-financial performance (Hyvönen, 2007). Hertenstein (2000) ever used the profit and income, cost of production, R&D cost as three financial indicators, and used product satisfaction, style satisfaction and use convenient satisfaction as the three non-financial indicators to measure the business performance. Previous literature indicated it is common to consider the exclusive use of costs as a performance indicator among the companies (Beamon, 1998). However, in the sustainability research literature, scholars have argued that company performance should not just focus on a single indicator such as financial performance because it could offer very superficial information about reality. Other aspects such as social performance, economic performance and innovation performance should be also taken into consideration. Beamon (1996) mentioned that the selected indicators should present inclusiveness, simultaneity, measurability, universality and consistency. Companies often use financial performance and marketing performance to represent the business performance, financial performance indictors include a rate of return on investment, rate of return on sales, net income before taxes, sales and sales growth rate. In terms of marketing performance, market share ratio is the key measure indictor (Richardson, et el., 1985).

As for the indicators on selection of measuring the supply chain performance, there are mainly the following ideas in view of the existing research literature. According to Supply Chain Operations Reference model (SCOR), (Paul, 2014) stated SCOR is a method created by supply chain council in order to provide self-assessment and activities comparison of supply chain performances. SCOR includes five elements named plan, source, make, deliver and return (please see figure 2-1). There are also customer facing metrics and internal metrics. Customer metrics comprise of responsibility, responsiveness and flexibility. Meanwhile internal metrics comprise of cost and asset. The Model is not out of date, Chinese scholars

(Jian Tong, et. el) based on SCOR model existing index system, combined with a large number of supply chain practices and basing on customer satisfaction oriented, and offered the new supply chain performance evaluation parameters with the Order Fulfillment Efficiency (OFE) creatively.

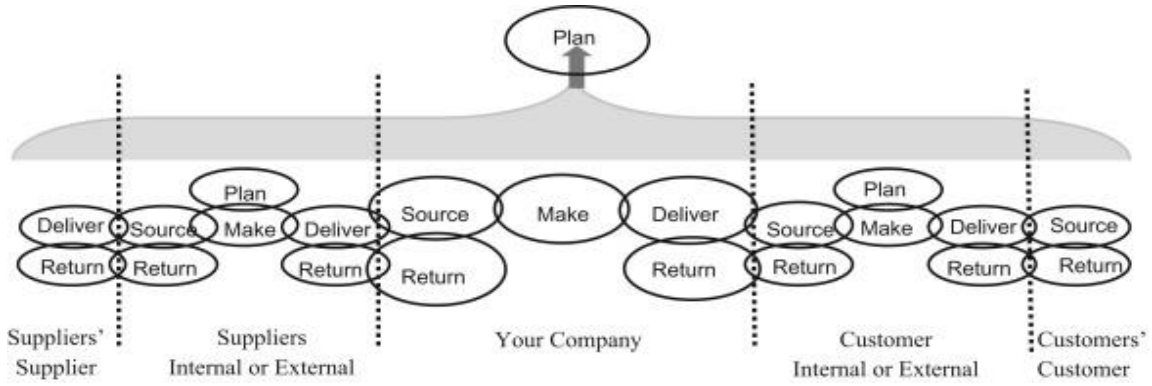

Figure 2-1 Schematic Representation of SCOR Management Processes(Adapted from Supply Chain Council, 2010)

From the aspect of balanced scorecard (BSC) approach, (Kaplan & Norton, 2005) have proposed the balanced scorecard (BSC), as the means to evaluate corporate performance from four different perspectives: the financial, the internal business process, the customer, and the learning and growth (see figure 2-2). Their BSC is designed to complement ‘‘financial measures of past performance with their measures of the drivers of future performance’’. (Kueng, 2000) presented it especially for modern process-based businesses. It assesses the performance of the processes for five aspects: financial view, employee view, customer view, societal view, and innovation view. Indicators of customer include flexibility, reliability, customer retention rate, customer acquisition rate and customer profitability. The internal operation index can be subdivided to supply chain cost, interaction lead time, product (service) cycle, and supply chain target cost rate. At new product development period, the structure of intellectual capital and the level of sharing information etc. are the indictors of learning and innovation aspects. In the recent researches, some scholars have chosen the index in view of the value creation of supply chain and the three levels of supply chain (Strategic level, tactical level, operational level).

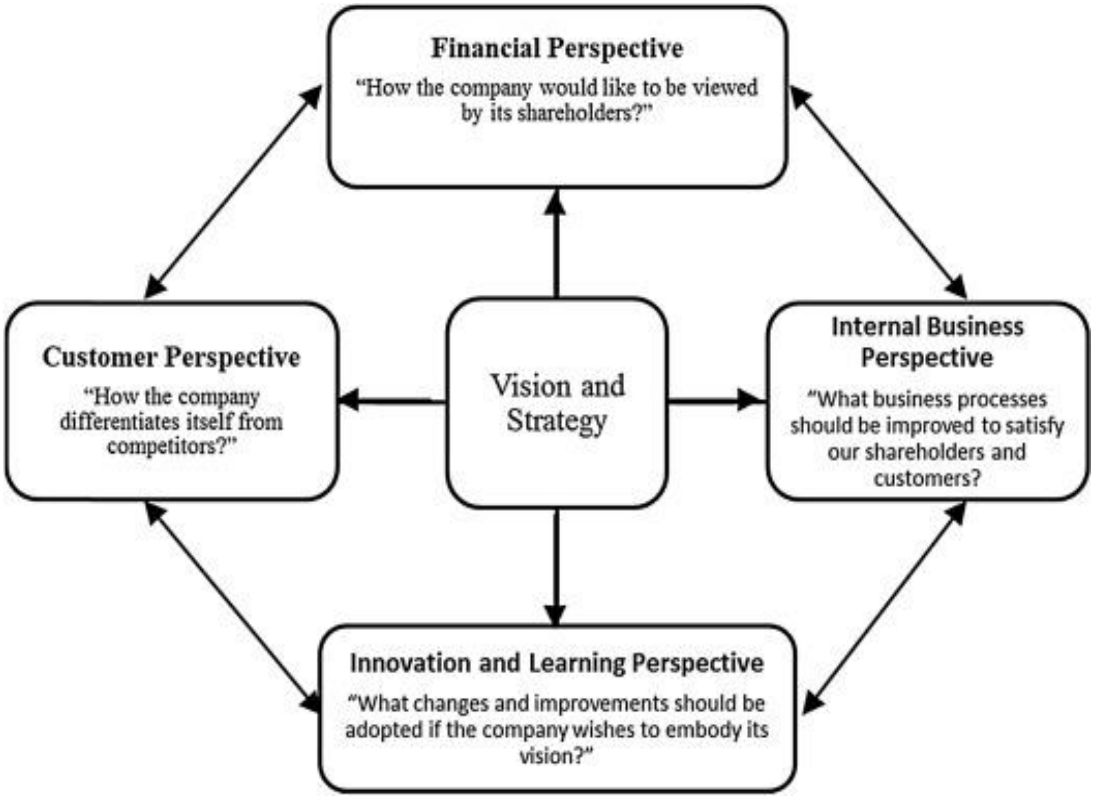

Figure 2-2 A Typical Balanced Scorecard Adapted from Kapan & Norton (1996)

2.3.3 Performance Evaluation

Performance evaluation can play an important guiding role in the supply chain structure, especially in the re-setting of business objectives, strategies and specific implementation process (Chan F T S, 2003). Performance evaluation mainly depends on statistical analysis methods. An increasing number of researchers have been devoted to the development of different kind of methodologies to evaluate performance. One of the most prominent methodologies is the Analytical Hierarchical Process (AHP) which is offered by Thomas L. Saaty in 1973. The AHP is a general theory of measurement that depends on the values and judgments of individuals and groups. AHP provides a simple and practical method to solve some complicated economic management problems. DuPont brothers put forward the DuPont analysis method, from the corporate profitability, operational, solvency capacity aspects to evaluate enterprise performance, and proposed the DuPont analysis based on the financial indicators through the relationship among the three aspects (Fengxia Wu, 2007). Some scholars used empirical methods to study the economic value added (EVA) and demonstrated

the added value of economic growth is more effective than the net profit when evaluating the enterprise performance (Kaplan R., Norton D., 1996). Robert Hall offered the "four scale theory" which namely the quality scale, operation time scale, resource utilization scale and human resources scale to carry company performance evaluation. The theory can reduce the risk of competition effectively through the improvement of the four scales. (Mark B, Susan G.W. 2009) put forward the concept of relative performance management (RPM), and think that the enterprise performance is based on the relative performance evaluation with the main competitors.

2.3.4 Supply Chain Management and Company Performance Relations

Flynn et al., (2010) defines supply chain integration (SCI) as “the degree to which a firm could cooperatively manage intra- and inter-organizational processes and strategically collaborate with supply chain partners to achieve efficient and effective flows of products, information, services, decisions and money, with the purpose of providing maximum value to its customer at high speed and low cost”. SCI represents firms’ capabilities in making strategic alliances, integrating resources, building seamless processes, and sharing information. Three dimensions comprise SCI: supplier integration, internal integration, and customer integration (Zhao et al., 2011). Supplier integration is considered as external integration. External integration is the degree to which a firm works with its core suppliers to structure collaborative and synchronized processes. It helps firms to establish strategic partnerships with members of the supply chain and enhance their core competitiveness at low transaction costs (Zhao et al., 2008). SCI can be regarded as a resource that leads to competitive advantages (Barney, 2012).

Extensive studies have examined the relationships between SCI and performance (Armistead and Mapes, 1993). Leuschner et al., (2013) finds the relationship between SCI and performance is significant with the method of meta-analysis. Strategic partnerships with suppliers could facilitate the suppliers’ understanding of the manufacturers’ requirements and help the manufacturers to better serve their customers. Supplier integration may also help firms to develop plans for timely production by communication of information regarding

demand, production time, and inventory obsolescence (Huo B., et al., 2016). Fabbe-Costes&Jahre, (2008) reviewed literature describing the impact of supply chain integration on company performance, and concluded that such studies take very different types of performance into account. While (Chen, Paulraj, 2004) argues that the buying firm's financial performance should be the main measure of SC performance given the shareholder profit motive, others have described the limitations of relying solely on financial criteria for performance (Flynn BB, et al, 2010). Several such authors focus on the operational performance, and the most widely-cited benefits related to SC integration include efficiency, quality, delivery and flexibility.

Supply base management is now recognized by many firms as a potential means to achieve sustainable advantages (Tully, 1995). Previous research has highlighted the importance of management of the customer-supplier relationship. To better manage supply base, many firms have dropped redundant suppliers and consolidated volumes with their most competent and trustworthy suppliers (Tully, 1995). During the past decade, the number of suppliers which the focal company maintained in its supply base is most commonly observed by the supply base management practiced we could call it supply base optimization or supply base rationalization. Rationalizing and optimizing the supply base is the main focuses of supply chain. Krause DR (1997) thinks that managing the supply chain implies streamlining and reducing the supplier base to facilitate managing supplier relationships. Copacino WC (1996) indicates developing strategies alliances with suppliers and working with suppliers are very important process when managing supplier relationship. Involving suppliers early in the product development process can take advantage of their capabilities and expertise (Monczka RM et al., 1994). Supply chain management literature provided evidence that supplier partnerships, supplier development, supplier involvement, and strategic sourcing, all of them positively influence the buying firm's operational performance and financial performance from the supply perspective.

Chapter 3: Research Framework and Research Questions

3.1 Research Framework and Model

The justification for the research framework is developed from the supply chain structure management and purchasing portfolio literature. As mentioned earlier, supply base structure has been considered as an important antecedent for a number of organizational performance dimensions such as productivity, effectiveness, efficiency, and so on (Tan et al., 1998). And without proper purchasing portfolio management in linking up of the supply chain, business cannot operate effectively (Van Weele 2005). This research studies the relationship between supply base structure and company performance, and suggests that various purchasing portfolio management capabilities of a company should impact the relationship of supply chain structure and company performance. The overall research framework is illustrated in figure 3-1.

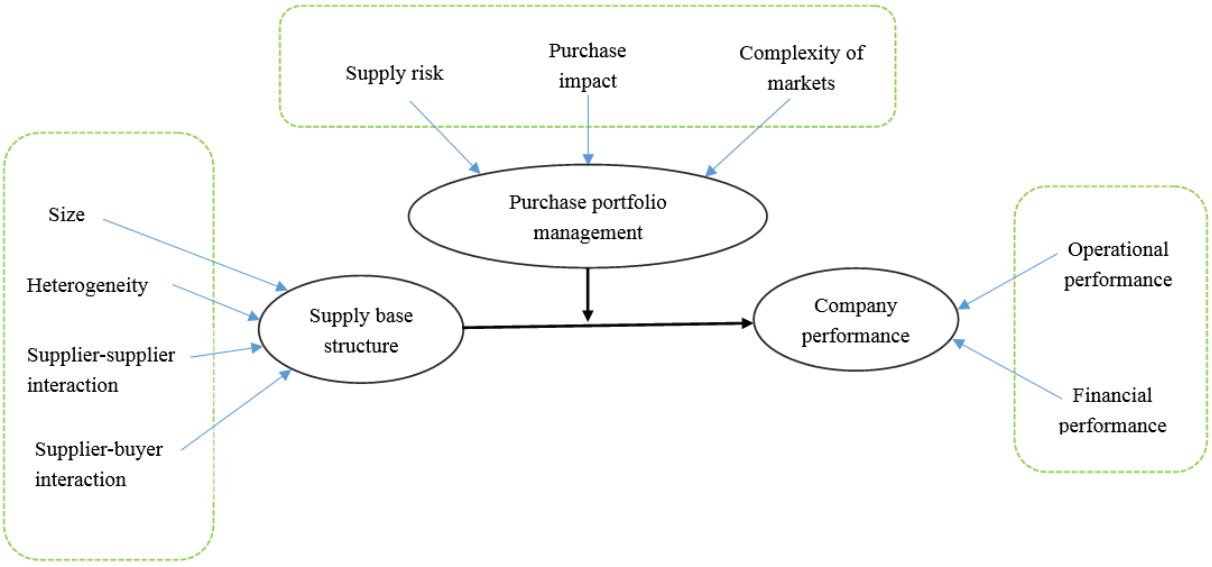

Figure 3-1 Initial Research Model 1

From the previous literature review, supply chain structure is composed of size, heterogeneous, supplier-supplier interaction and supplier-buyer interaction. Purchasing

portfolio management is defined with dimensions of supply risk, purchase impact and complexity of buyer's market. Also, company operational and financial performance is adopted as the measures of company performance in this research. The initial research model is proposed as shown figure 3-2. The underlying research questions are discussed next.

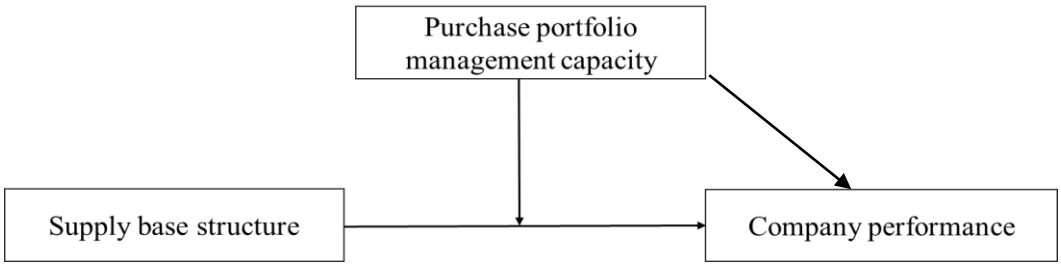

Figure 3-2 Initial Research Model 2

3.2 Research Questions

As mentioned earlier, a growing body of literature has suggested that the optimized supply base structure leads to the betterment of the firm performance. However, empirical evidence is still very limited. Hence, Question 1 is developed.

Question 1: How does supply base structure influence on company performance?

Furthermore, based on the reviewed literature, this suggests that purchasing portfolio management capabilities facilitate supply base structure for improving company performance. In other words, a firm would optimize the supply base structure better if the firm is equipped with better purchasing portfolio management capabilities (i.e. better categorizing the materials) across the supply chain.

Hence, the key research question is to identify which purchasing portfolio management capability variables play an important role in supply base structure for improving company performance, leading to research Question 2.

Question 2: How does purchasing portfolio influence the relationship between supply base structure and company performance?

From our literature review, it was demonstrated that purchasing portfolio management capability is associated with company performance. However, empirical evidence is still limited as to which purchasing dimensions of portfolio management capability drive company performance. Hence, Question 3 is developed.

Question 3: How does purchasing portfolio influence on company performance?

3.3 Summary

Based on the literature review in Chapter 2, the research framework and initial research model were developed in this chapter. The initial research model postulates that the identified purchasing portfolio management capability dimensions will impact the relationship of company performance and supply base structure, it provides better company performance through improving supply base structure. This is translated into 3 main research questions. The research methodology will be discussed next.

Chapter 4: Research Methodology

A triangulate approach was adopted in our study and in order to overcome some limitations of positivism and cross-sectional studies, we use qualitative method to obtain some initial research data via in-depth interviews with company senior purchasing managers or above level. The aim of qualitative is to get some suggestions about our research structure and make an initial judgment about the hypotheses we offered in this study. Actually, we modified our questionnaire based on the practical views of some senior managers. Subsequently a large sample base survey was carried to collect data for following statistical analysis which is the most important method of testing hypotheses in social science.

The qualitative and quantitative parts of the research are introduced in details as followings.

4.1 Qualitative Part: In- depth Interview

Interview is a kind of social science research method, which is widely used in the quantitative and qualitative research of social science to collect research data. And interview could be divided into the direct and indirect way. Semi-structured interview or in-depth interview was widely used in qualitative research and we adopted this way to carry our interview. Firstly, we design the interview syllabus as the basic framework of interview based on the research questions and objectives. Secondly, in the interview process, we could make elastic change according to the actual situation and specific interviewees particularly to reflect the high emphasis and sequence for the interview. Anyway, this kind of interview is more flexible than quantitative interview.

In this paper, we invited twenty enterprise employees to participate this interview which include eleven purchasing directors and above, and nine managers of purchasing department. And we designed these key questions (see Appendix 1) to explore the relationship between supply base structure and company performance, the relationship between purchasing

portfolio management and company performance, and make a further exploration about whether purchasing portfolio management is a moderator variable. And the results of interviews are summarized in Appendix 2.

From the interview summary, almost all participants have very similar views of supply structure that purchasing portfolio management has a positive impact on company performance. Every company that we interviewed thinks managing the supply base structure has positive impact on company performance. Specifically, effective management of supply base structure could improve service level, enhance buyer-seller relationship, reduce risks about productive process, etc. For some OEM enterprises, even though they have little power to choose suppliers, good relationship and effective management of supply base structure also improve performance and reduce risks.

In summary, the results could provide initial evidence and support to this study about the relationship between supply base structure and company performance.

4.2 Quantitative Part: Survey

In social sciences, quantitative research is the systematic empirical investigation of observable phenomena via statistical, mathematical or computational techniques. The process of measurement is central to quantitative research because it provides the fundamental connection between empirical observation and mathematical expression of quantitative relationships and the quantitative research can analyze the data with the help of statistics. On the other hand, qualitative research asks broad questions and collects word data from phenomena or participants and the researcher looks for themes and describes the information in themes and patterns exclusive to that set of participants. The above tells the difference between quantitative research and qualitative research.

Measurement often plays a more important role in quantitative research. To examine the hypotheses, we developed measurement scale to measure latent variables such as supply risk and financial performance based on the past literature. To guarantee the rationality of the scale, the survey instrument was pre-tested by the participants in the process of interview. In

view of their rich knowledge and practical experience in procurement management, we revised our questionnaire to make it easy to understand and answer. To make sure the rationality of questionnaire design, we adopted these methods as follows:

The formation of questionnaire: based on literature about supply base, purchasing management and company performance, designed the initial measurement items and combined with research purpose and we used multiple items to measure each construct in order to increase the reliability and validation of survey.

Revision of questionnaire: we revised the initial questionnaire via communication with experts in this area who include 2 professors, 2 associate professors and 3 doctoral students, all of them have researched on supply chain management in the long term. Considering the significance of theory, we invited 5 corporate executives to provide amendments. The revision contents include: the logical relation among items, the item wording and item deletion.

Improvement of questionnaire: the questionnaire was sent to 20 senior managers for pre-test, and we made the further modifications according to their feedback.

Bilingual translation of questionnaire: the questionnaire has Chinese and English versions and in order to reduce the semantic deviation, we invited two bilingual experts to translate the Chinese edition into English, then translated the English edition to Chinese again and make a comparison finally. If we find the semantic deviation, we could re-translate this part. Therefore, the survey was finalized for distribution to the sampling population.

4.2.1 Design of Survey Instrument

Based on proposed research conceptual model developed above, we designed the questionnaire combining with existing research literature to collect responses of each construct in supply base structure, purchasing portfolio management capacity and company performance as the research data. There are four sections in the questionnaire and the first section is related to the respondent's background information. We will introduce the structure of the questionnaire in details at below.

Section 1 is to collect the background information of every respondent. The information

was gathered to enable categorization of respondent's organization by:

- View point in answering the survey
- Industrial sector
- Company ownership
- Number of employees of company
- Annual sales revenue of company
- Job title/position of respondent
- Years of service in present company

Section 2 of the questionnaire is related to the construct of supply base structure which includes four dimensions: supply base size, heterogeneity, supplier-supplier interaction and supplier-buyer interaction. Melek Akın Ateş and Finn Wynstra (2015) elaborate on five supply base structure dimensions: size, heterogeneity, interaction, time and transparency, and discuss how they are related to cost and innovation strategies in purchasing.

Section 3 of the questionnaire is to collect responses related to purchasing portfolio management consisting of constructs of supply risk, purchase impact and complexity of markets. We adopted the Kamann matrix quadrant diagram which adds complexity of markets on basis of Kraljic analysis.

Section 4 of the questionnaire is to rate the change of company performance over the past three years. Perceived performance ratings are used in empirical studies because many respondents are unwilling to participate in survey with sensitive "hard" data. (Vickery et al., 1993, Ward et al., 1994). Actually, many previous researches used the published performance to establish casual relationships but they didn't produce the promising results (Bowersox et al., 1999). The reported performance data are usually the mixed performance result from multiple strategic business units. Therefore, we can't divide the part of performance that are contributed by managing supply base structure. The most respondents of the survey belong to the purchasing department and they don't have effective way to obtain the data of company's financial department. However, according to our interview results, we find that the purchasing cost always has an important impact on company performance and we have evidence to

believe the respondents have relatively accurate assessments on his/ her company performance. Hence, the use of perceived performance could provide a meaningful way to measure the company performance which consists of operational performance and financial performance in this research.

4.2.2 Constructs and Scales Development

The concept of construct is developed by American psychologist Kelly. Many scholars thought that the construct is unobservable and abstract, and it is associated with theory and model. Besides, construct must have a clear definition, for example, we use organizational relationship to describe the relations between employees and organizations, however this construct coincides with some mature factors, such as organizational commitment, leader and member exchange, trust and turnover intention, therefore, organizational relationship is not a reasonable construct. Another question we should consider is how to measure the construct. Normally, we use proxies or indicators to measure construct, for example, GPA could symbolize academic ability and ROE (Return on Equity) could measure the organizational performance. Another method is the usage of measurement scales, for example, we can use the list of turnover intention to measure the employee turnover intention.

In this part, we firstly introduced supply base structure, purchasing portfolio management construct and company performance construct. Secondly, we developed measurement scales of these constructs. Also, we summarized literature references of the measurement scales finally.

4.2.2.1 Supply Base Structure Construct

As mentioned in the part of literature review, Choi and Krause (2006) define the focal firm’s supply base as those suppliers that are actively managed through contracts and the purchase of parts, materials and services and introduce the size of suppliers, the differentiation among suppliers, the relationship among suppliers and the reliability of suppliers to reflect the complexity of supply base. The supply base structure depends on the supply base definitely, and there are two main streams of literatures which focus on better designing the supply base structure: research on supply base network and research on supply

base optimization methods.

Supply base structure was first coined as a term by Gadde and Hakansson (1994) who considered it as one of top three strategical issues in purchasing (i.e. supply base structure, make-or-buy and customer-supplier relationships). They argued that the number of suppliers and the way for suppliers to be organized should be considered as two aspects of supply base structure. Later, Choi and Krause (2006) broadened the definition as the degree of differentiation of the focal firm's suppliers, the overall number, and the degree to which they interrelate. The shape and the size of supply base are becoming increasingly important issues but the main focus has been on the number of suppliers (Holmen et al., 2007).

Melek Akın Ateş and FinnWynstra (2015) think there are five dimensions of supply base structure: Size (sourcing model such as single, dual, multiple), Heterogeneity (differentiation of suppliers such as technological, geographical, organizational, size), Interaction (supplier-supplier interaction such as competition, collaboration), Time (contract duration such as short-, moderate-, long-term), and Transparency (supplier information sharing such as operational, cost, technological). Therefore, according to supply base structure dimensions mentioned in the previous literature, we elaborate of four supply base structure dimensions: supply base size, heterogeneity, supplier-supplier interaction and supplier-buyer interaction.

Having the right number of suppliers has become a major consideration of firms for a long time (Richardsson, 1993). Some literature indicated that optimizing and rationalizing the supply base often refer to reducing the supplier numbers. It is argued that introducing new suppliers or reducing the old suppliers have many advantages respectively. Introducing new suppliers which is innovative could increase the competition level and reducing the number of suppliers to realize the integration of supply base could lead to cost reduction of raw materials for manufacturing companies. Additionally, in order to achieve better quality control and improve cooperative relationships between supply chain partners, recent advances in the supply base management have a favor to use fewer suppliers even one supplier (Seong-Hyun Nam et al., 2009). It is an important strategic purchasing decision to select an appropriate number of suppliers for each purchase category (Faes and Matthyssens, 2009). There are several types of sourcing modes such as single, dual and multiple sourcing (Richardsson,

1993). The intent of a sole sourcing strategy is to reduce complexity, minimize the total purchasing cost and improve the quality of inputs in the long run (Seong-Hyun Nam et al., 2009). Ramasesh et al. (1991) studied how a two-supplier system can create more value and efficiency in production in a situational context where uncertainty in lead times is high but the ordering costs are low. A third strategy is to optimize the number of suppliers supporting the supply base. Multiple sourcing is also useful as a hedge against the risk of supply disruption. In our measurement scales, we design questions to measure the supply size of firms in three aspects as discussed above.

The second construct of supply base structure is supplier heterogeneity. The supply base size is an important determinant of the operational load born by the focal firm, but that heterogeneity among the suppliers further contributes to this operational load and complexity (Choi and Krause, 2006). Choi & Krause (2006) indicated that the differentiation of suppliers is defined as "the degree of different characteristics such as geographical separation, operational practices, technological capabilities and organizational cultures that exist between the suppliers in the supply base". Choi & Krause (2006) summarized that the supply base complexity is mainly embodied in operational practices, cross-border barriers or varying levels of technical capability. It is suggested that managing the different suppliers could produce extra operational burden and coordination costs, in other words, the supply base heterogeneity has negative impact on the performance. However, from the point of technological diversity, homogenous suppliers might lack the diversity of knowledge for innovation which might result in declining the buying firm's new product creativity. We measure the heterogeneity from four items: technical capabilities, organizational structures, geographical separation and the size difference that exist among the suppliers in the supply base.

The third dimension of supply base structure is supplier-supplier interaction. Wynstra et al., (2003) point out that the relationships between two firms cannot be considered in isolation from relationships with and between other firms. Cooperation and competition are the common ways of interaction between suppliers. The buying firms often keep a high level of competition between their suppliers in order to obtain the advantageous prices of raw

materials and also promote the innovation performance. Another form of interaction between is cooperation. Dubois and Gadde (2000) affirm that more and more collaboration between suppliers take place with or without intervention of the buying firm. Some researches argue that the focal firm's suppliers could cooperate through sharing patents to achieve the technology complementary and improvement. In addition to exchange of physical goods, information exchange often occurs in supplier-supplier interaction. Some evidences showed the focal firm would welcome the supplier-supplier interaction if the information exchange among suppliers is for better coordination of product quality, product specification or delivery timing (Choi & Krause, 2006).

Buyer-supplier relations have received ample attention in the literature. We set many items to measure the last dimension of supply base structure including the location of firm's suppliers, the capital investment which is not re-deployable for other buyers, collaboration within different suppliers, product-specificity equipment to produce specific products, exclusive contracts with suppliers about technology, information and business, transaction cost, quality improvement, cost reduction, contract duration and trust in suppliers about price and quality. Most of the items we considered are from the previous literatures. For instance, Handfield & Nichols J R (2004) indicated that supplier involvement on project team is very important when technology is complex and the suppliers have a high level of expertise in this area. They share information and better utilize suppliers' expertise in the productive process to achieve better performance and long-term collaboration. Some scholars also thought maintaining positive buyer- supplier relationships when buying firm faces difficult economic times is very difficult but important. The buying firm should explain the need for cost reductions and the suppliers should understand the economic realities the buying firm faces. Buying firm is more willing to build long- term relationships with the selected suppliers.

Some of them were adopted in view of the practical needs according to the results of the structured interview. For example, many senior managers think that sometimes the collaboration between different suppliers were intervened by the focal company and this strategy such as pre-assembling could reduce the total cost, hence we consider it as an item to measure the supplier-buyer interaction. As you can see the procedure when we design the

measurement scales, we read previous literatures for references and combine with our research cores to form the original edit, then we conduct interview with managers in company and solicit their opinions to make up the missing but important points in practical operation. Hence, to a great extent, we could guarantee the measurement scales is reliable. Please see table 4-1: for the summary of the measurement scales of supply base structure construct.

Table 4-1 Measurement Scales of Supply Base Structure Construct

Construct	Label	Scales	Reference
Size	B-1-1 B-1-2 B-1-3	introduces new suppliers reduces suppliers number sourcing modes	Choi and Krause, 2006; Tully, 1995; Richardsson, 1993; Watts and Hahn 1993
Heterogeneity	B-2-1 B-2-2 B-2-3 B-2-4	technical capabilities organizational structures geographical separation the size difference	Choi and Krause, 2006; Gao et al., 2015
Supplier-supplier interaction	B-3-1 B-3-2	competition cooperation	Choi et al., 2002; Brandenburger &Nalebuff, 1996; Gadde and Hakansson, 1994)
Supplier-buyer interaction	B-4-1 B-4-2 B-4-3 ⋮ B-4-10	suppliers' location the capital investment collaboration ⋮ trust in suppliers	Handfield & Nichols Jr 2004; Choi and Krause, 2006; Holmen et al., 2007; Tully, 1995; Swink et al.,2007

4.2.2.2 Purchasing Portfolio Management Construct

As mentioned in the second chapter, most manufacturing enterprises purchase many kinds of raw materials which show difference in type, value, characteristic and other aspects. Hence, the first step for purchasing department is to classify the materials. The most common methods are Activity Based Classification and Kraljic Matrix Classification. In this paper, we adopted the Kamann matrix quadrant diagram which adds complexity of markets on basis of Kraljic analysis. This three-dimensional model (supply risk, complexity of market and purchase impact) not only reflects the complexity of supplier market (from the perspective of purchasers), but also reports the market of buyers (from the point of view of suppliers).

Purchase management consists of many classic activities of the firms such as planning, purchasing and sales. These actions aim to attain the objective of managing the network for vendor and supplier and product categories as strategic business units to create a range of appropriate structure that will best suit the customer and will increase profits. Category management has developed gradually with increasing cooperation manufacturers and suppliers (Bohuslava Mihalčováa & Michal Pružinskýa, 2015). Hence, according to previous literature, we think that purchasing portfolio management in purchasing process could play a moderating factor in the relationship between supply base structure and company performance.

The first construct of this part is supply risk. Managing the supply risk refers to minimizing potential negative events which might occur in procuring the goods and services from the suppliers and they think these risks include the supplier responsiveness which addresses the timeliness of the movement of goods and suppliers' ability to meet changing requirements and services such as in-time delivery (Choi & Krause, 2006). According to Zsidisin (2001), supply risk is defined as "the potential occurrence of an incident associated with … suppliers of the supply [base] in which its outcomes result in the inability [of a focal company] to meet [its] customer demand". Hence, the negative events which hinder the focal firm could associate with the supply risk in most situations. We develop seven items to measure the supply risk construct such as supply availability, supply reliability, technologies' autonomy and patents' legitimacy, external risks, sustainability of suppliers, the entry barrier and financial risk. Additionally, we add the items of technology autonomy and patents legitimacy and internal and external risks under the guidance of respondents who we interviewed.

Kamann divided the products into four categories: ordinary products, patent products, customized products and designed products by customer in the point view of suppliers. Refer to the above classifications, we develop three items to measure the complexity of market consisting of the degree of customization of raw materials, the diversity of buyers of raw materials and the number of buyers of raw materials. These items above are reconsidered and revised after the interviews, hence, we have confidence that our items could represent these

constructs to a great extent.

The other dimension of Kraljic analysis says purchase impact, with the supply risk, divide categories into four types: low supply risk and high purchase impact – leverage, high supply risk and low/moderate purchase impact – bottleneck, low supply risk and low purchase impact – non-critical and moderate/high supply risk and high purchase impact – strategic. We set 2 items to measure purchase impact construct: the proportion of purchasing cost in the total cost and the impact of purchasing volume on the total cost. We will carry the validity analysis in the following chapter.

We summarized the main literature sources of measurement scales of purchasing portfolio management construct as table 4-2.

Table 4-2 Measurement Scales of Purchasing Portfolio Management Construct

Construct	Label	Scales	Reference
Supply risk	C-1-1	supply availability	Choi and Krause, 2006; Zsidisin, 2001; Handfield and Nichols, 1999; Krause and Handfield, 1999; Luthmann, 1995;
	C-1-2	supply reliability	
	C-1-3	technologies' autonomy and patents' legitimacy	
	C-1-4	external risks	
	C-1-5	sustainability of suppliers	
	C-1-6	the entry barrier	
	C-1-7	financial risk	
Complexity of buyer market	C-2-1	customization of raw materials diversity of raw materials	Choi and Krause, 2006; Dooley, 2002
	C-2-2	number of buyers	
Purchase impact	C-3-1	the proportion of purchasing cost in the total cost	Fitzgerald 1996; Melek Akın Ateş et al., 2015
	C-3-2	the impact of purchasing volume on the total cost	

4.2.2.3 Company Performance Construct

The extant literature refers to numerous researches and studies proposing different types and dimensions of performance measures and metrics in a supply chain environment (Handifield and Nichols, 1999). And the research content is enriched from a single enterprise

to the whole performance of the supply chain. Neely (1995) argues that there are four basic aspects of performance assessment: quality, cost, flexibility and delivery time. Many scholars think service and innovation are also the key factors in measuring the company performance. In line with these perspectives, Supply Chain 2000 research (Bowersox et el., 1999) developed 14 items to measure company performance including the aspects of cost management, quality, customer service, productivity and asset management.

There is a common categorization which is to divide performance into financial and non-financial performance. However, they have failed to represent measurements in a balanced framework. Some researchers have concentrated on operational measures when most companies have paid more attention to financial measures. In this paper, we measure company performance from the aspects of operational performance and financial performance. Reference to previous literature, we developed 5 items including delivery lead-times, inventory turn-over rates, on time deliveries to customer and total cost of quality in production and three items consisting of average return on investment, average profit and profit growth to measure operational and financial performance respectively. Items are scored in 7-point Likert scales, ranging from "1= substantially worse" to "7= substantially better" in operational performance part and "1=well below industry average" to "7= well above industry average" in the financial performance part.

Please see table 4-3 for the summary of measurement scales of company performance construct.

Table 4-3 Measurement Scales of Company Performance Construct

Construct	Label	Scales	Reference
Operational performance	D-1-1 D-1-2 D-1-3 D-1-4	delivery lead-time inventory turn-over rates on time deliveries to customer total cost of quality in production	Germain and Iyer, 2006; Fawcett and Clinton, 1996; Stank and Lackey, 1997
Financial performance	D-2-1 D-2-2 D-2-3	average return on investment average profit profit growth	Beamon and Ware, 1998; Ittner, 2008; Germain and Iyer,2006;

4.2.3 Content Validity

Content validity (logical validity) refers to the extent to which a scale truly measured represents all facets of a given construct that is intended to measure. It is the degree to which an instrument has an appropriate sample of items for the construct being measured and is an important procedure in scale development. In other words, content validity refers to how accurately an assessment or measurement tool taps into the various aspects of the specific construct in question, do the questions really assess the construct in question, or are the responses by the person answering the questions influenced by other factors? Content validity is most often measured by relying on the knowledge of people who are familiar with the construct being measured. Theses subject-matter experts are usually provided with access to the measurement tool and are asked to provide feedback on how well each question measures the construct in question. Their feedback is then analyzed and informed decisions can be made about the effectiveness of each question. Assessment and measurement tool like surveys and questionnaires are quite common in the social and behavioral sciences. For instance, a depression scale may lack content validity if it only assesses the affective dimensions of depression without taking into account the behavioral dimension. Content validity index (CVI) is the most widely used index in quantitative evaluation.

To establish validity for the survey instrument in this research, we reviewed extensive literature about supply base structure, purchasing management and company performance prior to the development of the instrument. Also, to ensure the items collected to represent the constructs domains, we conducted a small pre-test to evaluate the appropriateness of content combining with the interview process. Moreover, we have the field of experts to conduct an overall check of the survey. Therefore, we have confidence in the content validity of the revised questionnaire.

4.2.4 Data Sampling Population

The data sampling population consists of three groups of respondents:

The purchasing or supply chain executives listed in the directory of China Supply Chain & Operations Management Club (SCOM) which is a platform that provides and shares professional knowledge, career development and social fellowship for supply chain and

operations managers of Chinese manufacturing, trading and retailing.

The purchasing or supply chain executives listed in the directory of the Council of Supply Chain Management Professionals (CSCMP) which founded in 1963, and about 14,000 individuals in the organization have responsibilities in logistics, supply chain management and related functions. It provides educational, networking opportunities and career development to members.

Personally invited purchasing or SCM practitioners (invited respondents).

4.2.5 Data Collection and Data Processing

We adopted three ways to distribute the questionnaire: interviews, e-mails and the questionnaire distribution platform through the internet website which is called Le Diao Cha (http://www.lediaocha.com). For details, we collected 29 complete responses through e-mails and all of them are usable and effective. We have Chinese edition and English edition through an online survey platform named Le Diao Cha, after many weeks of survey period was completed, we collected 24 complete English questionnaires and complete responses. Also, we distributed 15 questionnaires to the respondents who are interviewed and all of them answer the questions are objective and complete. However, this part of collecting process is used to do the pre-test for the reliability and rationality of the finalized questionnaires, therefore, we did not use the part of data for data analysis because we revised the questionnaire after interview. Luckily, there are almost no missing data though missing data is a very common problem in empirical research. The main reason is that the platform Le Diao Cha did not allow submitting answers if there are missing questions. Please see table 4.4 for the summary of response statistics.

Table 4-4 Response Statistics

Response Statistics	English edition respondents	Chinese edition respondents	E-mail respondents	Total respondents
Potential respondents	60	264	29	353
Complete response	24	166	29	219
Usable response	18	119	29	166
Effective Response Rate	30%	45%	100%	47%

From the table 4-4, it can be seen that total effective response rate is relatively low because of two reasons: first, there are too many uncompleted responses. Second, we deleted about 53 unreliable data according to two criteria: the time of answering the questionnaire is less than 3 minutes and the same answer for 8 eight questions in a row. They were considered non-usable response and removed from the database if they meet any of the criteria above. This resulted in 166 responses considered valid for the following data analysis through data processing.

4.3 Summary

This chapter mainly introduced the development of survey instrument based on the extensive literature review, qualitative input and pre-tests from experts. Hence, the content validity of constructs in the research model was guaranteed. The data base reserved finally is reliable and effective after data processing. The next chapter we will address the validation of measurement scales and factor analysis in order to confirm the constructs dimensions of the proposed research model. Then we establish the hypotheses for testing the revised research model

.

Chapter 5: Validation of Measurement Scales

In order to verify the hypotheses for the research on the impact of supply base structure and company performance, in this paper we used the methods of distributing questionnaire for data collection, then used the SPSS 19.0 for doing the variables analysis. Using this software to do the standardized and systematic validation processes of hypotheses includes descriptive statistics, correlation analysis, reliability and validity test.

5.1 Descriptive Statistics

Descriptive statistical analysis is used to describe the characteristics of a set of samples or the connection of variables, to summarize and explain the sample data.

We summarize the background information of the 166 valid responses through these charts and tables below which include the view in answering the survey, industrial sector, company ownership, number of employees of company, annual sales of respondent and years of service in present company.

5.1.1 Point of View in Answering The Survey

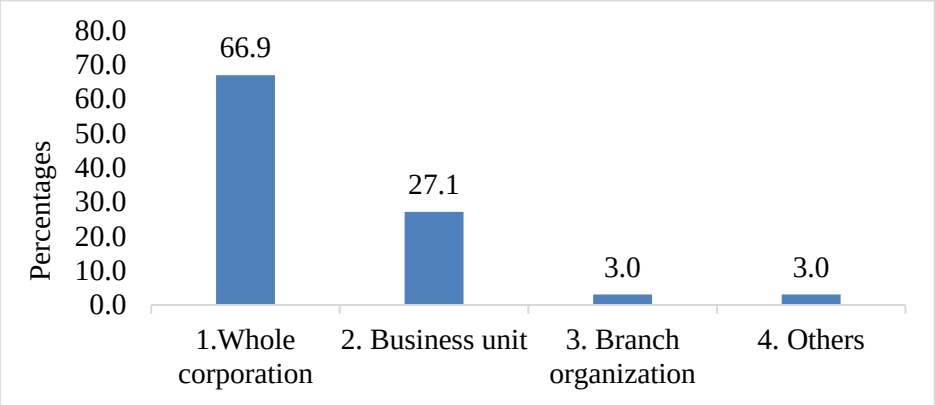

Figure 5-1 Respondents' Point of View in Answering The Survey

As chart 5.1 illustrates, 66.9% of respondents responding to the survey express their

point of view at the whole corporation level, followed by the business unit level (27.1%) and the proportion of branch organization is only 3%. This question was asked to guarantee the respondents could adopt the same point of view without causing the mixed results. Moreover, the distribution of the point of view in answering the question is suitable because we thought that respondents at the level of Whole Corporation or the Business Unit could have more accesses to get the information about performance in our survey.

5.1.2 Industry Sector

Table 5-1 Industry Sector of Respondents' Organization

`	Percentages of valid respondents
1. Manufacturing	79.5%
2. Wholesaler, Distributor, Retailer	6.6%
3. Logistics Service Provider	7.8%
4. Others	6.0%
Total	100%

As demonstrated in the table 5.1, most of the respondents came from the manufacturing industry sector (79.5%), followed by the logistics service provider (7.8%) and the wholesaler, distributor, retailer (6.6%). The main object of the questionnaire is the senior procurement staff, therefore, we chose the manufacturing industry as our main industry sector. In order to protect the experimental results from the impact of variations across industries, only three major industries were selected in our survey.

5.1.3 Company Ownership

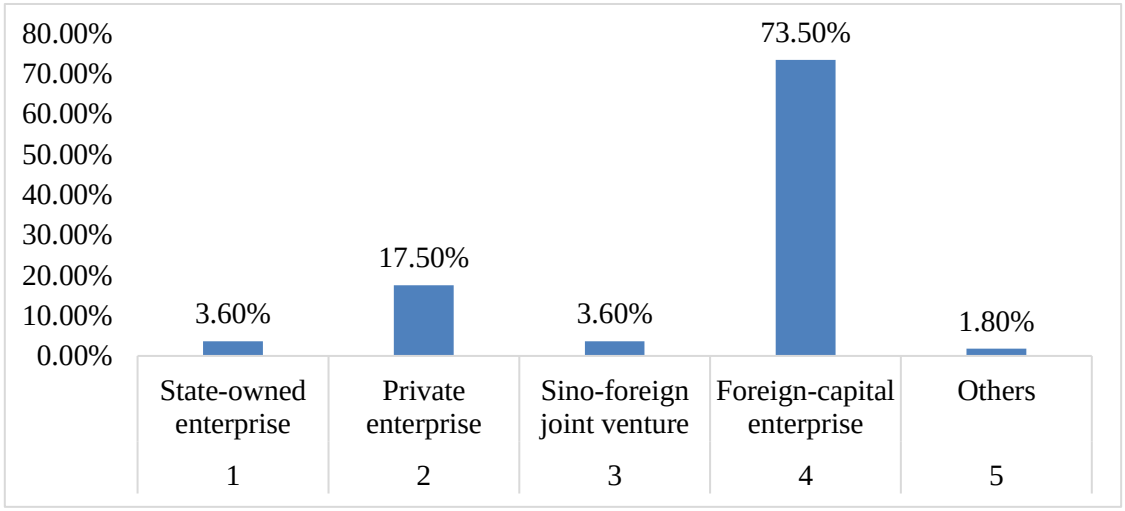

Figure 5-2 Company Ownership

From the chart 5.2 we can see that most companies we surveyed are Foreign-capital enterprise (73.5%), followed by the private enterprise but it is only 17.5% of total. We set the question to have the good understanding of the nature of the firms that we studied. Many studies have indicated that there are differences such as the aspects of the enterprise culture and company management between the foreign-capital enterprise and the domestic enterprise, however, this is not a research topic of the paper.

5.1.4 Number of Employee

Table 5-2 Number of Employee of Respondents' Organization

No. of employee	Percentages of valid respondents
1. Less than 500	46.4%
2. 500 – 2000	18.7%
3. 2001 – 3000	10.2%
4. 3001 - 500	7.8%
5. More than 5000	16.9
Total	100%

From the table 5-2 above it can be seen that most respondents came from the companies with less than 500 employees (46.4%), followed by firms with 500- 2000 employees (18.7%)

and companies with 2001-3000 employees (10.2%). Also, that means more than 50% of respondents' organizations have more than 500 employees in our survey.

5.1.5 Annual Sales Revenue

Table 5-3 Annual Sales Revenue

Annual sales revenue	Percentages of valid respondents
1. Less than USD 50 million	33.7%
2. USD 50 – 300 million	25.9%
3. USD 301 – 500 million	10.2%
4. USD 501 million – 1 billion	9.6%
5. More than USD 1 billion	20.5%
Total	100%

The table shows that 33.7% of the companies we surveyed with the annual sales revenue less than USD 50 million and the proportion of firms with revenue more than 50 million is more than 60%. Actually, usually there is some relationship between the enterprise scale and the annual revenue as some literatures indicated, however we did not involve this research area in this paper.

5.1.6 Job Title / Position

Table 5-4 Job Title

Job title / position	Percentages of valid respondents
1. Executive (buyer, operations supervisor, SCM coordinator)	8.4%
2. Manager	39.2%
3. Director/Senior Manager	36.7%
4. Vice President or above	12.7%
5. Others	3.6%
Total	100%

Most of respondents' job title/position is manger (39.2%) or director/senior manager (36.7%). In other words, more than 85% of the respondents were employed at the managerial level or above. Job title reflects the degree of contacting the company information in most

situations. The higher level of respondents, the more information they know. This distribution of job title in the survey is beneficial to our data reliability.

5.1.7 Years of Service in Present Company

Table 5-5 Respondents' Years of Service in Present Company

Years of service in present company	Percentages of valid respondents
1. Less than 3 years	17.5%
2. 3 - 5 years	13.9%
3. 5 - 8 years	18.1%
4. 8 – 10 years	12.7%
5. More than 10 years	38.0%
Total	100%

The table 5-5 shows that 38% of respondents in our survey serviced their working companies for more than 10 years and about 70% respondents had more than 5 years of service in their present companies. Therefore, we can infer that most respondents have a good comprehensive view of their firms and their company performance in recent 3 years. This increases the reliability of our survey.

5.1.8 Descriptive Statistics for Each Response Variable

Table 5-6 Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Size	166	1.00	7.00	5.0984	1.20508	1.452
Heterogeneity	166	1.00	7.00	4.5562	1.38700	1.924
Supplier-buyer interaction	166	1.50	7.00	4.5934	1.10454	1.220
Supplier-buyer interaction	166	1.83	6.67	5.0171	1.02931	1.059
Supply risk	166	2.38	4.88	3.6468	.49332	.243
Purchase impact	166	2.25	5.75	4.0377	.64937	.422
Complexity of markets	166	2.00	7.00	4.8916	1.11477	1.243
Operational performance	166	2.00	6.80	4.9000	.86711	.752
Financial performance	166	1.00	7.00	4.3594	1.23364	1.522
Valid N	166					

From table 5-6, the minimum and maximum scores for the variables are ranged from 1 to 7. The standard deviation ranged from 0.49 (supply risk) to 1.39 (heterogeneity) and the

variance ranged from 0.243 (supply risk) to 1.9 (heterogeneity), they indicated that the data variation was the most in heterogeneity variable and the least in supply risk variable.

5.2 Item Analysis

5.2.1 t-Test

In this paper, we use 27% of the high- and low-score groups as the classification basis. Then t-test was performed on the high- and low-score groups to observe the significance of difference between high-score group and low-score group of each item. According to the previous criteria, the t-value must be more than 3 and the value of significance probability should be less than 0.05 in this paper.

5.2.2 Correlation Analysis

Correlation is a term that refers to the strength of a relationship between two variables. A strong or high correlation means that two or more variables have a strong relationship with each other while a weak or low correlation means that the variables are hardly related. Correlation analysis is used to test the significance of the relationship between two variables. From the analysis, we can know the following three things: firstly, how close is the relationship between two variables concerned? Secondly, whether the relationship is significant or not? Thirdly, what is its direction, positive or negative? Positive direction refers to the case where two variables are varied in the same direction, while negative direction, to the case where two variables are varied in the opposite direction. When we read and interpret the results, the following two rules should be remembered：Not all significant findings at the 95% level of confidence are equal important. The significant, high correlation between two variables does not necessarily mean that there exists a causal relation between them.

This paper examined the correlation matrix of supply base structure (Size, heterogeneity, Supplier-buyer interaction, and Supplier-buyer interaction), purchasing portfolio management (supply risk, market complexity, and purchase impact) and company performance (operational performance, financial performance) through Pearson Correlation analysis and examined

whether the research variables were significantly correlated. In this paper, the Item to Total correlation coefficients of not less than 0.40 were taken as the evaluation indicators of the Item and Total correlation strength.

5.2.3 Reliability

Reliability in statistics is the overall consistency and stability of the measure results which can be understood in the probability of obtaining the same observation data (results) for the same object when using the same method. It is said that the measure has a high reliability if it produces similar results under consistent conditions. Higher reliability means that the stronger ability to exclude random errors. Reliability indicators such as stability, equivalence and internal consistency are most commonly used in empirical studies. In this paper, we mainly test the internal consistency to focus on the differences of measurement results which caused by different items and use Cronbach's α coefficient as the test indicator. According to the existing empirical research, the minimum acceptable Cronbach's α coefficient of the items under the first order index is 0.6. And the items under the secondary index, the Cronbach's α coefficient requires more than 0.7.

5.2.4 Commonality and Factor Loadings

The significance of commonality is to describe the retained degree of the information about the original variable when the original variable is replaced by a common factor. The item with lower commonality shows less homogeneity with the scale, it could be deleted through consideration. Factor loading represents the degree of relationship between item and factor. The higher the factor loading is, the closer relationship between the item and the total scale is. In general, if the commonality value is less than 0.2 (at this moment, the factor loading is less than 0.45), it means that the relationship between the item and the common factor is not close. Under this condition, this item could be deleted.

5.3 Common Factor Analysis

Common factor analysis is a mathematical model which attempts to explain the

correlation between a large set of variables in terms of a small number of underlying latent variables (factors). A major assumption of factor analysis is that it is not possible to observe these factors directly. The variables depend upon the factors but are also subject to random errors. Construct validity is the degree to which a test measures what it claims, or purports, to be measuring (Anastiasi, 1998). Construct validity is the appropriateness of inferences made on basis of observations or measurements (often test scores), specifically whether a test measures the intended construct. Factor analysis could be used to measure the construct validity of the scale. There exist two types of factor analysis: Exploratory factor analysis (EFA) is used to identify complex interrelationships among items and group items that are part of unified concepts. The researcher makes no a priori assumptions about relationships among factors. Confirmatory factor analysis (CFA) is a more complex approach that tests the hypothesis that the items are associated with specific factors. CFA uses structural equation modeling to test a measurement model whereby loading on the factors allows for evaluation of relationships between observed variables and unobserved variables.

In this paper, we tested the validity based on the large samples data from the questionnaire, and judged whether the scale was suitable for factor analysis by Kaiser-Meyer-Olkin (KMO) measure and Bartlett Test of Sphericity. The judgment criteria are: when KMO>0.9, pretty good; when 0.8<KMO<0.9, very good; when 0.7<KMO<0.8, general good; when 0.6<KMO<0.7, fairly good; and when KMO<0.6, not good. Meanwhile, Bartlett ball test statistics should be significantly different from zero. The SPSS19.0 software was used to carry out the exploratory factor analysis. In particular, the principal component analysis method was applied and the maximum variance method of rotation was adopted in this paper.

5.4 Supply Base Structure Constructs

5.4.1 The Scale Analysis of Supply Base Structure

Based on the research of previous scholars, we have designed 4 constructs with totaling 18 items for supply base structure, including 3 items for supplier number labeled b-1-1, b-1-2,

and b-1-3; 3 items for supplier heterogeneity labeled b-2-1, b-2-2, and b-2-3; 2 items for the relationship between the suppliers of the same category labeled b-3-1, b-3-2, and 10 items for the supplier-buyer relationship labeled from b-4-1 to b-4-10. According to the item analysis method, we add an item labeled b-total. This item refers to the total score item of measurement score of 18 items. Please refer to Table 5.7 below for the specific classification and meaning of the items.

Table 5-7 Items of Supply Base Structure

Constructs	Label	Items
Size	b-1-1	Introduce new suppliers to increase the innovation level
	b-1-2	Reduce the number of suppliers to realize the integration of supply base
	b-1-3	My organization sources from multiple suppliers for the same material
Heterogeneity	b-2-1	Suppliers are different in product technology
	b-2-2	Suppliers are located at different geographical areas
	b-2-3	Suppliers have different organizational structures
Supplier-supplier interaction	b-3-1	Compete each other in market
	b-3-2	My suppliers cooperate through sharing patents
Supplier-buyer interaction	b-4-1	My suppliers located near my organization
	b-4-2	My suppliers invest capital equipment which is not re-deployable for other buyers
	b-4-3	Different Suppliers collaborate to reduce the total cost
	b-4-4	My organization provides suppliers with product-specificity equipment to produce specific products
	b-4-5	My organization signs exclusive contracts with suppliers about technology, information and business
	b-4-6	My suppliers have high transaction cost
	b-4-7	My organization assists supplier in quality improvement
	b-4-8	My organization assists supplier in cost reduction
	b-4-9	My organization signs average long contract duration
	b-4-10	My organization trusts the supplier to be fair in price and quality

5.4.1.1 t-Test

Using SPSS19.0 statistical analysis software, we divided the samples into high-and low-score groups (see Appendix 4) and conducted t-test to observe the difference between the high- and low-score groups of their respective item (results in table 5-8). It can be seen that the p-value of each item about supply base structure reached the level of significance (0.05) and the t-value were more than 3. Hence, we think that all the items should be accepted.

Table 5-8 Independent Samples Test of Supply Base Structure

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
b-1-1	Equal variances assumed	34.805	.000	6.81	91	.000	2.092	.307	1.482	2.701
	Equal variances not assumed			6.70	69.245	.000	2.092	.312	1.469	2.714
b-1-2	Equal variances assumed	27.924	.000	7.72	91	.000	2.347	.304	1.744	2.951
	Equal variances not assumed			7.61	72.871	.000	2.347	.308	1.733	2.961
b-1-3	Equal variances assumed	34.222	.000	5.42	91	.000	1.758	.324	1.114	2.403
	Equal variances not assumed			5.32	65.899	.000	1.758	.330	1.099	2.418
b-2-1	Equal variances assumed	19.265	.000	8.53	91	.000	2.311	.271	1.773	2.849
	Equal variances not assumed			8.42	75.108	.000	2.311	.274	1.765	2.858

b-2-2	Equal variances assumed	21.345	.000	7.44	91	.000	2.399	.322	1.758	3.039
	Equal variances not assumed			7.32	69.782	.000	2.399	.328	1.745	3.052
b-2-3	Equal variances assumed	20.166	.000	7.04	91	.000	2.286	.325	1.641	2.931
	Equal variances not assumed			6.94	74.094	.000	2.286	.329	1.630	2.942
b-3-1	Equal variances assumed	102.934	.000	7.64	91	.000	2.251	.295	1.666	2.837
	Equal variances not assumed			7.437	51.590	.000	2.251	.303	1.644	2.859
b-3-2	Equal variances assumed	.103	.749	4.10	91	.000	1.304	.317	.674	1.935
	Equal variances not assumed			4.10	90.591	.000	1.304	.317	.673	1.935
b-4-1	Equal variances assumed	9.561	.003	5.20	91	.000	1.654	.318	1.023	2.285
	Equal variances not assumed			5.16	83.179	.000	1.654	.320	1.017	2.291
b-4-2	Equal variances assumed	29.809	.000	8.376	91	.000	2.044	.244	1.560	2.529
	Equal variances not assumed			8.19	59.934	.000	2.044	.249	1.545	2.543
b-4-3	Equal variances assumed	15.451	.000	8.90	91	.000	2.304	.259	1.790	2.818
	Equal variances not assumed			8.79	76.617	.000	2.304	.262	1.782	2.826
b-4-4	Equal	21.404	.000	8.52	91	.000	2.508	.294	1.924	3.093

	variances assumed									
	Equal variances not assumed			8.39	71.766	.000	2.508	.299	1.913	3.104
b-4-5	Equal variances assumed	7.853	.006	6.91	91	.000	2.250	.325	1.604	2.896
	Equal variances not assumed			6.86	82.999	.000	2.250	.328	1.598	2.902
b-4-6	Equal variances assumed	6.131	.015	3.83	91	.000	1.136	.297	.547	1.725
	Equal variances not assumed			3.79	81.528	.000	1.136	.299	.541	1.731
b-4-7	Equal variances assumed	82.758	.000	10.3	91	.000	3.035	.293	2.453	3.616
	Equal variances not assumed			10.1	54.565	.000	3.035	.300	2.433	3.636
b-4-8	Equal variances assumed	77.965	.000	11.1	91	.000	2.864	.258	2.352	3.376
	Equal variances not assumed			10.8	53.336	.000	2.864	.265	2.333	3.395
b-4-9	Equal variances assumed	36.698	.000	8.30	91	.000	2.414	.291	1.837	2.991
	Equal variances not assumed			8.16	68.445	.000	2.414	.296	1.824	3.004
b-4-10	Equal variances assumed	13.626	.000	6.04	91	.000	1.744	.289	1.171	2.318
	Equal variances not assumed			5.96	76.713	.000	1.744	.292	1.162	2.327

5.4.1.2 Correlation Analysis

Table 5-9 shows the correlation coefficient of item- total, from the first column of the table, we can see that most item- total correlation coefficients is less than 0.4 except the item b-3-2 and item b-4-6, however, these two items correlation shows statistically significant. Hence, we can temporarily keep these two items and it is basically considered that the homogeneity of items and the whole scale can be accepted. Please check out the Appendix 13 for more details.

Table 5-9 Correlations of Supply Base Structure

		b-total	b-1-1	b-1-2	b-1-3	…	b-4-8	b-4-9	b-4-10
b-total	Pearson Correlation	1	.709**	.615**	.495**	….	.809**	.705**	.613**
	Sig. (2-tailed)		.000	.000	.000	…	.000	.000	.000
	N	166	166	166	166	…	166	166	166
b-1-1	Pearson Correlation	.709**	1	.462**	.352**	…	.566**	.471**	.438**
	Sig. (2-tailed)	.000		.000	.000	…	.000	.000	.000
	N	166	166	166	166	…	166	166	166
b-1-2	Pearson Correlation	.615**	.462**	1	.123	…	.502**	.430**	.348**
	Sig. (2-tailed)	.000	.000		.114	…	.000	.000	.000
	N	166	166	166	166	…	166	166	166
b-1-3	Pearson Correlation	.495**	.352**	.123	1	…	.389**	.227**	.224**
	Sig. (2-tailed)	.000	.000	.114		…	.000	.003	.004

	N	166	166	166	166	…	166	166	166
b-2-1	Pearson Correlation	.571**	.383**	.339**	.215**	…	.340**	.387**	.312**
	Sig. (2-tailed)	.000	.000	.000	.005	…	.000	.000	.000
	N	166	166	166	166	…	166	166	166
b-2-2	Pearson Correlation	.575**	.401**	.345**	.232**	…	.335**	.285**	.284**
	Sig. (2-tailed)	.000	.000	.000	.003	…	.000	.000	.000
	N	166	166	166	166	…	166	166	166
b-2-3	Pearson Correlation	.640**	.375**	.442**	.238**	…	.483**	.366**	.330**
	Sig. (2-tailed)	.000	.000	.000	.002	…	.000	.000	.000
	N	166	166	166	166	…	166	166	166
b-3-1	Pearson Correlation	.722**	.618**	.423**	.462**	…	.615**	.513**	.426**
	Sig. (2-tailed)	.000	.000	.000	.000	…	.000	.000	.000
	N	166	166	166	166	…	166	166	166
b-3-2	Pearson Correlation	.237**	.172*	.080	.067	…	.082	.054	.074
	Sig. (2-tailed)	.002	.027	.306	.391	…	.294	.489	.342
	N	166	166	166	166	…	166	166	166
b-4-1	Pearson Correlation	.496**	.341**	.247**	.274**	…	.444**	.346**	.253**
	Sig. (2-tailed)	.000	.000	.001	.000	…	.000	.000	.001

	N	166	166	166	166	…	166	166	166
b-4-2	Pearson Correlation	.604**	.393**	.323**	.387**	…	.497**	.291**	.257**
	Sig. (2-tailed)	.000	.000	.000	.000	…	.000	.000	.001
	N	166	166	166	166	…	166	166	166
b-4-3	Pearson Correlation	.573**	.305**	.279**	.213**	…	.532**	.405**	.210**
	Sig. (2-tailed)	.000	.000	.000	.006	…	.000	.000	.007
	N	166	166	166	166	…	166	166	166
b-4-4	Pearson Correlation	.551**	.299**	.242**	.202**	…	.361**	.304**	.289**
	Sig. (2-tailed)	.000	.000	.002	.009	…	.000	.000	.000
	N	166	166	166	166	…	166	166	166
b-4-5	Pearson Correlation	.529**	.246**	.248**	.168*	…	.384**	.337**	.276**
	Sig. (2-tailed)	.000	.001	.001	.031	…	.000	.000	.000
	N	166	166	166	166	…	166	166	166
b-4-6	Pearson Correlation	.323**	.103	.157*	.101	…	.053	.238**	.243**
	Sig. (2-tailed)	.000	.186	.043	.198	…	.497	.002	.002
	N	166	166	166	166	…	166	166	166
b-4-7	Pearson Correlation	.849**	.628**	.509**	.378**	…	.829**	.671**	.595**
	Sig. (2-tailed)	.000	.000	.000	.000	…	.000	.000	.000

	N	166	166	166	166	…	166	166	166
b-4-8	Pearson Correlation	.809**	.566**	.502**	.389**	…	1	.675**	.520**
	Sig. (2-tailed)	.000	.000	.000	.000	…		.000	.000
	N	166	166	166	166	…	166	166	166
b-4-9	Pearson Correlation	.705**	.471**	.430**	.227**	…	.675**	1	.514**
	Sig. (2-tailed)	.000	.000	.000	.003	…	.000		.000
	N	166	166	166	166	…	166	166	166
b-4-10	Pearson Correlation	.613**	.438**	.348**	.224**	…	.520**	.514**	1
	Sig. (2-tailed)	.000	.000	.000	.004	…	.000	.000	
	N	166	166	166	166	…	166	166	166

**. Correlation is significant at the 0.01 level (2-tailed).

5.4.1.3 Reliability

As shown in table 5-10 and table 5-11, we used SPSS19.0 software to obtain the Cronbach's α coefficient for analyzing the internal consistency between items. From the table 5-10, the overall Cronbach's α coefficient of scale is more than 0.8 which can be inferred that the consistency of the scale is good. From table 5-11, most corrected item-total correlation coefficient is more than 0.4 except the item b-3-2 and item b-4-6. Moreover, if we deleted item b-3-2 and item b-4-6, the Cronbach's α coefficient could become better which are from 0.889 to 0.896 and from 0.889 to 0.892 respectively. We chose to delete these two items combining with the result of correlation analysis. Furthermore, there is only one item b-3-1 under the construct of supplier-supplier relationship, and during the process of interviewing with the company executives, they all agree that the relationship among the same category suppliers is competitive. Therefore, there is no need of the existence of item b-3-1.

Table 5-10 Reliability Statistics of Supply Base Structure

Cronbach's α	N of Items
0.889	18

Table 5-11 Item-Total Statistics of Supply Base Structure

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's α if Item Deleted
b-1-1	82.85	255.583	.660	.879
b-1-2	82.95	257.555	.547	.883
b-1-3	83.20	264.645	.414	.887
b-2-1	83.75	260.517	.499	.884
b-2-2	83.63	258.514	.498	.884
b-2-3	83.25	255.981	.575	.882
b-3-1	82.55	255.424	.675	.879
b-3-2	84.45	279.934	.146	.896
b-4-1	83.09	266.252	.421	.887
b-4-2	82.90	264.803	.551	.883
b-4-3	83.32	262.170	.507	.884
b-4-4	83.43	261.495	.477	.885
b-4-5	83.43	261.411	.448	.886
b-4-6	83.43	276.586	.244	.892
b-4-7	82.56	244.090	.817	.873
b-4-8	82.73	248.647	.773	.875
b-4-9	82.90	255.094	.654	.879
b-4-10	83.22	262.902	.558	.883

5.4.2 Validity

In this paper, although reference was made to the research results of previous scholars for the supply base structure scale, it was entirely developed on our own, so we decided to adopt the exploratory factor analysis to test the validity of the questionnaire. The results of

KMO and Bartlett's Test, Total Variance Explained and Rotated Component Matrix are shown in table 5-12, 5-13 and 5-14.

Table 5-12 KMO and Bartlett's Test of Supply Base Structure

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.893
Bartlett's Test of Sphericity	Approx. Chi-Square	1051.703
	df	105
	Sig.	.000

From table 5-12, the value of KMO is 0.897, the p-value is less than the level of significance (0.05), and hence it is suitable to carry factor analysis. As shown in table 5-13, three factors' initial eigenvalues are all more than 1, and they explained the 56.692% of the total variance. Obviously, the results of three factors are different from the previous setting of four factors under the construct of supply base structure.

Table 5-13 Total Variance Explained of Supply Base Structure

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.103	40.686	40.686	6.103	40.686	40.686	3.654	24.360	24.360
2	1.365	9.100	49.786	1.365	9.100	49.786	2.617	17.448	41.809
3	1.036	6.906	56.692	1.036	6.906	56.692	2.233	14.884	56.692
4	.973	6.485	63.177						
5	.794	5.295	68.473						
6	.758	5.053	73.526						
7	.696	4.642	78.168						
8	.635	4.232	82.400						
9	.574	3.827	86.227						
10	.492	3.281	89.509						
11	.446	2.975	92.484						

12	.403	2.690	95.173						
13	.329	2.191	97.365						
14	.252	1.678	99.043						
15	.144	.957	100.000						

Extraction Method: Principal Component Analysis.

Table 5-14 Rotated Component Matrix of Supply Base Structure

	Component		
	1	2	3
b-1-1	.547		
b-1-2	.560		
b-1-3		.606	
b-2-1			.591
b-2-2			.851
b-2-3			.693
b-4-1		.509	
b-4-2		.761	
b-4-3		.558	
b-4-4		.679	
b-4-5			
b-4-7	.763		
b-4-8	.732		
b-4-9	.790		
b-4-10	.717		

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

From the table 5-14, there are three factors from the result of rotated component matrix of exploratory factor analysis. All of fourteen items have corresponding factor loading on one of the three factors except the item b-4-5 which did not show in the table, because its factor

loadings of the three factors are all less than 0.45. Hence, we consider deleting the item b-4-5 in order to avoid random error. We found from the table that item b-1-1, b-1-2, b-4-7, b-4-8, b-4-9 and b-4-10 belong to the common factor one. Similarly, factor two includes item b-1-3, b-4-1, b-4-2, b-4-3 and b-4-4. Item b-2-1, b-2-2 and b-2-3 compose the factor three. The presence of cross phenomenon among the previous classification of supply base structure result in the necessity to re-divide the component of supply base structure.

We renamed three constructs to represent the supply base structure: Heterogeneity, Supplier development and Relation specific investment. Supplier development refers to an organization's efforts to create and maintain a network of competent suppliers. Supplier development also involves a long-term cooperative effort between a buying firm and its suppliers to upgrade the suppliers' technical, quality, delivery, and cost capacities (Charles A, 1993). And relation specific investment includes distance between plants, percent of capital equipment that is not re-deployable and so on (Jeffrey H. Dyer, 1998). The corresponding items and item codes are shown in the table 5-15.

Table 5-15 Revised Measurement Scales of Supply Base Structure

Constructs	Labels	Items
Heterogeneity	B-1-1	In my organization, suppliers are different in product technology
	B-1-2	In my organization, suppliers are in different geographical areas
	B-1-3	In my organization, suppliers have different organizational structures and cultural types
Supplier development	B-2-1	Introduce new suppliers to increase the innovation level
	B-2-2	Reduce the number of suppliers to realize the integration of supply base
	B-2-3	My organization assists supplier in quality improvement
	B-2-4	My organization assists supplier in cost reduction
	B-2-5	My organization signs average long term contract with suppliers
	B-2-6	My organization trusts the supplier to be fair in price and quality

Relation specific investment	B-3-1	My organization sources from multiple suppliers for the same materials and products
	B-3-2	My supplier located near my organization
	B-3-3	My supplier invests capital equipment which is not redeployed for other buyers
	B-3-4	Different suppliers collaborate to reduce the total cost
	B-3-5	My organization provides suppliers with product-specificity equipment to produce specific products

Correlation analysis and reliability analysis were used to test the items of new scale whether meeting the corresponding standards or not. We found from the results that all the items reached the standard to retain. For the specific results, please see Appendix 5, Appendix 6, Appendix 7. Table 5-16, 5-17 and 5-18 are the output results of validity test of new scale. From the table 5-16, the value of KMO is 0.888, the p-value is less than the level of significance (0.05). Therefore, it is suitable to carry the following factor analysis. The result indicated three factors' initial eigenvalues are all more than 1, and they explained the 59.068% of the total variance. Please see Appendix 8.

Table 5-16 KMO and Bartlett's Test of Revised Supply Base Structure

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.888
Bartlett's Test of Sphericity	Approx. Chi-Square	1007.555
	df	91
	Sig.	.000

Table 5-17 Rotated Component Matrix of Revised Supply Base Structure

	Component		
	1	2	3
B-1-1			.596
B-1-2			.852
B-1-3			.698
B-2-1	.554		
B-2-2	.561		
B-2-3	.760		
B-2-4	.731		
B-2-5	.788		
B-2-6	.719		
B-3-1		.609	
B-3-2	.493	.514	
B-3-3		.768	
B-3-4		.556	
B-3-5		.677	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

From the results of Rotated Component Matrix, the factor loadings of the fourteen items are all more than 0.45 and item codes under every factor are consistent with the scale what we redesigned.

5.5 Purchasing Portfolio Management Constructs

5.5.1 The Scale Analysis of Purchasing Portfolio Management

Based on the previous studies, this paper divided the first order index purchasing portfolio management into three secondary indices including twelve items. For details, six

items coded from C-1-1 to C-1-6 represent the construct of supply risk; the construct of complexity of buyer market consists of three items: C-2-1, C-2-2, C-2-3; and the construct of purchase impact is made up of item C-3-1, C-3-2 and C-3-2. C-total is the sum scores of total twelve items measuring scores because of the necessity of following item analysis method.

Table 5-18 Items of Purchasing Portfolio Management

Constructs	Labels	Items
Supply risk	C-1-1	Supply availability of suppliers' products and service in the market
	C-1-2	Supply reliability of suppliers' products and services
	C-1-3	The technologies' autonomy and patents' legitimacy of suppliers' product
	C-1-4	The external risks (e.g, geological disaster, political risk, environment, health, safety)
	C-1-5	Sustainability of supplier
	C-1-6	Entry barrier of new supplier
	C-1-7	Financial risk
Complexity of buyer market	C-2-1	The degree of customization of raw materials
	C-2-2:	The diversity of buyers of raw materials
	C-2-3	The number of buyers of raw materials
Purchase impact	C-3-1	The proportion of important materials' purchasing cost in the total purchasing cost
	C-3-2	The impact of important materials' purchasing volume on the total volume

5.5.1.1 t-Test

SPSS19.0 is used to divide the part of data into high- and low-score groups (see Appendix 9) and by using it we carried one sample t-test to observe the difference between the high- and low-score groups in their respective items (see table 5-19). The p-value of each item is more than 3 except item C-1-7. But the p-value is less than the level of significance (0.05), hence, we chose to keep the item temporarily and to observe the results of following validity analysis.

Table 5-19 Independent Samples Test of Purchasing Portfolio Management

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
C-1-1	Equal variances assumed	5.226	.025	5.573	92	.000	1.214	.218	.781	1.647
	Equal variances not assumed			5.642	88.378	.000	1.214	.215	.786	1.642
C-1-2	Equal variances assumed	.018	.893	7.853	92	.000	1.463	.186	1.093	1.833
	Equal variances not assumed			7.953	88.074	.000	1.463	.184	1.097	1.829
C-1-3	Equal variances assumed	.852	.358	7.962	92	.000	1.991	.250	1.494	2.488
	Equal variances not assumed			8.004	91.886	.000	1.991	.249	1.497	2.485
C-1-4	Equal variances assumed	4.818	.031	4.779	92	.000	1.244	.260	.727	1.762
	Equal variances not assumed			4.712	78.769	.000	1.244	.264	.719	1.770
C-1-5	Equal variances assumed	5.643	.020	5.731	92	.000	1.413	.246	.923	1.902
	Equal variances not assumed			5.830	83.536	.000	1.413	.242	.931	1.895
C-1-6	Equal variances assumed	.657	.420	6.276	92	.000	1.512	.241	1.034	1.991

	Equal variances not assumed			6.286	91.757	.000	1.512	.241	1.035	1.990
C-1-7	Equal variances assumed	.588	.445	2.035	92	.045	.475	.234	.012	.939
	Equal variances not assumed			2.017	84.790	.047	.475	.236	.007	.944
C-2-1	Equal variances assumed	.070	.792	5.365	92	.000	1.090	.203	.686	1.493
	Equal variances not assumed			5.395	91.810	.000	1.090	.202	.689	1.491
C-2-2	Equal variances assumed	1.672	.199	7.071	92	.000	1.515	.214	1.089	1.940
	Equal variances not assumed			7.161	88.138	.000	1.515	.212	1.094	1.935
C-2-3	Equal variances assumed	4.753	.032	6.477	92	.000	1.376	.212	.954	1.797
	Equal variances not assumed			6.557	88.332	.000	1.376	.210	.959	1.792
C-3-1	Equal variances assumed	.113	.737	6.261	92	.000	1.439	.230	.982	1.895
	Equal variances not assumed			6.318	90.540	.000	1.439	.228	.986	1.891
C-3-2	Equal variances assumed	2.122	.149	6.259	92	.000	1.440	.230	.983	1.897
	Equal variances not assumed			6.338	88.206	.000	1.440	.227	.989	1.892
	Equal variances not assumed			5.967	76.713	.000	1.744	.292	1.162	2.327

5.5.1.2 Correlation Analysis

Table 5-20 shows the correlation coefficient of item-total with the help of SPSS 19.0, from the first column of the table, we can see that most item- total correlation coefficients are more than 0.4 except the item C-1-4, C-1-7 and item C-2-1, however, the correlation for these three items shows statistically significant and there are only three items to measure complexity of buyer market. Hence, we can temporarily keep item C-2-1 and delete item C-1-4 and item C-1-7. Please refer to the Appendix 14 for more details.

Table 5-20 Correlations of Purchasing Portfolio Management

		C-1-1	C-1-2	C-1-3	…	C-3-1	C-3-2	C-total
C-1-1	Pearson Correlation	1	.400**	.412**	…	.114	.153*	.518**
	Sig. (2-tailed)		.000	.000	…	.143	.050	.000
	N	166	166	166	…	166	166	166
C-1-2	Pearson Correlation	.400**	1	.397**	…	.037	.071	.551**
	Sig. (2-tailed)	.000		.000	…	.635	.365	.000
	N	166	166	166	…	166	166	166
C-1-3	Pearson Correlation	.412**	.397**	1	…	.076	.057	.568**
	Sig. (2-tailed)	.000	.000		…	.333	.469	.000
	N	166	166	166	…	166	166	166
C-1-4	Pearson Correlation	.095	.090	.103	…	.097	.116	.379**
	Sig. (2-tailed)	.222	.250	.185	…	.216	.135	.000
	N	166	166	166	…	166	166	166
C-1-5	Pearson Correlation	.305**	.537**	.433**	…	.010	.009	.505**
	Sig. (2-tailed)	.000	.000	.000	…	.900	.907	.000
	N	166	166	166	…	166	166	166
C-1-6	Pearson Correlation	.417**	.207**	.363**	…	.057	.110	.427**
	Sig. (2-tailed)	.000	.007	.000	…	.464	.160	.000
	N	166	166	166	…	166	166	166

C-1-7	Pearson Correlation	.049	-.108	-.107	…	.104	.114	.207**
	Sig. (2-tailed)	.533	.168	.171	…	.184	.142	.008
	N	166	166	166	…	166	166	166
C-2-1	Pearson Correlation	-.027	.090	.013	…	.187*	.158*	.376**
	Sig. (2-tailed)	.733	.250	.865	…	.016	.042	.000
	N	166	166	166	…	166	166	166
C-2-2	Pearson Correlation	-.079	.185*	.085	…	.121	.198*	.480**
	Sig. (2-tailed)	.310	.017	.274	…	.119	.010	.000
	N	166	166	166	…	166	166	166
C-2-3	Pearson Correlation	-.042	.143	.054	…	.188*	.230**	.448**
	Sig. (2-tailed)	.591	.066	.489	…	.015	.003	.000
	N	166	166	166	…	166	166	166
C-3-1	Pearson Correlation	.114	.037	.076	…	1	.675**	.478**
	Sig. (2-tailed)	.143	.635	.333	…		.000	.000
	N	166	166	166	…	166	166	166
C-3-2	Pearson Correlation	.153*	.071	.057	…	.675**	1	.516**
	Sig. (2-tailed)	.050	.365	.469	…	.000		.000
	N	166	166	166	…	166	166	166
C-total	Pearson Correlation	.518**	.551**	.568**	…	.478**	.516**	1
	Sig. (2-tailed)	.000	.000	.000	…	.000	.000	
	N	166	166	166	…	166	166	166

**. Correlation is significant at the 0.01 level (2-tailed).

5.5.1.3 Reliability

Cronbach's α coefficient is used to measure the internal consistency among items as shown in table 5-21. According to the internal consistency reference standard proposed by Wu (2009), if Cronbach's α coefficient is more than 0.7, it indicates the reliability is good. And the overall Cronbach's α coefficient of scale is more than 0.6, it could be inferred that the consistency of the scale can be accepted basically. Furthermore, most literature measured the

partial Cronbach's α coefficient not the overall scale coefficient to test the reliability. We believe that the reliability of our questionnaire is qualified.

Table 5-21 Reliability Statistics of Purchasing Portfolio Management

First-level dimension	Item	Cronbach's α if Item Deleted	Cronbach's α	
Supply risk	C-1-1	0.695	0.745	0.686
	C-1-2	0.698		
	C-1-3	0.684		
	C-1-5	0.691		
	C-1-6	0.730		
Complexity of buyer market	C-2-1	0.786	0.788	
	C-2-2	0.555		
	C-2-3	0.664		
Purchasing impact	C-3-1		0.806	
	C-3-2			

5.5.2 Validity

Even though most items are developed from the previous literature, some others are also developed according to experts' suggestions and the need of practice. We carried the same process called exploratory factor analysis to test the rationality of the basic mode of this paper. The results of KMO and Bartlett's Test and Rotated Component Matrix are shown in table 5-22, and 5-23.

Table 5-22 KMO and Bartlett's Test of Purchasing Portfolio Management

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.655
Bartlett's Test of Sphericity	Approx. Chi-Square	509.840
	df	45
	Sig.	.000

It can be seen from the table 5-22, the value of KMO is 0.655, and the level of

significance is 0.000, hence, it is barely suitable to do factor analysis. The results showed three factors' initial eigenvalues are all more than 1, and they explained the 64.384% of the total variance. Obviously, the results of three factors are consistent with the previous setting of three factors under the construct of purchasing portfolio management. For the details, please see Appendix 10.

Table 5-23 Rotated Component Matrixa of Purchasing Portfolio Management

	Component		
	1	2	3
C-1-1	.701		
C-1-2	.732		
C-1-3	.742		
C-1-5	.745		
C-1-6	.608		
C-2-1		.687	
C-2-3		.911	
C-2-4		.852	
C-3-1			.889
C-3-2			.888

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

According to table 5-23, every factor loading of all items under the responding factor is more than 0.5. When we compare the analytical results and the previous designed scale of purchasing portfolio management, we could find this part scale is suitable after deleting the item C-1-4 and C-1-7. We will conduct the same procedure for the construct of company performance.

5.6 Company Performance Constructs

As the literature review said, the research on enterprise performance is very mature. This paper studies the company performance from two prospects of operation and finance. We developed four items for company operational performance and three items for company

financial performance respectively and coded as the table 5-24 below.

Table 5-24 Items of Company Performance

Constructs	Labels	Items
Operational Performance	D-1-1	Delivery lead-time
	D-1-2	Inventory turn-over rates
	D-1-3	On time deliveries to customer
	D-1-4	Total cost of quality in production
Financial Performance	D-2-1	Average return on investment
	D-2-2:	Average profit %
	D-2-3	Profit growth %

5.6.1 The Scale Analysis of Company Performance

5.6.1.1 t-Test

We divided the data into high and low groups (see Appendix 11) and conducted one sample t-test to observe the difference between the high and low groups in their respective items (results see table 5-25). It can be seen that the value of each item in this paper reached the level of significance (0.05). Hence, we considered the difference among the items is high and no items need to be cleaned out.

Table 5-25 Independent Samples Test of Company Performance

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
D-1-1	Equal variances assumed	.841	.361	11.15	97	.000	2.034	.182	1.672	2.396
	Equal variances not assumed			11.24	96.78	.000	2.034	.181	1.675	2.394
D-1-2	Equal variances assumed	.489	.486	8.087	97	.000	1.764	.218	1.331	2.197
	Equal variances not assumed			8.154	96.65	.000	1.764	.216	1.335	2.193
D-1-3	Equal variances assumed	3.495	.065	9.588	97	.000	1.725	.180	1.368	2.082
	Equal variances not assumed			9.690	95.89	.000	1.725	.178	1.371	2.078
D-1-4	Equal variances assumed	5.485	.021	7.073	97	.000	1.493	.211	1.074	1.911
	Equal variances not assumed			7.193	92.07	.000	1.493	.208	1.080	1.905
D-2-1	Equal variances assumed	13.692	.000	14.50	97	.000	2.475	.171	2.136	2.813
	Equal variances not assumed			14.81	87.71	.000	2.475	.167	2.143	2.807
D-2-2	Equal variances assumed	.266	.607	16.99	97	.000	2.743	.161	2.422	3.063

	Equal variances not assumed			17.05	96.90	.000	2.743	.161	2.423	3.062
D-2-3	Equal variances assumed	1.065	.305	15.78	97	.000	2.711	.172	2.370	3.052
	Equal variances not assumed			16.17	84.81	.000	2.711	.168	2.378	3.045

5.6.1.2 Correlation Analysis

Table 5-26 shows the correlation coefficient of item-total with the help of SPSS 19.0, from the first column of the table, we can see that all item- total correlation coefficients are more than 0.4, thus the items have a strong correlation with the total score item. Please refer to the Appendix 15 for more details.

Table 5-26 Correlations of Company Performance

		D-1-1	D-1-2	D-1-3	…	D-2-2	D-2-3	D-total
D-1-1	Pearson Correlation	1	.467	.552	…	.417	.446	.696
	Sig. (2-tailed)		.000	.000	…	.000	.000	.000
	N	166	166	166	…	166	166	166
D-1-2	Pearson Correlation	.467	1	.429	…	.429	.408	.671
	Sig. (2-tailed)	.000		.000	…	.000	.000	.000
	N	166	166	166	…	166	166	166
D-1-3	Pearson Correlation	.552	.429	1	…	.342	.333	.687
	Sig. (2-tailed)	.000	.000		…	.000	.000	.000
	N	166	166	166	…	166	166	166
D-1-4	Pearson Correlation	.257	.274	.498	…	.236	.231	.549
	Sig. (2-tailed)	.001	.000	.000	…	.002	.003	.000
	N	166	166	166	…	166	166	166
D-2-1	Pearson Correlation	.417	.408	.417	…	.799	.668	.815
	Sig. (2-tailed)	.000	.000	.000	…	.000	.000	.000
	N	166	166	166	…	166	166	166
D-2-2	Pearson	.417	.429	.342	…	1	.871	.828

	Correlation							
	Sig. (2-tailed)	.000	.000	.000	…		.000	.000
	N	166	166	166	…	166	166	166
D-2-3	Pearson Correlation	.446	.408	.333	…	.871	1	.802
	Sig. (2-tailed)	.000	.000	.000	…	.000		.000
	N	166	166	166	…	166	166	166
D-total	Pearson Correlation	.696	.671	.687	…	.828	.802	1
	Sig. (2-tailed)	.000	.000	.000	…	.000	.000	
	N	166	166	166	…	166	166	166

5.6.1.3 Reliability

Cronbach's α coefficient is used to measure the internal consistency among items as shown in table 5-27. According to the internal consistency reference standard proposed by Wu (2009), when we delete one item, if the α coefficient of the rest items is increased, that is to say the Reliability between this item and total items is bad. It should be deleted. From the table 5-27 we can see all other items showed a decreased α coefficient meeting the reference standard, except when D-2-1 is deleted, the α coefficient of the rest items is increased. The item D-2-1 should be deleted. However, as the internal consistency of the company financial performance and the total item is very high (α>0.9), therefore item D-2-1 is temporarily retained.

Table 5-27 Reliability Statistics of Company performance

First-level dimension	Items	Cronbach's α if Item Deleted	Cronbach's α	
Company operational performance	D-1-1	0.663	0.735	0.849
	D-1-2	0.695		
	D-1-3	0.601		
	D-1-4	0.733		
Company financial performance	D-2-1	0.931	0.914	
	D-2-2	0.800		
	D-2-3	0.888		

5.6.2 Validity

In this paper, not only reference was made to the research results and scales of the

pervious scholars for the company performance, but also some adjustments were made based on the actual situations, so exploratory factor analysis was used to test the validity of the scale. The results of KMO and Bartlett's Test, Total Variance Explained and Rotated Component Matrix are shown in table 5-28 and 5-29.

Table 5-28 KMO and Bartlett's Test of Company Performance

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.765
Bartlett's Test of Sphericity	Approx. Chi-Square	625.084
	df	21
	Sig.	.000

From table 5-28, the value of KMO is 0.765, the p-value 0.000 is less than the level of significance (0.05), hence it is suitable to carry factor analysis. Meanwhile, two factors with initial eigenvalues greater than 1 are obtained through exploratory factor analysis, explaining 56.692% of the total variance. This is consistent with above mentioned theoretical design of company performance which contains three factors in this paper. Please see Appendix 12 for details.

Table 5-29 Rotated Component Matrix of Company Performance

	Component	
	1	2
D-1_1		.634
D-1_2		.558
D-1_3		.850
D-1_4		.750
D-2_1	.808	
D-2_2	.948	
D-2_3	.906	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

From table 5-29, there are two factors from the result of rotated component matrix of

exploratory factor analysis. All of seven items have corresponding factor loading on one of the two factors and factor loadings are all more than 0.5. The analysis result is consistent with the theoretical design. Hence, the validity of this part scale can be accepted.

5.7 Summary

Through the correlation analysis and reliability analysis, the unreasonable items were deleted in supply base structure and purchasing portfolio management. According to the factor analysis, only three constructs were extracted in supply base structure, instead of four potential constructs derived from the literature. And the classification of items has been changed, it was organized to get three constructs (Heterogeneity, Supply development, Relation specific investment). They were also derived from the literature.

So, our initial research model will be modified accordingly to reflect the correct number of validated construct dimensions. The revised research model and research hypotheses to be tested are elaborated on next

.

Chapter 6: Revised Research Model and Research Hypotheses

6.1 Revised Research Model

After the validation of constructs in chapter 5, the initial research model proposed in chapter 3 is now revised as in figure 6-1. Supply base structure consists of 3 constructs: heterogeneity, supply development, and relation specific investment. Purchasing portfolio management still owns 3 constructs: supply risk, purchase impact, and complexity of buyer markets. Company performance consists of 2 constructs: company operational performance, and company financial performance.

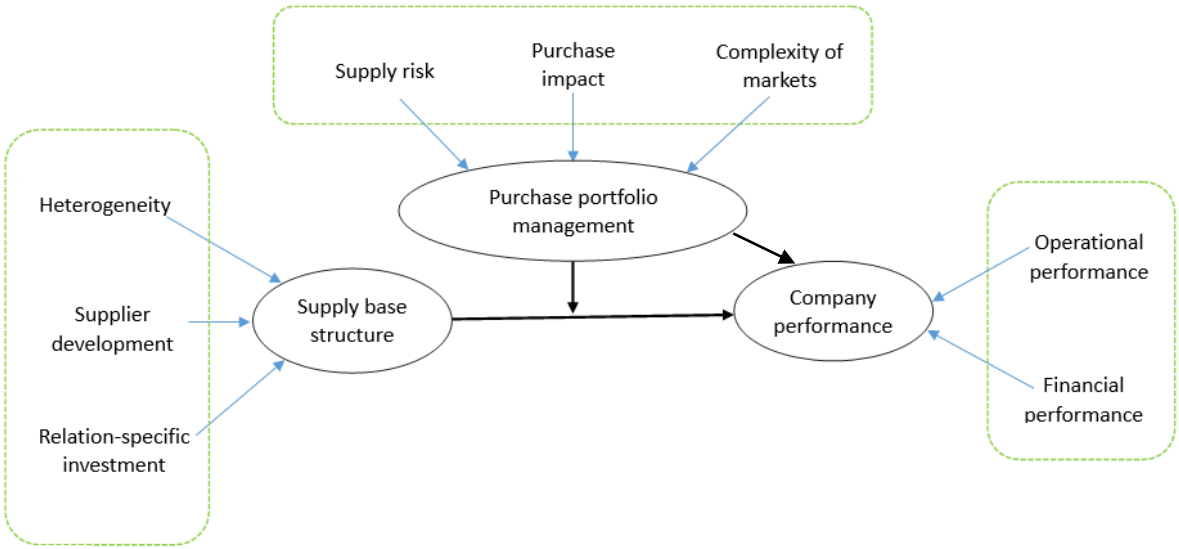

Figure 6-1 Revised Research Model

6.2 Research Hypotheses

Revisiting the research questions, hypotheses are developed based on the revised research model. Supply base structure will be measured by 3 variables: heterogeneity, supply development, and relation specific investment. Purchasing portfolio management will be

measured by 3 variables: supply risk, purchase impact, and complexity of buyer markets. Performance will be measured by 2 variables: company operational performance, and company financial performance.

Question 1: How does purchasing portfolio influence on company performance?

Table 6-1 Hypotheses for Research Question 1

Question 1: How does purchasing portfolio influence on company performance?	
H1.1.1	The Supply Risk is negatively related to Company Operational Performance
H1.1.2	The Purchase Impact is positively related to Company Operational Performance
H1.1.3	The Complexity of Buyers Markets is positively related to Company Operational Performance
H1.2.1	The Supply Risk is negatively related to Company Financial Performance
H1.2.2	The Purchase Impact is positively related to Company Financial Performance
H1.2.3	The Complexity of Buyers Markets is positively related to Company Financial Performance
H1.3.1	The Supply Risk is negatively related to Company Performance
H1.3.2	The Purchase Impact is positively related to Company Performance
H1.3.3	The Complexity of Buyers Markets is positively related to Company Performance

Question 2: How does supply base structure influence on company performance?

Each supply base structure construct will be examined in relation to company performance, company operational performance, and company financial performance constructs, leading to hypotheses of H1.1 to H1.2 as shown in below table 6-2.

Table 6-2 Hypotheses for Research Question 2

Question 2: How does supply base structure influence on company performance?	
H2.1.1	The Heterogeneity is negatively related to Company Operational Performance
H2.1.2	The Supply Development is positively related to Company Operational Performance
H2.1.3	The Relation Specific Investment is positively related to Company Operational Performance
H2.2.1	The Heterogeneity is negatively related to Company Financial Performance
H2.2.2	The Supply Development is positively related to Company Financial Performance
H2.2.3	The Relation Specific Investment is positively related to Company Financial Performance
H2.3.1	The Heterogeneity is negatively related to Company Performance
H2.3.2	The Supply Development is positively related to Company Performance
H2.3.3	The Relation Specific Investment is positively related to Company Performance

Question 3: How does purchasing portfolio influence the relationship between supply base structure and company performance?

This question can be solved from three sets, which include company performance, company operational performance and company financial performance.

Question 3.1: How does purchasing portfolio influence the relationship between supply base structure and company operational performance?

Question 3.2: How does purchasing portfolio influence the relationship between supply base structure and company financial performance?

Question 3.3: How does purchasing portfolio influence the relationship between supply base structure and company overall performance?

These three sets of sub-questions can be further sub-divided into three sub-questions for each supply base structure dimension, including heterogeneity, supply development, and relation specific investment.

And each of the above sub-questions translates into 3 hypotheses for each purchasing

portfolio management dimension. In table 6-3 to table 6-5, twenty-nine hypotheses are established.

Table 6-3 Hypotheses for Research Question 3.1

Question 3.1: How does purchasing portfolio influence the relationship between supply base structure and company operational performance?	
H3.1.1a	The greater Supply Risk, the worse the relationship between Heterogeneity and Company Operational Performance
H3.1.1b	The greater Purchase Impact, the stronger the relationship between Heterogeneity and Company Operational Performance
H3.1.1c	The greater Complexity of Buyers Markets, the stronger the relationship between Heterogeneity and Company Operational Performance
H3.1.2a	The greater Supply Risk, the worse the relationship between Supply Development and Company Operational Performance
H3.1.2b	The greater Purchase Impact, the stronger the relationship between Supply Development and Company Operational Performance
H3.1.2c	The greater Complexity of Buyers Markets, the stronger the relationship between Supply Development and Company Operational Performance
H3.1.3a	The greater Supply Risk, the worse the relationship between Supplier- Buyer Relational Behavior and Company Operational Performance
H3.1.3b	The greater Purchase Impact, the stronger the relationship between Supplier- Buyer Relational Behavior and Company Operational Performance
H3.1.3c	The greater Complexity of Buyers Markets, the stronger the relationship between Supplier-Buyer Relational Behavior and Company Operational Performance

Table 6-4 Hypotheses for Research Question 3.2

Question 3.2: How does purchasing portfolio influence the relationship between supply base structure and company financial performance?	
H3.2.1a	The greater Supply Risk, the worse the relationship between Heterogeneity and Company Financial Performance
H3.2.1b	The greater Purchase Impact, the stronger the relationship between Heterogeneity and Company Financial Performance
H3.2.1c	The greater Complexity of Buyers Markets, the stronger the relationship between Heterogeneity and Company Financial Performance
H3.2.2a	The greater Supply Risk, the worse the relationship between Supply development and Company Financial Performance
H3.2.2b	The greater Purchase Impact, the stronger the relationship between Supply Development and Company Financial Performance
H3.2.2c	The greater Complexity of Buyers Markets, the stronger the relationship between Supply Development and Company Financial Performance
H3.2.3a	The greater Supply Risk, the worse the relationship between Supplier- Buyer Relational Behavior and Company Financial Performance
H3.2.3b	The greater Purchase Impact, the stronger the relationship between Supplier- Buyer Relational Behavior and Company Financial Performance
H3.2.3c	The greater Complexity of Buyers Markets, the stronger the relationship between Relation Specific Investment and Company Financial Performance

Table 6-5 Hypotheses for Research Question 3.3

Question 3.3: How does purchasing portfolio influence the relationship between supply base structure and company overall performance?	
H3.3.1a	The greater Supply Risk, the worse the relationship between Heterogeneity and Company Performance
H3.3.1b	The greater Purchase Impact, the stronger the relationship between Heterogeneity and Company Performance
H3.3.1c	The greater Complexity of Buyers Markets, the stronger the relationship between Heterogeneity and Company Performance
H3.3.2a	The greater Supply Risk, the worse the relationship between Supply Development and Company Performance
H3.3.2b	The greater Purchase Impact, the stronger the relationship between Supply Development and Company Performance
H3.3.2c	The greater Complexity of Buyers Markets, the stronger the relationship between Supply Development and Company Performance
H3.3.3a	The greater Supply Risk, the worse the relationship between Supplier-Buyer Relational Behavior and Company Performance
H3.3.3b	The greater Purchase Impact, the stronger the relationship between Supplier- Buyer Relational Behavior and Company Performance
H3.3.3c	The greater Complexity of Buyers Markets, the stronger the relationship between Relation Specific Investment and Company Performance

6.3 Summary

Based on the validation of constructs and measurement items in chapter 5, a revised research model is developed. The model is based on the key relationship between supply base structure and company performance. The revised research model proposes that the purchasing portfolio management will strengthen this relationship, and would provide greater performance benefits to the company through enhanced supply base structure.

The two main research questions were revisited and their sub-questions were presented. A total of forty-five hypotheses are developed. Statistical analysis of the survey results and hypotheses testing are presented in the next chapter.

Chapter 7: Data Analysis and Results

7.1 Multiple Linear Regression Model

In statistics, linear regression is an approach for modeling the relationship between a scalar dependent variable *Y* and one or more explanatory variables (or independent variables) denoted *X*. The case of one explanatory variable (independent variable) is called simple linear regression. For more than one explanatory variable (independent variable), the process is called multiple linear regression. A multiple regression model is an extension of simple regression models in which several predictors are used to model a single response variable. Multiple linear regression analysis was used to investigate the effects of two or more independent variables on the dependent variable. The aim is to find a regression equation of the independent variable, and to explain the relationship and the relationship strength between the independent variables and the dependent variable.

There are several methods of doing multiple regression which include the following procedures: Enter (enters all variables in the list in a single step); Forward (enters the variables in the list one by one (the order determined by the significance in the model) until no more can be entered.); Backward (enters all the variables in the list in a single step, then removes the insignificant variables one by one (the order determined by the significance in the model) until no more can be removed); Stepwise (a combination of the Forward and Backward procedures). In this paper, the methods of Enter and the Stepwise are adopted according to the research issue.

7.2 Hypotheses Testing

In order to answer research question and verify the relevant assumptions, this paper uses software SPSS 19.0 to carry the multiple linear analysis. And the code meanings as shown in table 7-1.

Table 7-1 Variables

B-1	Heterogeneity
B-2	Supply development
B-3	Relation specific investment
C-1	Supply risk
C-2	Complexity of buyer market
C-3	Purchase impact
D-1	Company operational performance
D-2	Company financial performance
D	Company performance

The following table 7-2 is the output of correlations matrix among variables.

Table 7-2 Correlations

Variables	Mean	Std. Deviation	B-1	B-2	B-3	C-1	C-2	C-3	D-1	D-2	D
B-1	13.668	4.160	1								
B-2	29.939	5.591	.501**								
B-3	24.566	3.896	.228**	.480**							
C-1	18.361	2.890	.002	-.185*	-.104						
C-2	12.379	2.415	-.174*	-.005	.095	.023					
C-3	9.783	2.229	.053	.075	.048	.038	.072				
D-1	19.596	3.560	-.035	.187*	.432**	-.147	.258**	.267**			
D-2	13.078	3.700	-.225**	.109	.274**	-.049	.224**	.172*	.537**		
D	32.674	6.365	-.150	.168*	.401**	-.110	.275**	.250**	.871**	.882**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

It can be seen from Table 7-2 that the supply base structure, purchasing portfolio management and company performance are overall correlated except some predictor variables, and the correlation coefficient is too small, which lays the foundation for the further test of multiple regressions.

The results of multiple linear regression analysis are detailed in the appendix. Table 7-3 to Table 7-9 are the key data tables after collation. Standardized β indicates the degree of influence of the independent variable on the dependent variable. The higher the value is, the greater the influence degree will be. Positive and negative values of β indicate positive or negative effects respectively. The symbol for * indicates the significance and the significance degree is explained in the table. R^2 and adjusted R^2 measure the goodness-of-fit of the equation, when its value closer to 1, the goodness-of-it test result is better. F is the significance test of the regression equation, when its value is greater, its significance test result is better. Then, the attention should be paid to the observation of its significance.

7.2.1 Q1: How does purchasing portfolio management influence on company performance?

In Table 7-3 showed the impacts of purchasing portfolio management (supply risk, complexity of buyer market and purchase impact) on company operational performance, company financial performance and company performance. The regression results showed that there are significantly negative associations between overall supply risk and company operational performance, company financial performance and company performance as expected. Hence hypotheses H1.1.1，H1.2.1 and H1.3.1 are supported.

Complexity of buyer markets showed the significantly positive impact on company operational performance, company financial performance and company performance. Hence, hypotheses H1.1.2, H1.2.2 and H1.3.2 are supported. For the third construct purchase impact, the result showed that it has significantly positive impact on company financial performance and company performance ($p<0.001$). However, the result did not show any significant impact on company operational performance. Hence, hypotheses H1.2.3, H1.3.3 are supported and H1.1.3 is rejected.

Table 7-3 Regression Results of Question 1

Variables	D-1	D-2	D
	Standardized β	Standardized β	Standardize β
Constant	***	**	***
C-1	-0.162*	-0.059*	-0.125*
C-2	0.244***	0.214**	0.261**
C-3	0.255	0.159*	0.236**
R^2	0.155	0.178	0.144
Adjusted R^2	0.139	0.161	0.128
F	9.883***	4.598**	9.101***

***. Correlation is significant at the 0.00 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

7.2.2 Q2: How does supply base structure influence on company performance?

From above analytical results, the purchasing portfolio management has significantly positive impact on company performance. In order to answer Q2 and verify the hypothesis, we decide to eliminate the purchasing portfolio management impact on company performance and carry a single study which only consider supply base structure (heterogeneity, supply development and relation specific investment) as the independent variable to adopt multiple linear regression method for analysis.

Q2.1: How does supply base structure influence on company operational performance?

The testing results are summarized in table 7-4.

Table 7-4 Regression Results of Question 2.1

	Model 1	Model 2	Model 3	Model 4
C-1	-0.162*	-0.162*	-0.123	-0.115
C-2	0.244***	0.243***	0.225**	0.184**
C-3	0.255***	0.256***	0.246***	0.243***
B-1		-0.006	-0.110	-0.113
B-2			0.202*	0.006*
B-3				0.414***

Q2.2: How does supply base structure influence on company financial performance?

The testing results are summarized in table 7-5.

Table 7-5 Regression Results of Question 2.2

	Model 1	Model 2	Model 3	Model 4
C-1	-0.059	-0.059	-0.008	-0.003
C-2	0.214**	0.178**	0.155*	0.129
C-3	0.159*	0.173*	0.160*	0.158*
B-1		-0.203**	-0.339***	-0.342***
B-2			0.266**	0.141*
B-3				0.264***

Q2.3: How does supply base structure influence on company overall performance?

The testing results are summarized in table 7-6.

Table 7-6 Regression Results of Question 2.3

	Model 1	Model 2	Model 3	Model 4
C-1	-0.125	-0.124	-0.074	-0.066
C-2	0.261***	0.239***	0.216**	0.178**
C-3	0.236***	0.243***	0.230***	0.228***
B-1		-0.121*	-0.259**	-0.262***
B-2			0.268**	0.086*
B-3				0.385***

The regression results showed that the negative effect of heterogeneity on operational performance company is not significant, but it has a significant negative effect on financial performance company. Therefore, hypotheses H2.2.1 is supported, but H2.1.1 and H2.3.1 are rejected.

Supply development has significant positive effect on company operational performance，company financial performance and company performance. Hypotheses H2.1.2, H2.2.2 and

H2.3.2 are supported.

The positive effect of relation specific investment on company operational performance, company financial performance and company performance are significant, hence, hypotheses H2.1.3, H2.2.3 and H2.3.3 are supported.

7.2.3 Q3: How does purchasing portfolio management influence the relationship between supply base structure and company performance?

In this paper, we further make an investigation of the moderating effects of the purchasing portfolio management on supply base structure and company performance. In this paper, we defined the supply base structure (heterogeneity, supply development, relation specific investment) as independent variable, company performance (company operational performance, company financial performance) as dependent variable, purchasing portfolio management (supply risk, complexity of buyers markets and purchase impact) as moderator variable, and the method of multiple linear regression is adopted. The regression results are summarized in the Table 7-7, Table 7-8 and Table 7-9 for the key data after collation. (i=1 if the moderator variable B-1, i = 2 if the moderator variable B-2, and i = 3 if the moderator variable B-3).

Q3.1: How does purchasing portfolio management influence the relationship between supply base structure and company operational performance?

Model 7 in table 7-7 indicated the relationship between heterogeneity and company operational performance under the moderating effect of purchasing portfolio management. From the results, that supply risk, purchase impact and complexity of buyers' markets did not show any significant impacts on the relationship between heterogeneity and company operational performance. Hence, hypotheses H3.1.1a, H3.1.1b and H3.1.1c are not supported.

The result of model 8 showed that supply risk, purchase impact and complexity of buyers' markets did not give any significant impacts on the relationship between supply development and company operational performance. Hence, H3.1.2a, H3.1.2b and H3.1.2c are not supported.

Model 9 showed the similar results, supply risk, purchase impact and complexity of

buyers' markets did not give any significant moderating impact on the relationship between relation specific investment and company operational performance. Hence, H3.1.3a, H3.1.3b and H3.1.3c are not supported.

Table 7-7 Regression Results of Question 3.1

Variables	Model 7	Model 8	Model 9
	Standardized β	Standardized β	Standardized β
Constant	***	***	**
B-1	.204		
B-2		.187*	
B-3			.393***
C-1	-0.015*	-.105	-.112
C-2	-0.160***	.242**	.216***
C-3	0.242***	.256***	.243***
B-i* C-1	0.005	-.075*	-.061
B-i* C-2	-0.022	-.055	.078
B-i* C-3	-0.109	-.100	-.060

***. Correlation is significant at the 0.00 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Q3.2: How does purchasing portfolio management influence the relationship between supply base structure and company financial performance?

Model 10, model 11 and model 12 in table 7-8 showed the relationship between heterogeneity and company financial performance, supply development and company financial performance, relation specific investment and company financial performance respectively under the moderating effect of purchasing portfolio management. From the regression results, supply risk shows significant impact on the relationship between supply development and company financial performance. Hence, H3.2.2a is supported, but all of the other hypotheses are not supported.

Table 7-8 Regression Results of Question 3.2

Variables	Model 10	Model 11	Model 12
	Standardized β	Standardized β	Standardized β
Constant	***		**
B-1	-.183*		
B-2		.122	
B-3			.241**
C-1	-.043	.002	-.014
C-2	.187*	.189*	.201**
C-3	.174*	.185*	.160*
B-i* C-1	-.111	-.204*	-.133
B-i* C-2	.018	-.072	.020
B-i* C-3	-.081	-.022	-.068

***. Correlation is significant at the 0.00 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Q3.3: How does purchasing portfolio management influence the relationship between supply base structure and company overall performance?

Table 7-9 showed the regression results of question 3.3, we can see that only supply risk shows significant impact on the relationship between supply development and company performance. Hence, H3.3.2a is supported. But all of other hypotheses are not supported.

Table 7-9 Regression Results of Question 3.3

Variables	Model 13	Model 14	Model 15
	Standardized β	Standardized β	Standardized β
Constant	***	**	
B-1	-0.098		
B-2		.176*	
B-3			0.360***
C-1	-0.114	-0.057	-.071
C-2	0.244****	0.245***	.238***
C-3	0.245***	0.251***	.229***
B-i* C-1	-0.062	-0.161*	-.111
B-i* C-2	-.081	-0.073	.056
B-i* C-3	-0.108	-0.069	-.073

***. Correlation is significant at the 0.00 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

7.3 Summary

45 hypotheses were postulated from the revised research model in this Chapter.

（1）9 hypotheses are related to the relationship between purchasing portfolio management (supply risk/purchase impact/complexity of buyer market) and company performance variables (company operational performance / company financial performance / company performance). 8 out of 9 hypotheses are supported and 1 of them is rejected.

（2）9 hypotheses are related to the relationship between supply base structure (heterogeneity / supply development / relation specific investment) and company performance variables (company operational performance / company financial performance / company performance). 8 out of 9 hypotheses are supported and 1 is rejected.

（3）27 hypotheses are related to the effect of purchasing portfolio management (supply risk/purchase impact/complexity of buyer market) on the relationship between supply base structure (heterogeneity / supply development / relation specific investment) and company performance variables (company operational performance / company financial performance / company performance). 24 out of 27 hypotheses are not supported. 3 are supported.

A summary of all hypotheses testing results is shown in table 7-10.

Table 7-10 Summary of The Hypothesis Testing Results

Hypotheses	Description	Supported (Y/N)
H1.1.1	The Supply Risk is negatively related to Company Operational Performance	Y
H1.1.2	The Purchase Impact, is positively related to Company Operational Performance	N
H1.1.3	The Complexity of Buyers Markets is positively related to Company Operational Performance	Y
H1.2.1	The Supply Risk is negatively related to Company Financial Performance	Y

H1.2.2	The Purchase Impact, is positively related to Company Financial Performance	Y
H1.2.3	The Complexity of Buyers Markets is positively related to Company Financial Performance	Y
H1.3.1	The Supply Risk is negatively related to Company Performance	Y
H1.3.2	The Purchase Impact, is positively related to Company Performance	Y
H1.3.3	The Complexity of Buyers Markets is positively related to Company Performance	Y
H2.1.1	The Heterogeneity is negatively related to Company Operational Performance	N
H2.1.2	The Supply Development is positively related to Company Operational Performance	Y
H2.1.3	The Relation Specific Investment is positively related to Company Operational Performance	Y
H2.2.1	The Heterogeneity is negatively related to Company Financial Performance	Y
H2.2.2	The Supply Development is positively related to Company Financial Performance	Y
H2.2.3	The Relation Specific Investment is positively related to Company Financial Performance	Y
H2.3.1	The Heterogeneity is negatively related to Company Performance	Y
H2.3.2	The Supply Development is positively related to Company Performance	Y
H2.3.3	The Relation Specific Investment is positively related to Company Performance	Y
H3.1.1a	The greater Supply Risk, the worse the relationship between Heterogeneity and Company Operational Performance	N

H3.1.1b	The greater Purchase Impact, the stronger the relationship between Heterogeneity and Company Operational Performance	N
H3.1.1c	The greater Complexity of Buyers Markets, the stronger the relationship between Heterogeneity and Company Operational Performance	N
H3.1.2a	The greater Supply Risk, the worse the relationship between Supply Development and Company Operational Performance	Y
H3.1.2b	The greater Purchase Impact, the stronger the relationship between Supply Development and Company Operational Performance	N
H3.1.2c	The greater Complexity of Buyers Markets, the stronger the relationship between Supply Development and Company Operational Performance	N
H3.1.3a	The greater Supply Risk, the worse the relationship between Supplier-Buyer Relational Behavior and Company Operational Performance	N
H3.1.3b	The greater Purchase Impact, the stronger the relationship between Supplier-Buyer Relational Behavior and Company Operational Performance	N
H3.1.3c	The greater Complexity of Buyers Markets, the stronger the relationship between Supplier-Buyer Relational Behavior and Company Operational Performance	N
H3.2.1a:	The greater Supply Risk, the worse the relationship between Heterogeneity and Company Financial Performance	N
H3.2.1b	The greater Purchase Impact, the stronger the relationship between Heterogeneity and Company Financial Performance	N
H3.2.1c	The greater Complexity of Buyers Markets, the stronger the relationship between Heterogeneity and Company Financial Performance	N
H3.2.2a	The greater Supply Risk, the worse the relationship between Supply Development and Company Financial Performance	Y
H3.2.2b	The greater Purchase Impact, the stronger the relationship between Supply Development and Company Financial Performance	N
H3.2.2c	The greater Complexity of Buyers Markets, the stronger the relationship between Supply Development and Company Financial Performance	N

H3.2.3a	The greater Supply Risk, the worse the relationship between Supplier-Buyer Relational Behavior and Company Financial Performance	N
H3.2.3b	The greater Purchase Impact, the stronger the relationship between Supplier-Buyer Relational Behavior and Company Financial Performance	N
H3.2.3c	The greater Complexity of Buyers Markets, the stronger the relationship between Relation Specific Investment and Company Financial Performance	N
H3.3.1a	The greater Supply Risk, the worse the relationship between Heterogeneity and Company Performance	N
H3.3.1b	The greater Purchase Impact, the stronger the relationship between Heterogeneity and Company Performance	N
H3.3.1c	The greater Complexity of Buyers Markets, the stronger the relationship between Heterogeneity and Company Performance	N
H3.3.2a	The greater Supply Risk, the worse the relationship between Supply Development and Company Performance	Y
H3.3.2b	The greater Purchase Impact, the stronger the relationship between Supply Development and Company Performance	N
H3.3.2c	The greater Complexity of Buyers Markets, the stronger the relationship between Supply Development and Company Performance	N
H3.3.3a	The greater Supply Risk, the worse stronger the relationship between Supplier-Buyer Relational Behavior and Company Performance	N
H3.3.3b	The greater Purchase Impact, the stronger the relationship between Supplier-Buyer Relational Behavior and Company Performance	N
H3.3.3c	The greater Complexity of Buyers Markets, the stronger the relationship between Relation Specific Investment and Company Performance	N

Chapter 8: Discussion and Implications for Managerial Practice

8.1 Q1: How does purchasing portfolio management influence on company performance?

In order to study this question, we further subdivided it into the following three sub-questions.

Q1.1: How does purchasing portfolio management influence on company operational performance?

Q1.2: How does purchasing portfolio management influence on company financial performance?

Q1.3: How does purchasing portfolio management influence on company overall performance?

The construct of purchasing portfolio management includes three dimensions in our model, which are supply risk, purchase impact and the complexity of buyer market. Therefore, according to the subdivision, we further proposed nine corresponding hypotheses. The test result shows that eight hypotheses therein are fully supported, and only one of them is rejected.

As indicated by the result, (1) The higher the risk is, the worse the operational performance, financial performance and overall performance of the enterprise would be. This is also consistent with the reality. If there is any risk in material purchase, e.g. materials/ product availability risk or supplier reliability risk, it would disrupt the production plan, delay the production schedule and extend the production cycle time and delivery lead time. More seriously, it would even affect the marketing of new products, resulting in the increase of production costs, thus the negative impacts on enterprise revenue and profit eventually.

A typical case in point is just a 10- minute fire brought a loss of USD 1.68 billion to Ericsson which had to announce the withdrawal of the mobile phone market. However, this risk helped Nokia make the success. Ericsson's chips were mostly supplied by Philips, only one of 5 chips produced by Philips could be supplied worldwide, the other 4 chips could be produced by none but Philips and/or a contractor of Philips. The fire in Philips chip factory resulted in the short supply of the chips. Moreover, the substitute suppliers and products were unavailable. Consequently, a new-type mobile phones of Ericsson could not be marketed on schedule. In contrast, Nokia demanded Philip to come up with a full production plan of its factories, tried every means to find the potential that could be tapped, and also demanded Philips to change its production plan. Ultimately, through adjustment and reschedule, the mobile phone business of Nokia remained unaffected, even its European market share got rise to 30% because of the lack of Ericsson's competition. From this practical case, we learned that enterprises should do efforts to reduce the risk of supply chain in practical management, for example, by establishing a strategic partnership with suppliers to enhance the stability of the supply, actively searching for alternative suppliers or supporting the relevant suppliers in the technology, capital and other aspects.

(2) The higher the market complexity is, the better the financial performance and overall performance would be. On one hand, this is because the higher degree of customization is, the greater difference between the same type of products, and the more competitiveness of enterprises in the market would be. This is helpful to meet the diverse needs of users and improve the company financial performance at the same time. On the other hand, enterprises can realize the scale of production because of a larger number of buyers, therefore, the production cost could be reduced and the company performance would be improved finally. And the increase of the difference between buyers is beneficial to promote the supplier's innovation and technology improvement (Pérez-Luño and Cambra, 2013) and also beneficial to the processes of the firm's product design, production and sale. Hence, company should choose the customized purchasing decisions when the complexity of buyer's market is high, otherwise, strategy of purchasing standard parts will be better.

(3) The higher the impact of purchasing materials is, the better of the operational

performance, the financial performance and the overall performance of the company would be. While the proportion of the important purchasing materials in the total purchase volume increases, the procurements which is not important are reduced, so that the enterprise operations are optimized. On the other hand, the decrease of that proportion means that the decrease of purchasing price, thus the company financial performance will be improved. The scholars in material management and inventory management have proposed the "20:80 principle", that is, 20% of the material accounts for 80% of the total purchasing cost. Enterprises should build up the managerial and systematic mechanism for material purchasing and inventory management based on the "20:80 principle". At the same time the importance of materials in the procurement also reflects the importance of the material to the production, so enterprises should adopt stricter and more effective management tools and methods to avoid negative effects such as out of stock. For example, the CommScope in Suzhou divided the materials into four types: leverage, bottleneck, non-critical and strategic materials and managed materials with the "20:80 principle", as the result, the company performance was improved apparently.

8.2 Q2: How does supply base structure influence on company performance?

Same as question Q1, we further break this question into the following three sub-questions.

Q2.1: How does supply base structure influence on company operational performance?

Q2.2: How does supply base structure influence on company financial performance?

Q2.3: How does supply base structure influence on company overall performance?

The construct of supply base structure includes three dimensions in our model: heterogeneity, supplier development and relation specific investment. Therefore, according to the subdivision, we further proposed nine corresponding hypotheses. The test result shows

that eight hypotheses therein are fully supported, and only one of them is rejected.

As indicated by the result, (1) the financial performance and the overall performance of the enterprises would be worse, when the degree of heterogeneity among the same type suppliers is higher. Similar suppliers have a large difference in organization culture, geographical location, etc. As the result, enterprises would pay a higher cost for supplier management and communication with suppliers, resulting in a negative impact on financial performance. Choi and Krause's (2006) also demonstrated this conclusion. Therefore, according to the conclusion of this article, the heterogeneity difference among the similar suppliers should not be extremely large.

(2) The better supplier development is, the better the operational performance, financial performance and overall performance of the enterprises would be. The aims of supplier development are the improvement of supplier performance and reducing supplier cost. The reduction of supplier production cost could decrease the purchasing cost of focal company, the betterment of on-time delivery could improve the productivity of operation, and the enhanced quality reliability can improve the qualified rate of products. Therefore, supplier development has a positive impact on firm performance. As indicated by the empirical research result of K.C. Tan (2016), supplier development can help improve enterprise performance. A case in point is the cooperation between Procter and Gamble, which reduced the cost of goods by 4% and other supply chain costs by an estimated 25% through effective management of suppliers (Fitzgerald 1996). Therefore, in the practical management, enterprises should appraise suppliers at regular intervals, eliminate the substandard suppliers, and promote the performance improvement of existing suppliers.

(3) The operational performance, financial performance and the overall company performance would be better when the degree of relation specific investment is higher. Due to resource constraints, the focal companies increasingly need to strengthen cooperation with suppliers, distributors and other channel partners and integrate resources in order to cope with complex and volatile market environment. Procter & Gamble, for example, has assigned special staff at WAL-MART headquarters to coordinate sales of P&G's products. Haier, a leading white goods producer in China, requires supplier Sanyo to set up a special R&D lab

near Haier's production plant to provide timely and targeted technical support. Specific investment behavior established a deeper cooperation and an inimitable competitive advantage. Dyer (1996) studied the impact of different special investment on enterprise performance which taking the supplier-manufacturer’s relationship in the United States and Japan's auto industry as an example, the result indicated the difference of special investment is an important cause for the performance difference. Dyer and Singh (1998) further pointed out that the special investment could reduce the cost of storage and transportation. Hence, enterprises should actively carry out the investment on suppliers and distributors and strengthen the channel relationship to achieve the purpose of improving performance at the same time. The relation-specific investment, to a certain extent, represents the trust and intensive cooperation between enterprises and suppliers. According to the test result, it should be popularized in reality.

As can be inferred from (2) and (3), the desirable partnership between suppliers and enterprises can help improve the enterprise performance.

8.3 Q3: How does purchasing portfolio management influence the relationship between supply base structure and company performance?

This paper makes a further study to explore the moderating effect of purchasing portfolio management on supply base structure and company operational performance. Therefore, we further break down this questions into three sub-questions.

Q3.1: How does purchasing portfolio management influence the relationship between supply base structure and company operational performance?

Nine hypotheses are proposed in this part since purchasing portfolio management and supply base structure include three dimensions respectively. The hypotheses testing results showed:

(1) According to the test result of hypothesis H2.1.1, the difference of the same type supplier has no influence on the enterprise operational performance, so that the corresponding

the moderating effect doesn't exist, hypotheses H3.1.1a, H3.1.1b, H3.1.1c are rejected.

(2) Hypothesis H3.1.2a is supported, that means supply risk has a significant negative moderating effect on the relationship between supplier development and company operating performance. The supplier development helps shorten the supplier delivery lead time, but the effectiveness of performance improvement is influenced by supply risk. The greater the supply risk, the reliability and stability of supply chain become worse, and the improvement of the company operational performance will be weakened. Therefore, the supplier development strategy should be carried out under the condition of small supply risk. According to the test result of hypothesis H1.1.1, supplier development should not only be limited to the optimization of supplier's cost, quality and delivery time, but also a deeper cooperation should be established. Hypothesis H3.1.2b is not supported, that means that the number of buyers does not affect the willingness of suppliers to improve, as well as the impact on the enterprise after the supplier development. Hypothesis H3.1.2c is not supported by the testing. Important materials play a key role in the production, and the improvement of the delivery of important material suppliers is beneficial to the focal company. But the production process is a synergistic effect of various materials. If you do neither improve the delivery of other materials, nor rearrange the delivery process, the improvement of company performance will not be obvious. Taking the Shanghai General Motors as an example, milk-run model is fully implemented from March 2003. The company's financial analysis shows that by implementing the milk-run model, the transportation cost for materials delivery can be saved with 3 million Yuan each year which dropped by more than 30 percent.

(3) Hypotheses H3.1.3a, H3.1.3b and H3.1.3c are not supported, it indicated the supply risk, complexity of buyer market and purchase impact don't have influence on the relationship of relation specific investment and company operational performance.

Q3.2: How does purchasing portfolio management influence the relationship between supply base structure and company financial performance?

Likewise, this question is also broken down into 9 hypotheses.

As indicated by the test result, (1) Hypotheses H3.2.1a，H3.2.1b，H3.2.1c are not verified,

proving that the importance of supply risk, the complexity of buyer market and purchase impact does not have an obvious negative moderating effect on the supplier's difference and the enterprise's financial performance.

(2) Hypothesis H3.2.2a is supported, proving that supply risk has a significant negative effect on supplier development and company financial performance. In the connection with hypothesis H3.1.2a, enterprise operational performance is also related to enterprise overall performance. Therefore, enterprise performance has a weaker improvement effect under the action of supply risk. Neither Hypotheses H3.2.2b nor H3.2.2c is supported, proving that importance of the complexity of buyer's market and the purchase impact does not have any moderating effect on supplier development and enterprise's financial performance.

(3) Hypotheses H3.2.3a and H3.2.3c are not verified, proving that the importance of supply risk, complexity of buyer’s market and purchase impact does not have any moderating effect on the relationship of relation specific investment and enterprise operational performance.

Q3.3: How does purchasing portfolio management influence the relationship between supply base structure and company performance?

The question is also broken down into 9 hypotheses. As indicated by the test result, 8 hypotheses are not verified, and only one hypothesis is supported. Namely, H3.3.2a, proves that supply risk has an obvious negative moderating effect on the relationship of supplier development and company performance. The hypothesis test results in this question can be derived in the connection with Q3.2 and Q3.1 analysis.

Chapter 9: Conclusions

In today's fierce business environment, implementing cost reduction and quality improvement strategies purely has been unable to meet the needs of the competition. The competition of supply chain has become the real competition between enterprises. On the one hand, enterprises obtain the competitive advantage through improving the relationship of upstream and downstream of supply chain, integrating and optimizing the information flow, logistics flow and capital flow of supply chain. On the other hand, the competitive advantage depends on the cost and performance of the suppliers. So the core task of the enterprise is to build the supply base which could meet the requirements of the enterprise and optimize the structure of the supply base structure.

From a theoretical perspective, research on the supply base structure has become a focus in recent years, however, there is no empirical study on the relationship between supply base structure and company performance. There is neither successful empirical research nor existing theoretical analysis which can be used for reference as systematic guidance to this research. Hence, this article makes an active attempt in the research field. Through the theoretical analysis, qualitative and quantitative empirical research, the main conclusions of this paper are as follows:

Firstly, the supplier group structure has influence on company performance. Heterogeneity of the same type supplier has a negative impact on company financial performance but an inconspicuous influence on operational performance. Therefore, companies should consider the degree of heterogeneity among suppliers when choosing suppliers. Supplier development and relation specific investments are beneficial to the improvement of enterprise performance, so strengthening the mutual cooperation between enterprises and suppliers is essential and necessary.

Secondly, purchasing portfolio management has a certain but not obvious moderating effect on the relationship of supply base structure and company performance. Supply risk in

purchasing portfolio management plays a role in regulating the relationship between supplier development and enterprise performance. Hence, the focal company should consider the characteristic and the status of suppliers when supplier development.

Thirdly, purchasing portfolio management has an influence on company performance. Supply risk has a negative impact on company performance, the complexity of the buyers' market and purchase impact have a positive impact on the performance of focal company. Hence, from the aspects of portfolio management, purchasing the leverage goods which has low risk but high purchase impact makes more contribution to company performance. Non-critical goods contribute more than critical goods to company performance. The customized products in bottleneck goods are more favorable to the enterprise performance than the standard products

Chapter 10: Limitations and Areas for Future Research

In term of theoretical construction and empirical analysis, although this paper has made major contribution in enriching existing theories and guiding business practice, it still contains a lot of shortcomings in research and some parts of research yet to be further optimized and perfected in the future. The research limitations of this paper and researches yet to be further intensified in the future are as follows.

The first limitation is related to the nature of empirical study. The hypotheses test supports there are positive or negative relationship between supply base structure, consisted with heterogeneity, supply development and relation specific investment, and company performance, but the test does not tell us what the mechanism works and how supply base structure influences the company performance. The inner mechanism and the corresponding strategy in supply base structure adjustment are worth further researching.

Second, the Liket-type scales were used to report the company performance rather than actual data. Although the constructs of this research were supported by previous literature, in-depth review with scholars and senior managers, and have passed the reliability and validity tests, the cross-sectional data may be biased with subjectivity since the scale reflected the trend of performance over past three years. At the same time, the surveyed managers may not all ranked high enough to know whole information of finance and operation, which may weaken the moderation effect of purchasing portfolio management in hypotheses test. More actual data could be used to exclude the subjective bias and more moderation effect such as company culture should be considered in the future research.

An additional limitation of this study was the geography distribution of survey companies. The respondent companies are mostly distributed throughout the south and east coastal provinces, where are the most active areas in supply base management. The research finding concluded from this survey sample may not be generalized to companies of other areas. More data from companies for all over china are needed to validate the generalization

of the research finding, and the analysis based on industry segment is needed for future research.

The study provides a starting point for further research discussing the relationship between the supply base structure and company performance. Based on the framework this research suggested, more case studies are needed to validate the research conclusion we got. And, with larger sample, advanced model such as structure equation model (SEM) could be applied to further understand the interrelationship between supply base structure, purchasing portfolio management and company performance.

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Annexes

Appendix 1: Questionnaire for The Semi-Structural Interview

1. This interview is about the study on structure of supply base and its impact on company performance. The interviewees include the purchasing staff. It is performed openly, and would be exclusive or not related to any personal private information. Thanks for your answering below questions.

Part One-Supply base structure

2. Could you introduce the current phenomenon of supply base in your company? What are the main criteria of supplier segmentation, e.g. product category, purchasing cost or purchasing risk?

3. Has your company ever devoted some efforts to improve the structure of supply base? If yes, could you introduce more details of practical implementing process? E.g., supplier number reduction, change or optimization of the buyer-supplier relationship and/ or diversification of suppliers

4. As some academic study says, do you think if the optimization of supply base structure can bring benefits to the company performance? If yes, which factors and aspects would it impact on?

5. In view of your company's current structure of supply base, which features should be further adjusted or improved? And why?

Part Two-purchasing portfolio management

6. What critical risks does your company face in purchasing raw materials? And what leads to those risks above? E.g., the availability, reliability, sustainability, financial risk and bargaining power of suppliers, the industries' entry barrier for new supplier, etc.

7. Could you introduce the complexity of your product market? Are most of products customized and differentiated? If yes, could you give us more details?

8. To which extent does the purchasing determine the final profits? E.g., total purchasing cost or total purchasing volume? Any others? And why?

Appendix 2: The Result of Questionnaire for The Semi-Structural Interview

Questions	Interviews Summary
S1: The current phenomenon of supply base	1. Divide the suppliers by business units e.g. CommScope China 2. The most companies that interviewed by us differentiated their suppliers through categories such as WUS PRINTED CIRCUIT (KUNSHAN) CO.LTD, ETRON ELECTRONICS CO., LTD. 3. For some companies, which need a large number of raw materials e.g. SUZHOU TIANYE MECHANICAL IND CO LTD, the materials are divided into big categories, then further subdivision. 4. Most companies source one kind of material from multiple suppliers and they have suitable allocation after concerning a series of factors. Very few organizations adopted one-single sourcing model.
S2: Optimization of supply base structure	1. Many organizations reduce the number of suppliers to realize the integration of supply base and cost reduction of raw material in recent years. 2. Company will introduce new suppliers on basis of suppliers' evaluation system in order to increase the competition level. 3. Some organizations will promote the interactions within supplier-supplier to achieve technology complementary and improvement besides the competition in market. 4. Company will strengthen the interaction with its suppliers in the aspects of information sharing, technology innovation, quality improvement, cost reduction, etc. 5. Most organizations would sign exclusive contracts with suppliers about technology, information and business.
S3: The effect of improving supply base structure on the company performance	1. Every company that we interviewed thinks managing the supply base structure has positive impact on company performance. Specifically, effective management of supply base structure could improve service level, enhance buyer-seller relationship, reduce risks about productive process, etc. 2. For some OEM enterprises, even though they have little power to

	choose suppliers, good relationship and effective management of supply base structure also improve performance and reduce risks.
S4: The future improvement	1. The company's own inferior strength or weak point should be taken into consideration when introducing new suppliers in order to achieve complementary and win-win status. 2. Company should establish an effective and real practical information channel in supply chain to understand customer demand accurately and receive feedback quickly.
P1: Critical risks in purchasing raw materials	1. The materials offered by suppliers may have some quality problems but the occurrence is very few because company has critical process to choose suppliers. 2. Company sometimes has unknown problem with suppliers, but the company could cooperate with long-term suppliers to guarantee service and quality. 3. Concerning about the sustainability of suppliers, many suppliers located at long-distance could set up warehouse near the purchaser. 4. In order to get suitable bargaining power, company could adjust the supplier base structure to improve competition level among suppliers. 5. Most companies could assess their suppliers every year mainly including service, product quality, delivery time, price, finance risk, etc. 6. The duration of contract depends on the suppliers' status. Most companies could sign the outline contract and the contract could change according to specific case.
P2: The complexity of raw materials market	1. Most companies we interviewed have a relatively low degree of customization of raw materials because these materials are purchased by other manufacture enterprises. 2. For some companies located in the downstream of supply chain generally have higher degree of customization of raw materials because these factories produce according to customers' demand. 3. The complexity of raw materials market of a company depends on many factors such as the difference among consumer groups, procurement category and the characteristic of product market, etc.
P3: The effect of purchasing on the final profits	1. Purchasing cost of a company is generally high and the proportion of purchasing cost in the total cost is approximately 60 percent. 2. Purchasing managers think that the purchasing volume and the unit value of materials are important factors influencing the total cost.

Appendix 3: Survey Instrument

In answering the questions, you may respond from the point of view of the whole corporation, a single business unit, or a branch organization at a particular geographical location, whichever is most appropriate level for you.

Please indicate the point of view from which you will be responding to the questionnaire:

1. Whole Corporation
2. Business Unit
3. Branch organization
4. Others----------

It would be appreciated if you would consistently answer all questions from the perspectives you have chosen above.

A. General Company Information

Which industry type is your company best described?

1. Manufacturing
2. Wholesale, Distributor, Retailer
3. Logistics Service Provider
4. Others----------

Which enterprise type is your company best described?

1. State-owned enterprise
2. Private enterprise
3. Sino-foreign joint venture
4. Foreign-capital enterprise
5. Others----------

Number of employees:

1. Less than 500
2. 500 - 2,000
3. 2,001 - 3,000
4. 3,001 - 5,000
5. More than 5,000

Annual sales revenue:

1. Less than USD50 million
2. USD50 - 300 million
3. USD 301 - 500 million
4. USD 501million - 1 billion
5. More than 1 billion

What is your job title/position?

1. Executive (buyer, operations supervisor, SCM coordinator)

2. Manager
3. Director / Senior Manager
4. Vice president and above
5. Others----------

How long have you been with your present company?

1. < 3 years
2. 3 – 5 years
3. 5 – 8 years
4. 8 – 10 years
5. > 10 years

The questions below relate to various attribute of supply base structure, purchase category management and performance of your organization. Please respond ONLY for CURRENT situation of your organization.

B. Supply base structure

B-1: Size

	Strongly Disagreed ←			Uncertain			→ Strongly agreed
My organization introduces new suppliers which's innovative level	□	□	□	□	□	□	□
My organization reduces the number of suppliers to realize the integration of supply base	□	□	□	□	□	□	□
My organization source from multiple suppliers for the same material	□	□	□	□	□	□	□

B-2: Heterogeneity

	Strongly Disagreed ←			Uncertain			→ Strongly agreed
In my organization, suppliers are different in product technology	□	□	□	□	□	□	□
In my organization, suppliers are located in different geographical areas	□	□	□	□	□	□	□
In my organization, suppliers have different organizational structures	□	□	□	□	□	□	□

B-3: Supplier-Supplier Interaction

	Strongly Disagreed ←			Uncertain			→ Strongly agreed
My suppliers compete each other in market	□	□	□	□	□	□	□
My suppliers cooperate through sharing patents to achieve the technology complementary and improvement	□	□	□	□	□	□	□

B-4: Supplier-Buyer Interaction

	Strongly Disagreed ←			Uncertain			→ Strongly agreed
My supplier located near my organization	□	□	□	□	□	□	□
My supplier invests capital equipment which is not re-deployable for other buyers	□	□	□	□	□	□	□
Different Suppliers collaborate to reduce the total cost	□	□	□	□	□	□	□
My organization provides suppliers with product-specificity equipment to produce specific products	□	□	□	□	□	□	□
My organization signs exclusive contracts with suppliers about technology, information and business	□	□	□	□	□	□	□
My suppliers have high transaction cost	□	□	□	□	□	□	□
My organization assists supplier in quality improvement	□	□	□	□	□	□	□
My organization assists supplier in cost reduction	□	□	□	□	□	□	□
My organization signs average long contract duration	□	□	□	□	□	□	□
My organization trusts the supplier to be fair in price and quality	□	□	□	□	□	□	□

C. Purchase category management

C-1: Supply risk

	Very Low			Medium			Very High
Supply availability of suppliers' products and service in the market	□	□	□	□	□	□	□
Supply reliability of suppliers' products and services	□	□	□	□	□	□	□
The technologies' autonomy and patents' legitimacy of suppliers' product	□	□	□	□	□	□	□
The internal and external risks (e.g, geological disaster, political risk, environment, health, safety)	□	□	□	□	□	□	□
Sustainability of supplier	□	□	□	□	□	□	□
Entry barrier of new supplier	□	□	□	□	□	□	□
Financial risk	□	□	□	□	□	□	□

C-2: Complexity of market

	Very Low			Medium			Very High
The degree of customization of raw materials	□	□	□	□	□	□	□
The diversity of buyers of raw materials	□	□	□	□	□	□	□
The number of buyers of raw materials	□	□	□	□	□	□	□

C-3: Purchase impact

	Very Low			Medium			Very High
The proportion of important materials' purchasing cost in the total purchasing cost	□	□	□	□	□	□	□

The impact of important materials' purchasing volume on the total volume	□	□	□	□	□	□	□

D. Company Performance

Please rate the change in firm performance over the <u>past three years</u>:

D-1: Operation Performance

	Substantially Worse ← → Substantially Better						
Delivery lead-time	□	□	□	□	□	□	□
Inventory turn-over rates	□	□	□	□	□	□	□
On time deliveries to customer	□	□	□	□	□	□	□
Total cost of quality in production	□	□	□	□	□	□	□

D-2: Financial Performance

	Well below Industry average ← → Well above Industry average						
Average return on investment	□	□	□	□	□	□	□
Average profit %	□	□	□	□	□	□	□
Profit growth %	□	□	□	□	□	□	□

END OF SURVEY -THANK YOU FOR YOUR COOPRATION

Please tick whether you wish to receive a summary of the findings:

1: YES

2: NO

Please indicate the email address to be sent to if you wish to receive a summary of the findings:

Appendix 4: Group Statistics of Supply Base Structure

	b-group	N	Mean	Std. Deviation	Std. Error Mean
b-1-1	1	48	5.96	1.051	.152
	2	45	3.87	1.829	.273
b-1-2	1	48	6.13	1.104	.159
	2	45	3.78	1.770	.264
b-1-3	1	48	5.63	1.044	.151
	2	45	3.87	1.973	.294
b-2-1	1	48	5.67	1.018	.147
	2	45	3.36	1.554	.232
b-2-2	1	48	5.69	1.114	.161
	2	45	3.29	1.914	.285
b-2-3	1	48	5.71	1.202	.174
	2	45	3.42	1.877	.280
b-3-1	1	48	6.23	.592	.085
	2	45	3.98	1.948	.290
b-3-2	1	48	4.44	1.529	.221
	2	45	3.13	1.531	.228
b-4-1	1	48	5.52	1.337	.193
	2	45	3.87	1.714	.255
b-4-2	1	48	6.00	.684	.099
	2	45	3.96	1.537	.229
b-4-3	1	48	5.77	.994	.144
	2	45	3.47	1.471	.219
b-4-4	1	48	5.71	1.051	.152
	2	45	3.20	1.727	.257
b-4-5	1	48	5.58	1.366	.197
	2	45	3.33	1.758	.262
b-4-6	1	48	5.29	1.220	.176
	2	45	4.16	1.623	.242
b-4-7	1	48	6.48	.684	.099
	2	45	3.44	1.902	.283
b-4-8	1	48	6.38	.570	.082
	2	45	3.51	1.687	.252
b-4-9	1	48	6.13	.981	.142
	2	45	3.71	1.740	.259
b-4-10	1	48	5.50	1.111	.160
	2	45	3.76	1.640	.244

Appendix 5: Correlations of Revised Supply Base Structure

		B_total	B_1_1	B_1_2	B_1_3	B_1_4	B_1_5	B_1_6	B_2_1	B_2_2	B_2_3	B_3_1	B_3_2	B_3_3	B_3_4	B_3_5
B_total	Pearson Correlation	1	.716**	.630**	.861**	.834**	.711**	.616**	.569**	.582**	.659**	.500**	.509**	.603**	.584**	.548**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
B_1_1	Pearson Correlation	.716**	1	.462**	.628**	.566**	.471**	.438**	.383**	.401**	.375**	.352**	.341**	.393**	.305**	.299**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
B_1_2	Pearson Correlation	.630**	.462**	1	.509**	.502**	.430**	.348**	.339**	.345**	.442**	.123	.247**	.323**	.279**	.242**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000	.000	.000	.000	.114	.001	.000	.000	.002
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
B_1_3	Pearson Correlation	.861**	.628**	.509**	1	.829**	.671**	.595**	.413**	.418**	.584**	.378**	.415**	.439**	.451**	.353**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
B_1_4	Pearson Correlation	.834**	.566**	.502**	.829**	1	.675**	.520**	.340**	.335**	.483**	.389**	.444**	.497**	.532**	.361**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
B_1_5	Pearson Correlation	.711**	.471**	.430**	.671**	.675**	1	.514**	.387**	.285**	.366**	.227**	.346**	.291**	.405**	.304**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000	.000	.000	.000	.003	.000	.000	.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
B_1_6	Pearson Correlation	.616**	.438**	.348**	.595**	.520**	.514**	1	.312**	.284**	.330**	.224**	.253**	.257**	.210**	.289**

	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000		.000	.000	.000	.004	.001	.001	.007	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
B_2_1	Pearson Correlation	.569**	.383**	.339**	.413**	.340**	.387**	.312**	1	.410**	.406**	.215**	.128	.240**	.221**	.224**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000		.000	.000	.005	.100	.002	.004	.004
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
B_2_2	Pearson Correlation	.582**	.401**	.345**	.418**	.335**	.285**	.284**	.410**	1	.591**	.232**	-.010	.279**	.265**	.249**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000		.000	.003	.902	.000	.001	.001
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
B_2_3	Pearson Correlation	.659**	.375**	.442**	.584**	.483**	.366**	.330**	.406**	.591**	1	.238**	.210**	.232**	.332**	.191*
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000		.002	.006	.003	.000	.014
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
B_3_1	Pearson Correlation	.500**	.352**	.123	.378**	.389**	.227**	.224**	.215**	.232**	.238**	1	.274**	.387**	.213**	.202**
	Sig. (2-tailed)	.000	.000	.114	.000	.000	.003	.004	.005	.003	.002		.000	.000	.006	.009
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
B_3_2	Pearson Correlation	.509**	.341**	.247**	.415**	.444**	.346**	.253**	.128	-.010	.210**	.274**	1	.334**	.247**	.376**
	Sig. (2-tailed)	.000	.000	.001	.000	.000	.000	.001	.100	.902	.006	.000		.000	.001	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
B_3_3	Pearson Correlation	.603**	.393**	.323**	.439**	.497**	.291**	.257**	.240**	.279**	.232**	.387**	.334**	1	.392**	.433**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.001	.002	.000	.003	.000	.000		.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
B_3_4	Pearson Correlation	.584**	.305**	.279**	.451**	.532**	.405**	.210**	.221**	.265**	.332**	.213**	.247**	.392**	1	.385**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.007	.004	.001	.000	.006	.001	.000		.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166

B_3_5	Pearson Correlation	.548**	.299**	.242**	.353**	.361**	.304**	.289**	.224**	.249**	.191*	.202**	.376**	.433**	.385**	1
	Sig. (2-tailed)	.000	.000	.002	.000	.000	.000	.000	.004	.001	.014	.009	.000	.000	.000	
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix 6: Reliability Statistics of Revised Supply Base Structure

	N of Items
.887	14

Appendix 7: Item-Total Statistics of Revised Supply Base Structure

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B-1-1	64.33	176.914	.658	.875
B-1-2	64.43	178.246	.550	.879
B-1-3	64.04	167.071	.825	.866
B-1-4	64.21	170.301	.794	.868
B-1-5	64.39	176.566	.650	.875
B-1-6	64.70	183.227	.550	.880
B-2-1	65.23	181.572	.482	.883
B-2-2	65.11	179.431	.491	.883
B-2-3	64.73	176.744	.583	.878
B-3-1	64.68	184.691	.404	.886
B-3-2	64.57	185.628	.422	.885
B-3-3	64.39	184.941	.539	.880
B-3-4	64.80	182.318	.505	.881
B-3-5	64.91	182.434	.458	.884

Appendix 8: Total Variance Explained of Revised Supply Base Structure

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.871	41.933	41.933	5.871	41.933	41.933	3.479	24.853	24.853
2	1.363	9.736	51.669	1.363	9.736	51.669	2.561	18.292	43.145
3	1.036	7.399	59.068	1.036	7.399	59.068	2.229	15.923	59.068
4	.898	6.411	65.479						
5	.758	5.415	70.894						
6	.711	5.078	75.973						
7	.652	4.654	80.627						
8	.634	4.531	85.158						

9	.495	3.534	88.692						
10	.449	3.207	91.898						
11	.406	2.901	94.800						
12	.331	2.365	97.165						
13	.252	1.803	98.968						
14	.144	1.032	100.000						

Extraction Method: Principal Component Analysis.

Appendix 9: Group Statistics of Purchasing Portfolio Management

	C-group	N	Mean	Std. Deviation	Std. Error Mean
C-1-1	1.00	45	4.62	.886	.132
	2.00	49	3.41	1.189	.170
C-1-2	1.00	45	5.42	.753	.112
	2.00	49	3.96	1.020	.146
C-1-3	1.00	45	4.89	1.133	.169
	2.00	49	2.90	1.279	.183
C-1-4	1.00	45	4.24	1.464	.218
	2.00	49	3.00	1.041	.149
C-1-5	1.00	45	5.56	.918	.137
	2.00	49	4.14	1.399	.200
C-1-6	1.00	45	4.78	1.146	.171
	2.00	49	3.27	1.186	.169
C-1-8	1.00	45	3.82	1.248	.186
	2.00	49	3.35	1.011	.144
C-2-1	1.00	45	5.60	.915	.136
	2.00	49	4.51	1.043	.149
C-2-3	1.00	45	5.56	.867	.129
	2.00	49	4.04	1.172	.167
C-2-4	1.00	45	5.60	.863	.129
	2.00	49	4.22	1.159	.166
C-3-1	1.00	45	5.62	.984	.147
	2.00	49	4.18	1.219	.174
C-3-2	1.00	45	5.64	.933	.139
	2.00	49	4.20	1.258	.180

Appendix10: Total Variance Explained of Purchasing Portfolio Management

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.676	26.759	26.759	2.676	26.759	26.759	2.513	25.131	25.131
2	2.278	22.775	49.534	2.278	22.775	49.534	2.217	22.167	47.298
3	1.485	14.850	64.384	1.485	14.850	64.384	1.709	17.086	64.384
4	.787	7.868	72.252						
5	.675	6.755	79.007						
6	.620	6.203	85.210						
7	.571	5.711	90.921						
8	.394	3.938	94.859						
9	.316	3.160	98.019						
10	.198	1.981	100.000						

Extraction Method: Principal Component Analysis.

Appendix 11: Group Statistics of Company Performance

	D-group	N	Mean	Std. Deviation	Std. Error Mean
D-1-1	1.00	47	5.96	.833	.121
	2.00	52	3.92	.967	.134
D-1-2	1.00	47	5.74	.988	.144
	2.00	52	3.98	1.163	.161
D-1-3	1.00	47	5.94	.791	.115
	2.00	52	4.21	.977	.135
D-1-4	1.00	47	5.72	.852	.124
	2.00	52	4.23	1.198	.166
D-2-1	1.00	47	5.94	.639	.093
	2.00	52	3.46	.999	.139
D-2-2	1.00	47	5.72	.772	.113
	2.00	52	2.98	.828	.115
D-2-3	1.00	47	5.60	.614	.090
	2.00	52	2.88	1.022	.142

Appendix 12: Total Variance Explained of Company Performance

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.709	52.992	52.992	3.709	52.992	52.992	2.712	38.748	38.748
2	1.164	16.624	69.615	1.164	16.624	69.615	2.161	30.868	69.615
3	.783	11.188	80.803						
4	.566	8.080	88.883						
5	.371	5.305	94.189						
6	.312	4.456	98.645						
7	.095	1.355	100.000						

Extraction Method: Principal Component Analysis.

Appendix 13: Correlations of Supply Base Structure

		b-total	b_1_1	b_1_2	b_1_3	b_2_1	b_2_2	b_2_3	b_3_1	b_3_2	b_4_1	b_4_2	b_4_3	b_4_4	b_4_5	b_4_6	b_4_7	b_4_8	b_4_9	b_4_10
b-total	Pearson Correlation	1	.709**	.615**	.495**	.571**	.575**	.640**	.722**	.237**	.496**	.604**	.573**	.551**	.529**	.323**	.849**	.809**	.705**	.613**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000	.002	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_1_1	Pearson Correlation	.709**	1	.462**	.352**	.383**	.401**	.375**	.618**	.172*	.341**	.393**	.305**	.299**	.246**	.103	.628**	.566**	.471**	.438**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000	.000	.027	.000	.000	.000	.000	.001	.186	.000	.000	.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_1_2	Pearson Correlation	.615**	.462**	1	.123	.339**	.345**	.442**	.423**	.080	.247**	.323**	.279**	.242**	.248**	.157*	.509**	.502**	.430**	.348**
	Sig. (2-tailed)	.000	.000		.114	.000	.000	.000	.000	.306	.001	.000	.000	.002	.001	.043	.000	.000	.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_1_3	Pearson Correlation	.495**	.352**	.123	1	.215**	.232**	.238**	.462**	.067	.274**	.387**	.213**	.202**	.168*	.101	.378**	.389**	.227**	.224**
	Sig. (2-tailed)	.000	.000	.114		.005	.003	.002	.000	.391	.000	.000	.006	.009	.031	.198	.000	.000	.003	.004
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_2_1	Pearson Correlation	.571**	.383**	.339**	.215**	1	.410**	.406**	.353**	.123	.128	.240**	.221**	.224**	.302**	.204**	.413**	.340**	.387**	.312**
	Sig. (2-tailed)	.000	.000	.000	.005		.000	.000	.000	.113	.100	.002	.004	.004	.000	.008	.000	.000	.000	.000

	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_2_2	Pearson Correlation	.575**	.401**	.345**	.232**	.410**	1	.591**	.452**	.059	-.010	.279**	.265**	.249**	.209**	.193*	.418**	.335**	.285**	.284**
	Sig. (2-tailed)	.000	.000	.000	.003	.000		.000	.000	.452	.902	.000	.001	.001	.007	.013	.000	.000	.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_2_3	Pearson Correlation	.640**	.375**	.442**	.238**	.406**	.591**	1	.487**	-.053	.210**	.232**	.332**	.191*	.303**	.180*	.584**	.483**	.366**	.330**
	Sig. (2-tailed)	.000	.000	.000	.002	.000	.000		.000	.498	.006	.003	.000	.014	.000	.021	.000	.000	.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_3_1	Pearson Correlation	.722**	.618**	.423**	.462**	.353**	.452**	.487**	1	.007	.336**	.416**	.248**	.171*	.303**	.122	.724**	.615**	.513**	.426**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000		.924	.000	.000	.001	.028	.000	.117	.000	.000	.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_3_2	Pearson Correlation	.237**	.172*	.080	.067	.123	.059	-.053	.007	1	.066	.207**	.210**	.253**	.026	.093	.039	.082	.054	.074
	Sig. (2-tailed)	.002	.027	.306	.391	.113	.452	.498	.924		.398	.007	.007	.001	.741	.231	.615	.294	.489	.342
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_4_1	Pearson Correlation	.496**	.341**	.247**	.274**	.128	-.010	.210**	.336**	.066	1	.334**	.247**	.376**	.248**	.055	.415**	.444**	.346**	.253**
	Sig. (2-tailed)	.000	.000	.001	.000	.100	.902	.006	.000	.398		.000	.001	.000	.001	.485	.000	.000	.000	.001
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166

b_4_2	Pearson Correlation	.604**	.393**	.323**	.387**	.240**	.279**	.232**	.416**	.207**	.334**	1	.392**	.433**	.216**	.199*	.439**	.497**	.291**	.257**
	Sig. (2-tailed)	.000	.000	.000	.000	.002	.000	.003	.000	.007	.000		.000	.000	.005	.010	.000	.000	.000	.001
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_4_3	Pearson Correlation	.573**	.305**	.279**	.213**	.221**	.265**	.332**	.248**	.210**	.247**	.392**	1	.385**	.347**	.037	.451**	.532**	.405**	.210**
	Sig. (2-tailed)	.000	.000	.000	.006	.004	.001	.000	.001	.007	.001	.000		.000	.000	.636	.000	.000	.000	.007
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_4_4	Pearson Correlation	.551**	.299**	.242**	.202**	.224**	.249**	.191*	.171*	.253**	.376**	.433**	.385**	1	.317**	.205**	.353**	.361**	.304**	.289**
	Sig. (2-tailed)	.000	.000	.002	.009	.004	.001	.014	.028	.001	.000	.000	.000		.000	.008	.000	.000	.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_4_5	Pearson Correlation	.529**	.246**	.248**	.168*	.302**	.209**	.303**	.303**	.026	.248**	.216**	.347**	.317**	1	.189*	.418**	.384**	.337**	.276**
	Sig. (2-tailed)	.000	.001	.001	.031	.000	.007	.000	.000	.741	.001	.005	.000	.000		.015	.000	.000	.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_4_6	Pearson Correlation	.323**	.103	.157*	.101	.204**	.193*	.180*	.122	.093	.055	.199*	.037	.205**	.189*	1	.145	.053	.238**	.243**
	Sig. (2-tailed)	.000	.186	.043	.198	.008	.013	.021	.117	.231	.485	.010	.636	.008	.015		.062	.497	.002	.002
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_4_7	Pearson Correlation	.849**	.628**	.509**	.378**	.413**	.418**	.584**	.724**	.039	.415**	.439**	.451**	.353**	.418**	.145	1	.829**	.671**	.595**

	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.615	.000	.000	.000	.000	.000	.062		.000	.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_4_8	Pearson Correlation	.809**	.566**	.502**	.389**	.340**	.335**	.483**	.615**	.082	.444**	.497**	.532**	.361**	.384**	.053	.829**	1	.675**	.520**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.294	.000	.000	.000	.000	.000	.497	.000		.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_4_9	Pearson Correlation	.705**	.471**	.430**	.227**	.387**	.285**	.366**	.513**	.054	.346**	.291**	.405**	.304**	.337**	.238**	.671**	.675**	1	.514**
	Sig. (2-tailed)	.000	.000	.000	.003	.000	.000	.000	.000	.489	.000	.000	.000	.000	.000	.002	.000	.000		.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166
b_4_10	Pearson Correlation	.613**	.438**	.348**	.224**	.312**	.284**	.330**	.426**	.074	.253**	.257**	.210**	.289**	.276**	.243**	.595**	.520**	.514**	1
	Sig. (2-tailed)	.000	.000	.000	.004	.000	.000	.000	.000	.342	.001	.001	.007	.000	.000	.002	.000	.000	.000	
	N	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix 14: Correlations of Purchasing Portfolio Management

		C_1_1	C_1_2	C_1_3	C_1_4	C_1_5	C_1_6	C_1_8	C_2_1	C_2_3	C_2_4	C_3_1	C_3_2	C_Total
C_1_1	Pearson Correlation	1	.400**	.412**	.095	.305**	.417**	.049	-.027	-.079	-.042	.114	.153*	.518**
	Sig. (2-tailed)		.000	.000	.222	.000	.000	.533	.733	.310	.591	.143	.050	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166
C_1_2	Pearson Correlation	.400**	1	.397**	.090	.537**	.207**	-.108	.090	.185*	.143	.037	.071	.551**
	Sig. (2-tailed)	.000		.000	.250	.000	.007	.168	.250	.017	.066	.635	.365	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166
C_1_3	Pearson Correlation	.412**	.397**	1	.103	.433**	.363**	-.107	.013	.085	.054	.076	.057	.568**
	Sig. (2-tailed)	.000	.000		.185	.000	.000	.171	.865	.274	.489	.333	.469	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166
C_1_4	Pearson Correlation	.095	.090	.103	1	.122	.007	.362**	-.032	-.006	-.011	.097	.116	.379**
	Sig. (2-tailed)	.222	.250	.185		.117	.929	.000	.686	.934	.886	.216	.135	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166
C_1_5	Pearson Correlation	.305**	.537**	.433**	.122	1	.288**	-.176*	.050	.118	-.018	.010	.009	.505**
	Sig. (2-tailed)	.000	.000	.000	.117		.000	.024	.522	.129	.815	.900	.907	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166
C_1_6	Pearson Correlation	.417**	.207**	.363**	.007	.288**	1	.004	-.086	-.071	-.101	.057	.110	.427**
	Sig. (2-tailed)	.000	.007	.000	.929	.000		.958	.272	.366	.195	.464	.160	.000

	N	166	166	166	166	166	166	166	166	166	166	166	166	166
C_1_8	Pearson Correlation	.049	-.108	-.107	.362**	-.176*	.004	1	-.014	-.050	-.003	.104	.114	.207**
	Sig. (2-tailed)	.533	.168	.171	.000	.024	.958		.858	.522	.971	.184	.142	.008
	N	166	166	166	166	166	166	166	166	166	166	166	166	166
C_2_1	Pearson Correlation	-.027	.090	.013	-.032	.050	-.086	-.014	1	.498**	.385**	.187*	.158*	.376**
	Sig. (2-tailed)	.733	.250	.865	.686	.522	.272	.858		.000	.000	.016	.042	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166
C_2_3	Pearson Correlation	-.079	.185*	.085	-.006	.118	-.071	-.050	.498**	1	.765**	.121	.198*	.480**
	Sig. (2-tailed)	.310	.017	.274	.934	.129	.366	.522	.000		.000	.119	.010	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166
C_2_4	Pearson Correlation	-.042	.143	.054	-.011	-.018	-.101	-.003	.385**	.765**	1	.188*	.230**	.448**
	Sig. (2-tailed)	.591	.066	.489	.886	.815	.195	.971	.000	.000		.015	.003	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166
C_3_1	Pearson Correlation	.114	.037	.076	.097	.010	.057	.104	.187*	.121	.188*	1	.675**	.478**
	Sig. (2-tailed)	.143	.635	.333	.216	.900	.464	.184	.016	.119	.015		.000	.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166
C_3_2	Pearson Correlation	.153*	.071	.057	.116	.009	.110	.114	.158*	.198*	.230**	.675**	1	.516**
	Sig. (2-tailed)	.050	.365	.469	.135	.907	.160	.142	.042	.010	.003	.000		.000
	N	166	166	166	166	166	166	166	166	166	166	166	166	166

C_Total	Pearson Correlation	.518**	.551**	.568**	.379**	.505**	.427**	.207**	.376**	.480**	.448**	.478**	.516**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.008	.000	.000	.000	.000	.000	
	N	166	166	166	166	166	166	166	166	166	166	166	166	166

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed)

Appendix 15: Correlations of Company Performance

		D_1_1	D_1_2	D_1_3	D_1_4	D_2_1	D_2_2	D_2_3	D_Total
D_1_1	Pearson Correlation	1	.467	.552	.257	.417	.417	.446	.696
	Sig. (2-tailed)		.000	.000	.001	.000	.000	.000	.000
	N	166	166	166	166	166	166	166	166
D_1_2	Pearson Correlation	.467	1	.429	.274	.408	.429	.408	.671
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000	.000
	N	166	166	166	166	166	166	166	166
D_1_3	Pearson Correlation	.552	.429	1	.498	.417	.342	.333	.687
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000	.000
	N	166	166	166	166	166	166	166	166
D_1_4	Pearson Correlation	.257	.274	.498	1	.361	.236	.231	.549
	Sig. (2-tailed)	.001	.000	.000		.000	.002	.003	.000
	N	166	166	166	166	166	166	166	166
D_2_1	Pearson Correlation	.417	.408	.417	.361	1	.799	.668	.815
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000	.000
	N	166	166	166	166	166	166	166	166
D_2_2	Pearson Correlation	.417	.429	.342	.236	.799	1	.871	.828
	Sig. (2-tailed)	.000	.000	.000	.002	.000		.000	.000
	N	166	166	166	166	166	166	166	166
D_2_3	Pearson Correlation	.446	.408	.333	.231	.668	.871	1	.802
	Sig. (2-tailed)	.000	.000	.000	.003	.000	.000		.000
	N	166	166	166	166	166	166	166	166
D_Total	Pearson Correlation	.696	.671	.687	.549	.815	.828	.802	1

	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	
	N	166	166	166	166	166	166	166	166

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed)