Supply Chain Perspectives and Issues in China
A Literature Review

"China could not have emerged as the world’s largest trading economy, without appreciating the central role of the evolution of Global Value Chains (GVCs) within China, but these GVCs could not have evolved to become a major factor without significant institutional, process and business model innovations, including the role played by local governments and universities.

The Fung Business Intelligence Centre and the Fung Global Institute is fortunate to have Professor Song Hua from the Renmin University of China, one of the foremost authorities on Chinese supply chains, to author and lead this volume of writings by Chinese academics and practitioners to capture the core features and themes of the exploding literature on GVCs in China. Most of these works were available only in Chinese and thus not available to the wider English-speaking audience.”

- Andrew Sheng, President of the Fung Global Institute

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Supply Chain Perspectives and Issues in China
A Literature Review

Edited by
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## Contents

**Foreword** ........................................................................................................................................................................... 10

**Introduction: Analysing the literature on supply chain management** ................................................................. 13

1. **Global supply chains and outsourcing management** ......................................................................................... 17

   **Overview** ........................................................................................................................................................................ 17

   1.1 **Economic Globalisation** ........................................................................................................................................ 17

      1.1.1 *Enterprises in international mode* .................................................................................................................. 18

      1.1.2 *Global supply chains* ......................................................................................................................................... 18

      1.1.3 *Accent on management* ..................................................................................................................................... 19

   1.2 **Management and country- and industry-level perspectives** ................................................................. 20

   1.3 **An enterprise-level perspective on management** ......................................................................................... 22

      1.3.1 *Internationalisation process model* .............................................................................................................. 22

      1.3.2 *Internationalisation theory* .......................................................................................................................... 23

   1.4 *“Network and relationship” perspectives* .......................................................................................................... 26

   1.5 **Recommended reading** ........................................................................................................................................ 28

      1.5.1 *Global Supply Chain Management (Quanqiu gongyinglian guanli)* ......................................................... 28

      1.5.2 *The Relationship between Internalization, Supply Chain Management Practice and Performance: An Empirical Research Based on the Panel Data* ........................................... 28

      1.5.3 *Determinants of Receiving International Outsourcing for Developing Countries* ............................................... 29

   1.6 **References** ........................................................................................................................................................... 30

2. **Third-party logistics and supply chain service integrators** ................................................................................. 35

   **Overview** ........................................................................................................................................................................ 35

   2.1 **Developments in China’s TPL industry** ............................................................................................................. 35

   2.2 **Core competences of TPL enterprises** ............................................................................................................... 37

   2.3 **Customer satisfaction and performance evaluation** ...................................................................................... 39

      2.3.1 *Customer satisfaction evaluation system* ......................................................................................................... 39

      2.3.2 *Supply-demand relationship between TPL providers and their customers* .................................................. 40

   2.4 **Integrated supply chain services providers** .................................................................................................... 41

   2.5 **Recommended reading** .......................................................................................................................................... 43

      2.5.1 *Report of China Logistics Development 2011* .............................................................................................. 43

      2.5.2 *Creating Value through Advanced Logistics* .................................................................................................. 44

      2.5.3 *Shenzhen Supply Chain Management Industry Development Report* .......................................................... 45

   2.6 **References** ............................................................................................................................................................. 46
3. Green supply chains and sustainability .............................................. 49
   Overview............................................................................................................ 49
   3.1 The concept of green supply chains ...................................................... 49
   3.2 Green supply chain operations ............................................................... 51
      3.2.1 Factors affecting the implementation of green supply chain management strategies ........................................................................ 51
      3.2.2 Green supply chain strategies ............................................................ 52
      3.2.3 Green supply chain management technologies ................................ 52
      3.2.4 Green supply chain operations in industries – using food manufacturing as an example ................................................................. 53
   3.3 Management of green supply chains and enterprises performance evaluation .................................................................................. 55
   3.4 An integrated framework for green supply chain research .................. 56
   3.5 Recommended reading ............................................................................. 57
      3.5.1 Green Supply Chain Management: Sustainable Development Model for Enterprises (Lüse gongyingliang guanli: qiye kechixufazhan moshi) ........................................................................ 57
      3.5.2 Statistics Analysis on Relationship between Practice and Performance of Green Supply Chain Management among Enterprises ........................................................................ 58
      3.5.3 Investigation into the Barriers of Enterprise Green Procurement ........................................................................................................ 59
   3.6 References ................................................................................................ 59
4. Supply chain risk management .............................................................. 63
   Overview............................................................................................................ 63
   4.1 Understanding the concept of supply chain risks .................................. 64
      4.1.1 Supply chain risks .............................................................................. 64
      4.1.2 Supply chain risk management ............................................................ 64
   4.2 Major themes in supply chain risk literature .......................................... 65
      4.2.1 Supply chain risk identification ............................................................ 65
      4.2.2 The impact of supply chain risks on enterprises and supply chain performances ........................................................................ 66
      4.2.3 Supply chain risk management ............................................................ 67
   4.3 The way forward ....................................................................................... 68
      4.3.1 Research perspective ........................................................................... 68
      4.3.2 Research content .................................................................................. 68
      4.3.3 Research methodology ........................................................................ 68
4.4 Recommended reading.............................................................................69
   4.4.1 A Study on Supply Chain Risk Managerial Integration Model Based on Knowledge Management..........................69
   4.4.2 Option Mechanism in Supply Chain Risk Management.....69
4.5 References.................................................................................................70

5. SME supply chains and industry clusters .............................................73
   Overview...............................................................................................................73
   5.1 SME supply chains and entrepreneurship...............................74
      5.1.1 Defining supply chain entrepreneurship..........................74
      5.1.2 The SME supply chain.........................................................74
      5.1.3 Managing SME supply chains .............................................74
      5.1.4 Collaboration between SMEs and external partners.....76
   5.2 Industry clusters......................................................................................77
      5.2.1 Definition of industry clusters ..............................................77
      5.2.2 Resources and capabilities SMEs can acquire from cluster supply chains .......................................................77
   5.3 Recommended reading.............................................................................79
      5.3.1 Cluster Supply Chain Management.................................79
      5.3.2 Analysis of Technological Innovation Game Model in Firms of Supply Chain in Clusters.................................80
      5.3.3 Empirical study on Influence of GUANXI Culture on the Stability of Symbiosis of Entrepreneurial Supply Chain...81
   5.4 References..................................................................................................82

6. Servitisation and service supply chains................................................85
   Overview...............................................................................................................85
   6.1 Introducing the concept...........................................................................85
      6.1.1 Defining service........................................................................85
      6.1.2 The “services-dominant logic”...............................................86
   6.2 Service supply chain: definition and network structure ............86
      6.2.1 General definitions and different models of service supply chains.................................................................86
      6.2.2 Service supply chains in different industries.........................90
   6.3 Service supply chain processes............................................................94
      6.3.1 Information exchange in service supply chain..................94
      6.3.2 Service procurement and capacity in service supply chain.................................................................94
      6.3.3 Relationship between customers and suppliers in service supply chain..........................................................94
      6.3.4 Coordination and relationship governance in service supply chain............................................................95
6.4 Recommended reading

6.4.1 Service-oriented Supply Chain Operations ........................................... 96
6.4.2 A Review on the Service Supply Chain Literature ............................. 98
6.4.3 An Order Allocation Model in Two-Echelon Logistics
Service Supply Chain ........................................................................... 98
6.4.4 Research on Market Risk Sharing Mechanism of Two
Stage Application Service Supply Chain under Demand
Uncertainty ...................................................................................... 98

6.5 References ............................................................................................ 99

7. Supply chain flexibility ........................................................................... 103

Overview ............................................................................................... 103
7.1 Definitions and dimensions of supply chain flexibility .......................... 104
  7.1.1 Definitions of supply chain flexibility ........................................... 104
  7.1.2 Dimensions of supply chain flexibility ....................................... 105
  7.1.3 Measurements of supply chain flexibility .................................... 106
7.2 Factors affecting supply chain flexibility .............................................. 107
  7.2.1 Internal factors ............................................................................ 107
  7.2.2 External factors ........................................................................... 109
7.3 Performance indicators of supply chain flexibility ............................... 111
  7.3.1 Enterprise-level performance indicators .................................... 111
  7.3.2 Supply-chain-level performance indicators ................................ 111
7.4 An integrated framework .................................................................... 112
7.5 Recommended reading ....................................................................... 113
  7.5.1 Measurement of Supply Chain Flexibility ................................... 113
7.6 References ............................................................................................ 113

8. Supply chain finance .............................................................................. 117

Overview ............................................................................................... 117
8.1 The concepts of supply chain finance ................................................ 118
8.2 Supply chain finance models .............................................................. 119
8.3 Supply chain finance risk management .............................................. 120
8.4 Challenges and developments ............................................................ 122
8.5 Recommended reading ....................................................................... 122
  8.5.1 Supply Chain Finance ................................................................ 122
  8.5.2 Operating Models of Finance-Transportation-Warehouse (FTW) Service .................................................. 123
  8.5.3 Credit Risk Analysis of Supply Chain Finance ............................. 124
8.6 References ............................................................................................ 124
   Overview .............................................................................................................127
9.1 Logistics costs measurements .................................................................127
   9.1.1 Understanding logistics costs from different perspectives ................127
   9.1.2 Logistics costing models .................................................................128
   9.1.3 Logistics cost accounting methods ..............................................129
9.2 Current picture of enterprise logistics costs in China ....................130
9.3 Supply chain performance evaluation ................................................132
   9.3.1 Indicator selection .......................................................................132
   9.3.2 Performance evaluation ..............................................................135
9.4 Recommended reading ...........................................................................138
   9.4.1 Logistics Costs and Supply Chain Performance Management .........138
   9.4.2 The Status and Development of China Company’s Logistics Cost Management .......................................................138
9.5 References .................................................................................................139
Consolidated Bibliography .......................................................................... 145
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The Fung Business Intelligence Centre (formerly known as the Li & Fung Research Centre) collects and analyses market data on China’s economy, with special reference to sourcing, distribution and retailing, and produces reports on sourcing in selected Asian countries.

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The Institute is a not-for-profit organisation based in Hong Kong.
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**Foreword**

As you may be aware, the Fung Global Institute (FGI) has been working on Global Value Chains (GVCs) as one of its four key research themes. Value Chains or production and distribution networks are everywhere and together they comprise all real sector activities of production from basic raw materials, design, manufacturing, assembly and distribution to final consumers. The emergence of the Global Supply Chain, begun in Japan and today with its Factory Asia with main activities in China supplying consumer goods to the world, is the economic story of global trade and production in the last 60 years.

Global supply chains have evolved beyond the traditional international trade and investment linkages of the previous century. They reflect a fundamental shift in economic, political and social relationships among nations, raising unprecedented challenges for policymakers, academics and businessmen alike.

China could not have emerged as the world’s largest trading economy without appreciating the central role of the evolution of GVCs within China. But GVCs in China could not have evolved to become a major factor, without significant institutional, process and business model innovations, including the role played by local governments and universities. Chinese academics and businesses started from learning and adapting Western supply chain models from writings by foreign universities and practice by multinationals operating in China. But many of the innovations in institutions, such as centralized production cities, and processes are original.

The Chinese national production system has consequently transformed gradually from the “world’s factory” into a more balanced economy, with its supply chain studies also diversifying from efficient production and distribution alignment to include new topics such as servitisation, trade finance and sustainability.

The Fung Business Intelligence Centre and the Fung Global Institute is fortunate to have Professor Song Hua from the Renmin University of China, one of the foremost authorities on Chinese supply chains, to author and lead this volume of writings by Chinese academics and practitioners to capture the core features and themes of the exploding literature on GVCs in China. Until very recently, most of the Chinese research on GVCs was available only in Chinese and thus not available to the wider English-speaking audience.

Focuses and concerns of the GVC literature in China and those in the English-speaking world have similarities as well as differences. Where they diverge reflects particularities of the political economy in China, which result in a fragmented market and a fiercely competitive environment. These are the unique features of the socialist market economy with Chinese characteristics. But they represent huge opportunities as well as barriers to further market efficiencies.

This volume reveals the emerging issues at the Chinese and global levels in the next stage of evolution of GVCs. First, dispersed manufacturing within China as a main assembly point tends to distort trade figures and make conditional “rules of origin” less
Supply Chain Perspectives and Issues in China

relevant. Second, not only are China’s fast developing supply chains important factors shaping the new global trade reality, these supply chains are shifting distribution from East to West, towards not only South-South, but also within China itself, one of the largest markets in the world.

Consequently, an understanding of GVCs in China is of paramount importance to businesses and governments around the world.

This publication is the third in the series produced by FGI in collaboration with other partners. In July, we produced two key publications. The first was with the World Trade Organization (WTO) and Temasek Centre for Trade & Negotiation, Nanyang Technological University (NTU): *Global Value Chains in Changing World*, edited by Deborah K. Elms, head of the Temasek Centre and Patrick Low, Chief Economist of the WTO and Senior Fellow at the FGI. This book features leading thinkers and practitioners in the field, such as Victor Fung, Richard Baldwin, Henry Weil, John Gattorna, Garry Gereffi and Timothy Sturgeon. In addition, *Supply Chains Perspectives and Issues*, written by Albert Park, Gaurav Nayyar and Patrick Low, is the latest comprehensive literature survey on global supply chains, produced in partnership with the WTO.

In this interconnected and rapidly changing world, no one can afford to overlook how firms in China are shaping, and at the same time being shaped by, the GVCs. By introducing the fascinating researches carried out by Chinese scholars to a wider international community, it is our hope that the volume may further academic collaboration and facilitate businesses and policy makers alike in formulating sound decisions.

We want to thank Song Hua and his colleagues, Chang Ka Mun, Lau Fong and Helen Chin of the Fung Business Intelligence Centre, Xiao Geng and Patrick Low of the Institute, in making this publication possible.

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Introduction

Analysing the literature on supply chain management

Song Hua (Renmin University of China)
Yu Kangkang (Renmin University of China)
Over recent years, supply chain management has evolved into an ever more mature field of research in China. By adapting theories and research methodologies from different disciplines such as industrial engineering, sales, marketing and strategic management, supply chain management studies have also become increasingly sophisticated.

This publication aims to provide an overview of developments in the field of China's supply chain management, showing the latest trends, important theoretical perspectives, major issues and other highlights through a review of available research.

Recommended reading on the relevant topics is also provided at the end of each of the coming chapters.

According to data from Wanfang, which hosts China's leading academic databases, research focus on the country's supply chain management levelled out between 2007 and 2012 after a phase of rapid output before 2008.

Also according to Wanfang, researchers have focused their attention between 2007 and 2012 on topics related to logistics technologies such as vehicle positioning, remote monitoring, vendor-managed inventory (VMI) and radio-frequency identification (RFID), as well as different basic supply chain management functions and activities.

Exploring these research themes more deeply, we see that performance evaluation and information sharing remain core issues in supply chain management. At the same time, value chain, game and third-party logistics theories have also received ample attention.

It is noteworthy that research interest in supply chain finance and supply chain risks has grown rapidly over recent years and these areas look set to emerge as a major research direction into the future.

By contrast, attention given to more traditional topics such as partner selection, supplier relationship management, inventory management and bullwhip effects have faded.

Different research themes on supply chain management are covered in this review of the literature, following the framework shown in the Exhibit below; the themes include macro-level analysis (global supply chains, the third-party logistics industry and its development, and green supply chains), industry- or chain-level analysis (supply chain
Analysing the literature on supply chain management

Supply chain risks, SMEs supply chains and clusters, and service supply chains), factor-level analysis (supply chain flexibility and supply chain finance), as well as logistics cost and supply chain performance evaluation.

Exhibit: Framework of the literature review

Here is a brief introduction to each of the following chapters:

**Global supply chains and outsourcing management.** To build successful global supply chains, enterprises have to possess the skills to find their most competitive partners around the world to match their requirements. Chapter 1 reviews global supply chain management from three perspectives: country- and industry-levels, enterprise-level and at the “network and relationship” level.

**Third-party logistics and supply chain service integrators.** Third-party logistics (TPL), also known as contract logistics or outsourced logistics, plays an important role in the Chinese economy today. Chapter 2 focuses on four areas: evaluation of the TPL industry, the core competences of TPL providers, customer satisfaction and performance evaluation, as well as the development of fourth-party logistics in China.

**Green supply chains and sustainability.** Green supply chain management is a recent model that takes environmental impact and resource efficiency into account when managing an entire chain encompassing suppliers, manufacturers, vendors and users. Chapter 3 explores the concepts, operations and performance evaluation of these green supply chains. There is also analysis of the driving forces and barriers of green supply chain operations in China.
Supply chain risk management. Internal and external uncertainties may have a negative impact on supply chains. In chapter 4, supply chain risks are explored from three angles: supply chain risk identification, the impact of supply chain risks on enterprise and supply chain performances, and supply chain risk management.

SME supply chains and industry clusters. SMEs are a potent force in the development of China's economy. Chapter 5 explores SME supply chains, their management and collaborations between SMEs and external partners. The concept of cluster supply chains is introduced, and the chapter has further elaboration on the resources and capabilities which SMEs can acquire from cluster supply chains.

Servitisation and service supply chains. As a new aspect of economic growth in the global economy, the service industry has captured the attention of businesses and academia. Chapter 6 reviews the definitions and characteristics of service supply chains. Examples from different industries and studies of various service supply chain processes are also included.

Supply chain flexibility. Supply chain flexibility is the capability of supply chains to respond to internal and external change. Chapter 7 introduces the definitions and dimensions of supply chain flexibility, and probes internal and external factors that affect the flexibility of supply chains. There is analysis of different performance indicators when considering supply chain flexibility.

Supply chain finance. Supply chain finance has captured considerable research attention over recent years. However, researchers in China have yet to offer a precise definition for such financing. Chapter 8 reviews the concepts of supply chain finance, different finance models, risk management and supply chain finance development in China.

Logistics cost and supply chain performance evaluation. This is one of the key components of supply chain management. Chapter 9 reviews the measurements of logistics costs, including different costing and accounting methods. There is a presentation on the current profile of enterprise logistics costing in China and an introduction to different supply chain performance evaluation methods.

In short, the publication aims to provide professionals and academics with the latest scholarly research emerging in China’s supply chains.
Chapter 1

Global supply chains and outsourcing management

Jia Jingzi (Renmin University of China)
Hou Haitao (Renmin University of China)
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Overview

Since the turn of this century, the world economy has grown rapidly and "gone global", developments that have been accompanied by the ever increasing reach of multinational corporations. The resulting global supply chains have brought greater economic interdependence between countries worldwide through the increasing volume and variety of cross border transactions in goods and services, freer international capital flows, and more rapid and widespread diffusion of technology. The right management tool is now an indispensible ingredient for handling this ongoing change, most typically in outsourcing.

Our review of the theories and practices tracking such changes, and management of them, starts with three important implications. First, interdependence of different countries has increased with growing economic ties; secondly, economic patterns within different countries have become more synchronised; and thirdly, the power of international cooperation has been strengthened through multilateral and regional organisations.

1.1 Economic Globalisation

Fan Aijun (2002) suggests that the current global trend can be observed specifically through its effect on different trade dimensions. These undoubtedly include the factors of production, the product market itself, the overarching industrial structure, market ideologies, and economic and trade rules.

Also, advances in information technologies have greatly facilitated operations and management of enterprises on a global scale, significantly speeding up global economic integration. With a more liberal trade environment, we have witnessed the rapid expansion of multinational production networks and a rise in the global flow of goods.

It follows that since countries have comparative advantages in different products and services, the implementation of an international management strategy is essential for enterprises trading between those countries to gain a competitive edge.
However, economic globalisation could also be seen as a double-edged sword. While this greatly boosts global productivity and offers developing countries better opportunities to match their counterparts in the developed world, competition also intensifies, while market speculation increases. Hence there are greater uncertainties.

Further, globalisation has posed huge challenges to national sovereignty. It also threatens the survival of state industries in many developing countries. Evidently today, every country must face the test of economic globalisation and adapt to the challenges, without exception.

1.1.1 Enterprises in international mode

Many scholars such as Lu Tong (1998) and Jin Rungui (1999) view the internationalisation of domestic enterprises as their expansion in a spatial dimension. This refers to enterprises’ active participation in the international division of labour, and their transformation into multinational corporations.

Facing globalisation and its fast-changing political, economic and technological environment, companies aiming externally have to develop new capabilities, such as the global allocation of production factors and management skills, in order to survive and thrive.

Some scholars have suggested that this internationalisation process is manifested in two main aspects. The first is through expansion of operations such as production and marketing abroad, and the second is by transforming from local to multinational enterprises (Liang Neng, 1999).

Wang Zengtao (2003) notes that such internationalisation is “the orientation targeting the international market, the international allocation of factors of production, and active participation in the international division of labour and international competition”. Operational modes are determined by goals to make international profits, Wang believes; enterprises today strive to achieve the overall optimisation of their global operations, instead of focusing on a particular country or region.

Meanwhile, Wan Tianwei (2006) points out that “enterprises with international activities” and “multinational corporations” are not conceptually identical.

The contemporary understanding of “multinational corporations” usually implies monopolistic advantages in particular economic or industrial sectors, says Wan, or an important class of products, enjoyed in one or more countries and regions, or even globally. By contrast enterprises engaged in international operations can vary greatly in size and by their degree of international involvement.

1.1.2 Global supply chains

Since 2005, the impact of globalisation on supply chains has become increasingly evident. From developed economies to emerging ones in South America, Africa, the Middle East and Asia, the impact of this trend can be felt around the world.

In fact, the concept of global supply chains has been widely discussed and refined by scholars. Today, global supply chains are seen as encompassing a series of interconnected, globally-dispersed business activities, including procurement of raw materials and components, manufacturing, and downstream through product distribution to retailers and consumers.
The essential information is shared between different parties; the ultimate goal of global supply chains is to reduce costs and boost revenues. To build a successful global supply chain, enterprises require the ability to select the most competitive partners around the world to match their needs.

Along with increasing economic globalisation, the future of competition will mainly – logically – be determined by the competitiveness of different global supply chains.

These chains have certain features. For a start, they are based on modern information technologies; secondly, to meet the demand of global consumers, the unobstructed flows of products, information and capital have to be achieved. Finally, strategic partnerships with different members form the backbone of such chains.

Shi Hong (2006) defines “global supply chains” as worldwide networks in which parties such as suppliers, manufacturers, distributors, merchandise wholesalers and retailers conduct activities that include material purchasing, processing, distribution, and customer sales.

Xie Jian (2005) notes that as multinational corporations actively increase foreign investment, they are able to acquire the resources and manpower possessed by other enterprises, and therefore optimise the allocation of resources worldwide in order to build their global chains.

Li Wenfeng (2011) defines global supply chains as operations initiated by customer demand, through research and development, design, raw material procurement, manufacturing and distribution, right down to delivery to the final customer.

Yang Qingding and Huang Peiqing (2004), however, only define international supply chains as those in which suppliers, manufacturers and retailers are located in two or more countries.

1.1.3 Accent on management

Global supply chain management is seen as an interdisciplinary subject, encompassing knowledge of different sorts, such as marketing, international business, operations and economics. But actually there are many different definitions. The key is that all point to the important institutional and cultural differences when managing a range of supply chain members in a global context.

Yang Sangen and Duan Gang (2005) suggest that “global supply chain management” must be driven by a comprehensive and efficient grasp of consumer needs worldwide. This involves planning, coordination, operations, control and optimisation activities to achieve the “6Rs” in the global market. The “6Rs” involve getting the right products to the right place at the right time, in the right quantity with the right quality and right status.

Li Zhengjia (2008) maintains that in order to lower costs, improve efficiency and enhance core competitiveness, many enterprises have adopted global operations, which give rise to global supply systems spanning different countries, regions, and cultures. Global supply chain management is a new management model, Li suggests, that organically links suppliers and end users to effectively control the physical, capital and information flows of the global supply chain.

Yu Mei (2008) studied the global supply chain management practices of US company Lexmark International and suggests that global supply chain management is a new mode of operation which international enterprises adopt in the new, competitive global environment.
Through optimising arrangements of existing supply chain systems, enterprises can reduce costs, trim inventory levels throughout the supply chain, increase corporate profits, and ultimately improve their competitiveness.

Chen Gongyu and Wang Jie (2007) consider global supply chain management as a breakthrough from its traditional variety, in both time and space. This means that in an era of economic globalisation, multinational corporations select suppliers, build production and research and development (R&D) bases, while developing sales and service channels across the globe.

Chen and Wang also suggest such corporations strive to effect “real-time” control of information, capital, and physical flows; all these activities have gradually developed to become today’s global supply chain management.

On the other hand, Lu Benfu and Xu Yuehong (2003) give a general depiction of the operating mechanism of international supply chains. First, they suggest, international supply chains are driven by market needs. Led by core enterprises, the goal of the supply chain is to enhance competitiveness, expand market share, improve customer satisfaction, and maximise profits. Also, supply chain members must make concerted efforts to collaborate with one another to create synergies, instead of pursuing their own best self-interest: Building “win-win” relationships is the key. Finally, the entire supply chain operation is dynamic, with value addition in each single process, they say.

Li Wenfeng (2011) also outlines the characteristics of global supply chains operations; the presumption is that these are operations led by multinational corporations from developed countries. Enjoying economies of scale as well as strengths in technology and branding, multinational corporations take a dominating position in global supply chain configurations, Li concludes.

Additionally, activities such as product design, parts procurement, production, assembly and sales are no longer confined to a single country. Li notes that global supply chain operations emphasise the collaboration between different members that include manufacturers, suppliers, distributors and retailers.

Li has other points. Enterprises focus on their core businesses and outsource non-core businesses to other partners. Rapid information flow is the enabler. Finally, supply chain operators offer total logistics solutions to their clients, so products can reach customers on time at lower cost.

1.2 Management and country- and industry-level perspectives

Cultural and institutional differences between countries are determining factors shaping the forms of global supply chains and management behaviours, academics maintain.

On the other hand, industry features that include product characteristics, degrees of uncertainty, and the level of competition also have influence over the generally adopted forms of global supply chain.

For instance, when multinational companies outsource supply chain processes to China, their key considerations are the country’s economic development, intellectual property protection, government policies and rules, and the capabilities of Chinese companies to undertake outsourcing projects. By comparison, India is seen as having a distinct edge in IT outsourcing and offshore outsourcing activity.
Wan Tianwei (2006) studied the internationalisation strategies of 569 manufacturing enterprises of different ownership types and from different industries in 16 cities in the Yangtze River Delta region of China. The study concludes that the progressive stages of development suggested in standard internationalisation theories may not fully apply to enterprises in that region; with “late-mover advantages”, enterprises can establish themselves more quickly and even leapfrog the growth of “early-mover” players, in the right circumstances.

With a backdrop of economic globalisation, the key motivators behind outbound foreign direct investment by Chinese enterprises are to acquire technology and to integrate into global supply chains (He Jun, 2008).

In his study of Wenzhou enterprises, Xie Jian (2005) however points out that the internationalisation of a regional economy becomes an inevitable trend for regional economic developments.

Xie believes that in Wenzhou, the establishment of self-owned sales and marketing channels and cooperation with multinational companies in different upstream and downstream activities are among the major ways private enterprises can embark on internationalisation. To these are added the formation of joint ventures with multinational companies and, crucially, greater involvement in global supply chains.

David Lee (2011) goes further and suggests that suppliers in emerging countries should offer more attractive value propositions, instead of relying on low cost competition.

He Hui and Zhang Wei (2009) analysed the participation, positions and mode of operations of China’s export manufacturing industry in global supply chains, while also describing the pressures and challenges facing China’s export manufacturing industry, with a series of corresponding solutions.

Then again, transfers of technology and expertise also comprise a strategy suggested for pursuit. Yang Xu and Li Xingwang (2000) propose that Chinese enterprises should actively draw on the technologies, capabilities, capital and management philosophies of their multinational clients. This allows them to enhance their competitive edge and expand participation in the international market.

Chen Gongyu and Wang Jie (2007) suggest that global supply chain management is reliant upon a variety of factors. These include the global revolution in information technology, the formation of global logistics networks and lowering of logistics costs. Equally, management is dependent on the reduction in global tariffs and increasing ease of capital flows.

Chen and Wang used the examples of Chinese firms Baosteel and Haier to illustrate the transformation of such enterprises from export and OEM manufacturers to become drivers of important nodes and regional centres for global supply chains.

Liu Zhibiao and Zhang Jie (2009) reviewed China’s strategy to achieve industry upgrading, and they advocate China actually shifting its focus from integration into the global value chain. The idea is to aim for construction of a “national value chain”, which is more driven by domestic demand.

That followed a comparative analysis of industrial clusters and supply chains by Li Junhua and Peng Yulan (2004) who propose a new model for countries and regions to develop their own competitive advantages.
1.3 An enterprise-level perspective on management

1.3.1 Internationalisation process model

Lu Tong (1998) points out that the internationalisation of enterprises can be divided into inward and outward approaches; he suggests that inward internationalisation is the precondition of outward internationalisation.

“Inward internationalisation” refers to activities such as importing, purchasing patent technology, engaging in compensation trade or processing trade, establishing joint ventures, and serving as branch companies of foreign companies. By contrast, “outward internationalisation” mainly involves exporting, technology transfers, establishing foreign joint ventures and setting up offshore branch companies.

Zhou Shangzhi (2003) suggests that Chinese manufacturing enterprises can carry out inward internationalisation by bringing in the products, capital, technology and human capital from foreign companies, and thereby gradually integrating with the global supply chains.

With the accumulation of knowledge and experience, Chinese manufacturing enterprises can further engage in outward internationalisation, actively extending their markets globally, Zhou suggests.

On the other hand, Sun Zhiyi and Qian Chuanfu (2004) point out three forms of internationalisation among enterprises, these being international trade, foreign economic and technological cooperation and foreign direct investment.

Wang Yaxing and Zhang Lei (2009) observe that the common forms of outward internationalisation of enterprises include exports (both direct and indirect), outbound contractual operations (such as licensing and international outsourcing) and outbound foreign direct investments (mainly joint ventures and sole proprietorship). Common forms of inward internationalisation include imports (both direct and indirect), inbound contractual operations (such as undertaking licensing and outsourcing projects such as OEM and ODM) and receiving foreign direct investment by setting up joint ventures.

Lu Tong (1998) proposes a “spider” model to evaluate the degree of internationalisation of enterprises. In her view, internationalisation can be measured in six dimensions, namely the international mode of operation, financial management, marketing strategy, organisational structure, personnel management and an internationalisation index.

For her, each dimension is determined by a number of factors and is indexed with a maximum score of five. The higher degree of internationalisation in one dimension, the higher the score. Exhibit 1.1 demonstrates the degree of internationalisation within two enterprises using the spider model. The more regular the shape of the hexagon implies the enterprise’s more balanced internationalisation.
1.3.2 Internationalisation theory

Chinese scholars have conducted extensive studies to understand the drivers behind global sourcing. Yu Ping (2008) believes that enterprises’ foreign direct investment decisions are subject to a number of factors (see Exhibit 1.2), and these may interact with one another to drive investment decisions.

Exhibit 1.2: Drivers behind foreign direct investment

Qi Junling (2007b), in his study of global sourcing and supplier collaboration, classifies global sourcing as “pull” and “push” factors. “Pull” factors are passive in essence, driving global sourcing decisions due to competitive pressure and more demanding customers. Contrastingly, “push” factors are active in nature; they are an important part of a competitive strategy that helps enterprises gain a sustainable competitive edge.
Zhou Ying and Liu Shuling (2011) suggest that global sourcing has two significant strategic meanings for enterprises. Specifically, it helps push forward internalisation, and also enhances competitiveness. They further explore the different stages of global sourcing by Chinese enterprises, and maintain that the primary drivers in the early stage of global sourcing are to seek quality supplies and high technology.

Along with greater involvement in global sourcing, Zhou and Liu believe that Chinese enterprises will pursue more diverse strategic interests. However, He Yumei and Sun Yanqing (2011) raise the point that the difficulty in monitoring production and contractual inadequacies will also affect the outsourcing decisions of enterprises, as high agency costs are involved to ensure product quality.

Jing Ruiqin (2008) has noted the rise of global outsourcing of services since the 1990s while Lu Danping (2010) finds that the contribution of the services outsourcing industry to GDP is 20 times higher than of the processing trade. With features of high value added, low resources consumption and better employment opportunities, Lu believes China should accelerate the development of modern services industries and participate more actively in global service outsourcing projects to improve the country’s economic structure.

Li Yuhong (2006) shares the view that the global division of labour is no longer confined to production; multinational companies today have dissected their entire value chains and now outsource their other business processes to different countries.

Zhang Huiqing and Tang Haiyan (2010) point out that when enterprises contract out their business processes offshore, lower labour costs in developing countries and transaction costs in outsourcing are the most important considerations. While enterprises in low-tech industries prefer outsourcing to low-wage countries in order to save labour costs, their counterparts in high-tech industries usually opt for countries that offer higher-quality services to reduce transaction costs.

Zeng Jing and Xiong Xiaolin (2008) also find that costs of production as well as transaction costs are the main factors affecting the offshore outsourcing decisions of US enterprises. They cite the competition between China and India in offshore outsourcing, when cost factors have a larger influence in China over the number of offshore outsourcing projects undertaken.

Tan Liwan and Ma Haiyan (2006) analyse the position of Chinese enterprises in the global outsourcing market using the international “smiling curve”, and propose that in the era of globalisation, Chinese enterprises should restructure their value chains and deploy resources globally.

Studies into the impact of outsourcing focus on aspects that include technology spillovers, industry upgrades, productivity, income growth and employment.

(1) Technology spillovers

Lang Yongfeng and Ren Zhicheng (2011) carried out an empirical study into “technology spillovers” achieved by the software industry by undertaking international outsourcing in 14 of China’s “service outsourcing base cities”. The results demonstrate that international outsourcing projects enhance labour productivity in the domestic software industry.
Huang Yejing and Zhangji (2011) also reaffirm the positive effects of outsourcing on the capacity of domestic suppliers to innovate, while Wei Ping (2012) explored different cooperative modes between outsourcing buyers and suppliers. Wei suggests that the intention of buyers to build long-term strategic partnerships offers indirect incentives for buyers to improve innovative capacity.

Lu Sheng and Liu Liqing (2008), on the other hand, point out that intellectual property rights also impact the division of labour in global value chains; developing intellectual property rights strategies, in particular on patents, is key to enhancing the competitiveness of both enterprises and countries.

(2) Industry upgrade

Zhang Mingzhi (2008) suggests that outsourcing is replacing vertical foreign direct investment (FDI) in many industries; by making better use of respective comparative advantages, outsourcing offers developing countries a rare opportunity to integrate into global production systems, and achieve industry upgrades by boosting labour productivity and technology levels.

In light of China’s current stage of economic developments, Liu Zhibiao (2009) advocates that China implement a strategy to coordinate the development of both manufacturing and service outsourcing, instead of pursuing transformation from a “global factory” into a “global office”.

A balanced manufacturing and service outsourcing strategy, in Liu’s view, can help China achieve its industry upgrade. Better integration with the global value chain is essential for China to establish a multi-tiered, modern industrial system and address its problem of uneven regional development.

(3) Productivity

Studies by Liu Haiyun and Tang Ling (2009) aim to prove that outsourcing is conducive to boosting China’s position in this regard; industries with high technology content and a low degree of openness register better increases in productivity.

The “panel data regression” model developed by Wang Li and He Shufeng (2010) also indicate that both service and material outsourcing significantly improve manufacturing productivity; of these, service outsourcing demonstrates a greater effect on productivity improvements. They further observe that the positive effects of service outsourcing have registered tremendous growth since 1997.

(4) Income growth and employment

Song Yuhua and Zhou Jun (2006) point out that, since the 1980s, a decline in demand for labour in some developed countries has drawn attention among academics to the impact of outsourcing; indeed, outsourcing activities of multinational corporations have significantly impacted income distribution and employment in both developed and developing countries.

Xu Yi (2011) examined the impact of international outsourcing on the wage gap between skilled labour and unskilled labour in China, finding that, contrary to the Stolper-Samuelson theorem, outsourcing reduces the wages of unskilled labour, which is in relative abundance in China.
Chinese scholars seek to explain the importance of global supply chain management for enterprises to gain sustainable competitive advantages on a theoretical level. But they also offer empirical evidence to support the claim that global supply chain management can help enterprises expand market share, increase their return on investment and improve their overall competitive position.

Ye Fei and Li Yin (2006) surveyed the manufacturing enterprises in the Pearl River Delta region and the results indicate that better relationships among supply chain partners facilitate information sharing, bringing about a positive impact on operating performances.

Zhao Quanwu, Huang Yafeng and Zhu Daoli (2007) reviewed the data of 49 pharmaceutical manufacturing companies listed on the Shanghai Stock Exchange, and employed ‘panel data’ methods to examine how relationships among supply chain partners affect the operating and financial performance of enterprises; this reveals that the higher the share of the top five suppliers in total purchasing value, the faster the inventory turnover.

Zhong Zuchang and Tan Qiumei (2007) studied China’s foreign trade enterprises and suggest that successful global supply chain management helps enterprises improve their core competence through the effective integration of different partners in the supply chain.

Liu Chunli (2004) investigated the impact of global supply chain management on business models and suggests that global supply chain management is changing the focus of company behaviour.

This change is manifested in several ways. First, it is evident when coordination between different departments becomes coordination between different companies. It also appears when enterprises move cost minimisation from production and distribution to lowering their overall supply chain management costs.

Management change is also shown when enterprises develop models moving from supply-driven to demand-driven supply chains, and when a single company decides to change its whole product design via cooperative product and supply chain design. Additionally, changes are evident in moving from cost reduction to business model innovation and from satisfying mass market demand to customisation through effective supply chain management. Liu believes that these changes will affect branding and enterprises’ competitive positioning.

On the other hand, Rong Qing and Zhan Honghui (2008) analysed the corporate social responsibility issues in global supply chains and offer recommendations on how Chinese enterprises can fulfill their social responsibilities in a global context.

1.4 “Network and relationship” perspectives

Mats Forsgren (1989) studied the internationalisation of Swedish companies and proposes a new network theory, which highlights the interactions between a company, the environment and how interactions influence both. Forsgren rejects the traditional approach to understanding internationalisation, which uses companies as single units of analysis isolated from the environment.

The traditional approach views internationalisation as a gradual transformation process, where companies start with exports and move up to branch offices, wholly-owned subsidiaries and outbound foreign direct investment.
According to the “network” theory developed by Forsgren, an enterprise must develop a variety of relationships along the entire supply chain, such as relationships with subcontractors, suppliers, distributors and wholesalers; these relationships are crucial in understanding the behaviour of enterprises. Besides, interconnections with other organisations within the “network”, such as competitors, local authorities and other third parties in the same industry are not to be ignored in understanding enterprise behaviour.

Yan Hong and Chen Xiangdong (2002) studied cooperation between buyers and sellers in global supply chains. In their view, the global supply chain relationship is actually cross-border cooperation between enterprises to share information and risks, as well as to realise mutual profits over a relatively long period of time. They further investigated cooperation between Chinese suppliers and foreign manufacturers in the global supply chain, and observe that the suppliers had not yet built strategic partnerships with their foreign partners.

Qi Junling (2007a) points outs that supplier selection is a key aspect of global sourcing. From the perspective of competitive strategy, he constructed a supplier selection model based on the perspective of competitive strategy.

In the face of challenges posed by economic globalisation and growing diversified user demand, Liu Caihong and Xu Fuyuan (2010) believe that enterprises should be more open and adaptive in order to enhance global competitiveness; they propose a new mode of enterprise operations called a “supply and demand network” (SDN), with multiple functions and open characteristics.

Shi Hong (2006) also shares the view that modern supply networks are dynamic and ever-changing.

Scholars have given additional attention to the coordination mechanism bringing buyers and sellers together in global supply chains.

Gao Junjun et al. (2002) studied the price discount contracts between buyers and sellers as a supply chain coordination mechanism with elastic demand. Based on their study, Yang Qingding and Huang Peiqing (2004) developed a model to determine the optimal pricing strategies for manufacturers under the same demand conditions.

One important goal of global supply chain management is to enhance customer satisfaction. To accomplish this, management stresses integration of various members in the supply chain, and effective sharing of information between members.

Song Hua, Liu Linyan and Li Wenqing (2011) investigated the relationship between enterprise internationalisation, the level of supply chain management practices and corporate performance. Through panel data analysis of listed companies in China, they find that a minimal degree of corporate internationalisation and low levels of supply chain management practices have indeed affected corporate performances in China. They urge Chinese enterprises to enhance global supply chain management to improve corporate performances in the early stages of internationalisation.

Liang Yansong and Du Mei (2004) analysed the challenges of global supply chain management, and point out that this is complicated by factors such as tariffs, exchange rates, trade barriers, the factor of government stability as well as differences in culture, language, tradition, preferences, operating and legal environments and general economic conditions.
Indeed, one important branch in global supply chain management is risk management. Institutional and cultural differences are considered to be the most significant sources of risk, which affect the integration of different members and their inclination to share information.

Niu Min (2004) studied the various factors behind global supply chain financial risks, including economic, political and institutional factors. Niu points out that due to political and institutional differences, unfamiliarity with country-specific regulations is likely to cause disputes and therefore increasing supply chain uncertainties.

Bao Xiao and Li Sulan (2010) studied different sources of risks in logistics outsourcing, and proposed a number of risk control measures. But they and others maintain the fundamental principle: Global logistics outsourcing is vital for enterprises to enhance their core competencies.

1.5 Recommended reading

1.5.1 Global Supply Chain Management (Quanqiu gongyinglian guanli)
Zhang Liangwei, and Yan Bo. 2008. Beijing: China Logistics Publisher House.

The book is part of the supply chain management series published under the "National Important Books Project for the Eleventh Five-Year Plan" launched by the General Administration of Press and Publication of the People’s Republic of China. With concerted effort by the Guangdong University of Foreign Studies and the South China University of Technology, the book provides a comprehensive and systematic overview of the principles and knowledge of global supply chain management. With special attention to the historical patterns of globalisation, this book aims to elaborate on the topic of supply chain management from a global perspective.

With over 30 case studies featuring supply chain systems of prominent firms including Li & Fung, the book offers its readers practical examples of how enterprises deal with business problems by making use of global supply chain management.

Content includes global supply chain design, outsourcing, global sourcing, and water and air logistics in global supply chains, customer relationship management, cost management, and the use of information technology in global supply chain management.

The book is recommended for logistics and supply chain management professionals, researchers and students.

1.5.2 The Relationship between Internalization, Supply Chain Management Practice and Performance: An Empirical Research Based on the Panel Data

Research theme: Despite extensive theoretical discussion on the internationalisation of enterprises and supply chain management within the academic community, topics such as the degree of internationalisation of Chinese enterprises, their supply chain management practices and the impact of supply chain management on enterprise performance (if any) remain under-researched.
In particular, there is a lack of quantitative study on the supply chain management practices of Chinese enterprises, and the relationship between internationalisation and supply chain management practice. This piece of research probes the relationship between internationalisation, supply chain management practices and enterprise performance.

**Methodology:** Targeting the automobile manufacturing and machinery manufacturing industries in China, the study extracts data from annual reports between 2005 and 2008 of listed automobile manufacturing and machinery manufacturing enterprises, among other sources. The conclusions of the study are drawn from panel analysis of secondary empirical data.

**Implications:** Through analysis of such empirical data, the paper concludes that deepening internationalisation and utilisation of supply chain management practice are conducive to the performance of China-based automobile manufacturing and machinery manufacturing industries.

However, the average value of various quantitative indicators also reveals a relatively low degree of internationalisation and utilisation of supply chain management practice. A major reason behind these phenomena is that Chinese enterprises mainly embark on a simple mode of internationalisation – via export trade. According to “internationalisation theory”, most Chinese enterprises are currently in the first and second stages of internationalisation. The authors suggest future research should expand the number of industries when investigating the relationship between the degree of internationalisation, supply chain management practices and enterprise performance.

1.5.3 *Determinants of Receiving International Outsourcing for Developing Countries*


**Research theme:** Based on bilateral trade data in intermediate goods to and from 20 developed countries/ economies and 40 developing countries, the paper analyses empirically the determinants for undertaking international outsourcing projects by developing countries from the perspectives of labour and transaction costs. Hoping to shed light on future trade policies, the paper offers a comprehensive comparison between China and its major competitors, and examines the comparative advantages and disadvantages for China in undertaking international outsourcing projects.

**Methodology:** Based on ordinary least squares regression analyses, the study investigates empirically the determinants of international outsourcing decisions using the panel data and cross-sectional data of bilateral trade in intermediate goods. The top 20 developed countries/ economies and 40 developing countries are selected according to respective trade value in 2006. The 60 sampled countries/economies represented 90% of international trade value of that year. Oil-producing countries in the Middle East and countries without available data are excluded from the study.

**Implications:** From a theoretical perspective, the paper offers recommendations to Chinese enterprises on outsourcing strategies. It reveals that labour cost and transaction cost have significant impact on the selection of offshore locations by foreign enterprises; but while enterprises in low-tech industries prefer outsourcing to choosing low-wage countries to trim labour costs, their counterparts in high-tech industries usually opt for countries that offer higher-quality services to reduce transaction costs.
The research findings suggest that China enjoys comparative advantages in most labour-cost and transaction-cost indicators. Going forward, however, China needs to expand its service sector and improve the country’s institutional conditions to offset the adverse impacts of rising labour costs. The paper investigates the determinants of outsourcing solely from the contractors’ point of view; to offer a more comprehensive analysis, the authors suggest future studies should look into the topic from the angle of enterprises that contract out their business processes.

1.6 References


Global supply chains and outsourcing management


Zhang Liangwei and Yan Bo. 2008. *Global Supply Chain Management* (Quanqiu gongyinglian guanli), Beijing: China Logistics Publisher House.


Chapter 2
Third-party logistics and supply chain service integrators
Song Hua (Renmin University of China)
Overview

Third-party logistics (TPL), also known as contract logistics or outsourced logistics, plays an increasingly important role in the Chinese economy today. Indeed, over recent years, third-party logistics has been extensively researched on the mainland, with the focus primarily in four areas: Evaluation of the TPL industry, core competences of TPL providers, customer satisfaction and performance evaluation systems, and developments in fourth-party logistics.

2.1 Developments in China’s TPL industry

TPL is defined as an arrangement in which a firm outsources its logistics operations to independent services providers. The concept of TPL was introduced into China in the mid-1990s. With a series of government measures at different levels to boost developments in the logistics industry, TPL operations in China have experienced a remarkably robust growth. Conversely, such TPL developments are still lagging those of foreign counterparts. Despite its huge market potential, TPL accounts for a minor share of the overall China logistics market, and services levels are relatively low (Wang Jiaqi and Fan Dan, 2005). In their study, Wang and Fan cite examples in other countries to explain the significant role TPL plays in lowering logistics costs as a share of GDP.

Based on a survey of 120 enterprises from several major industries, Song Hua (2007) used non-parametric techniques to study the drivers behind logistics outsourcing. He detects a higher degree of outsourcing activities in the automobile engineering, industrial goods, logistics and home electronics industries. The conclusion is that reducing investment in logistics facilities and seeking better-quality logistics services are the main drivers behind logistics outsourcing.

In terms of services, TPL providers in China mainly offer transshipment, warehousing and distribution within a given city, along with design of logistics systems and
Third-party logistics and supply chain service integrators

logistics information management. Enterprises also offer packaging and distribution processing services.

Another finding is that China’s TPL providers are relatively weak when it comes to distribution management, settlement of payments, inventory management, and transportation coordination and management. Most enterprises surveyed by Song (2007) used more than three logistics services providers.

Based on regression analysis of macro-operational data, Zhi Yan and Liu Binglian (2007) found a strong correlation between the overall performance of China’s logistics market and TPL providers’ market share, returns on assets, and asset-liability ratios. They note that the market share of the four and the eight largest firms (CR4 and CR8) are relatively low in China’s TPL industry, which suggests that the industry is highly fragmented.

Guo Tengda and Ou Chaomin (2010) conducted a comparative study of TPL providers in the US and China, and developed a paradigm for investment entitled “market structure - competitive advantage - operating performance - government regulation” for analysis. They reach several conclusions:

- TPL providers are more competitive in an oligopolistic market environment;
- Sophisticated technology systems serve an important differentiator for TPL providers;
- Market leaders in both the US and China are asset-based, with strong backgrounds in transportation, warehousing and courier services, and
- Poor government regulations in China have hindered developments of the country’s TPL providers.

On the other hand, Ouyang Qiangguo, Cheng Xiaobing and Wang Daoping (2010) compare the industry characteristics and operations of TPL enterprises in China to those in Japan, Europe and the US. They point out that boosting developments in China’s TPL industry requires the efforts of enterprises themselves, together with support from the government and relevant industry associations. A concerted approach is crucial to creating a favourable operating environment for the industry.

Chen Wenling and Cui Wei (2011) recognise the contribution of the modern logistics industry to China’s national economy, and believe that its development will continue to be a national strategy for years to come. But despite remarkable industry achievements over the past few years, many obstacles remain. Better regulation, innovation and improvements in both services and the distribution system are essential for the industry’s healthy development.

Chen Yaping (2007) believes that China’s TPL industry has considerable room for development, but there are some major challenges to be overcome, including its low level of resource sharing, poor information systems capabilities, a shortfall in talent and inadequate industry standards.

Chen Weiyu (2008) believes that TPL offers enterprises more logistics options. He points out that long-term TPL partnerships must be built on the prospects of better profits. But his analysis of the profit mechanism shows that in the same conditions, the total profits of independently operating logistics enterprises are lower than those of enterprises that cooperate with one another. He concludes that logistics industry agglomeration is the ultimate basis for successful TPL development.
2.2 Core competences of TPL enterprises

The core competence of an enterprise is determined by its resources and capabilities. Whether an enterprise possesses valuable, rare, unique or non-substitutable resources and capabilities will ultimately determine its market value and performance.

For TPL providers, their core competences are determined by resources such as their number of distribution centres, capacity in transport and sorting equipment, as well as capabilities in logistics management; such competences can reflect their speed of response, logistics costs, timeliness of order fulfilment, and efficiencies in delivery. Their qualities are reflected across their entire operations, from order processing, to sorting, transportation and accurate delivery to customers.

Research into such TPL core competences is relatively mature in China, and mainly focuses on three areas: 1) evaluation of TPL providers’ core competences; 2) the development of core competences by TPL providers, and 3) entrepreneurs’ innovation.

Many studies have endeavoured to develop a comprehensive and scientific model to evaluate these core competences. Wang Daoping and Zhai Shuqin (2005) established an index system to evaluate TPL providers’ core competences in three dimensions: Operational, managerial and financial (see Exhibit 2.1).

**Exhibit 2.1: Index system to evaluate TPL providers’ core competences**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Factor</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operational</strong></td>
<td>Market control</td>
<td>Market share, market expansion capability, customer loyalty</td>
</tr>
<tr>
<td></td>
<td>Logistics technology</td>
<td>Innovation capability, technological level</td>
</tr>
<tr>
<td></td>
<td>Types of logistics services offered</td>
<td>Transportation and warehousing capability, special services, internet services</td>
</tr>
<tr>
<td><strong>Managerial</strong></td>
<td>Human capital</td>
<td>Education level, mindset, and computer literacy of employees; performance of company management</td>
</tr>
<tr>
<td></td>
<td>Corporate culture</td>
<td>Adaptability, cohesion, and training expense</td>
</tr>
<tr>
<td></td>
<td>Organization structure</td>
<td>Rationality of organisation structure design, ability to build strategic partnerships, ability to coordinate, knowledge conversion ability</td>
</tr>
<tr>
<td></td>
<td>Social influences</td>
<td>Social responsibility</td>
</tr>
<tr>
<td><strong>Financial</strong></td>
<td>Operations performance</td>
<td>Inventory turnover, accounts receivable turnover, current assets turnover, operating cycles</td>
</tr>
<tr>
<td></td>
<td>Risk management</td>
<td>Debt to tangible assets ratio, current ratio, debt to assets ratio</td>
</tr>
<tr>
<td></td>
<td>Profitability</td>
<td>Operating profits, returns on total assets ratio, rate of return on capital</td>
</tr>
</tbody>
</table>

*Source: Wang Daoping and Zhai Shuqin (2005)*
On the other hand, Tong Mingrong, Xue Hengxin and Lin Lin (2006) suggest that TPL providers’ core competences can be evaluated from three dimensions:

(1) Logistics functions, which refer to the capability to provide customers integrated, personalised and IT-based logistics services, including transportation and distribution, warehousing, value-added services and information technology and other services;

(2) Services capability, which refers to services that TPL providers offer on behalf of their services buyers to the latter’s customers; these services usually include the evaluation of transportation services, warehouse management and operations, data entry operations, import and export operations, and payment settlement or other services; and

(3) Stability, which refers to whether TPL providers can develop long-term and stable relationships with their customers; the indicators include service prices, the management level, corporate image, and human resources or other services.


Logistics infrastructure refers to the assets, physical networks and logistics information systems of TPL providers; scalability refers to the capability of TPL providers to expand their services categories; customer value refers to TPL providers’ capability to help their customers achieve their value propositions; and finally, uniqueness suggests that the capabilities of TPL providers are difficult for competitors to imitate – this can be manifested in aspects such as integrated services, differentiation, technology, and innovation.

Ma Shihua and Meng Qingxin (2005) point out that most evaluation models do not analyse logistics capabilities of TPL providers from the perspective of supply chain management. Further, those limited attempts to evaluate logistics capabilities often focus solely on the distribution process, without paying much attention to production logistics.

Ma Shihua and Chen Tiewei (2007) classify supply chain logistics capabilities into internal and external capabilities. Internal capabilities cover those demonstrated within supply chains, such as storage, sorting and transportation, as well as the internal coordination between different members to improve operations consistency and information sharing. External capabilities concern those linking supply chain members with external parties; these capabilities are reflected in order processing speed, accuracy of delivery, flexibility, service consistency, information levels, personalised response and the handling of customer returns, emergency delivery and complaints.

Based on the SERVQUAL model, Wu Jun, Wang Lanyi and Li Yijun (2010) propose a series of parameters to evaluate core competencies of TPL providers, including (1) logistics operational capabilities, which refer mainly to the transportation, storage, loading and unloading, distribution and processing capabilities; (2) management planning, which concerns mainly cost and quality management, market development, and the ability to integrate resources; (3) risk management, which refers mainly to emergency response, and the capabilities to arbitrate and guarantee; (4) coordination, the ability to integrate and allocate resources of supply chains; (5) enterprise operations, such as quick response, innovation and strategic flexibility; and (6) corporate social influence, which mainly refers to branding and the ability to establish a corporate culture and reputation.
On the other hand, many believe that for TPL providers to develop core competencies is an ongoing, transformative process. Most TPL providers do not possess adequate service capabilities at the start, but have gradually transformed themselves from single logistics service providers into integrated services providers. Depending on the level of service capabilities, Wu Jun, Wang Lanyi and Li Yijun (2009) classified five types of TPL providers, from start-up to growth, competitive, mature and advanced level TPL providers.

Peng Benhong, Luo Ming and Zhou Ye (2007) note that the different objectives of logistics outsourcing may have counteracting effects among themselves, for example between schedule, quality and quantity, or between income and cost. They therefore offer a multitasking agency model to find the optimal contract design for logistics outsourcing.

Some research also attempts to explore the role of entrepreneurs in business development and innovation. Through case studies of various logistics enterprises, Su Jingqin and Wang Hechun (2010) suggest that entrepreneurs play a core role in driving business development and innovation; they propose a model setting out “Perception – Evaluation – Decision – Implementation – Routinisation”.

In the perception stage, entrepreneurs identify the business problems. Then, they evaluate the external constraints and their own resources, and make decisions regarding implementation of different strategies or problems based on this evaluation. Finally, implementation becomes the routine practice for enterprises.

2.3 Customer satisfaction and performance evaluation

The previous section looked at the core competencies of TPL providers from the perspective of service providers; in this section, we look at the performances of TPL providers from the perspective of their customers.

2.3.1 Customer satisfaction evaluation system

Wang Ling and Zhou Jinghua (2005) list five service elements to measure customer satisfaction, including availability, reliability, timeliness of response, the professionalism of service staff and the range of services offered.

Song Hua (2007) explored the relationship between various service elements and the consigners’ logistics costs management performance by means of multi-variable regression analysis; he finds that a timely response, information management, network coordination, and inventory management have the most direct impact on consigners’ logistics cost reduction.

Based on a study of the garment industry, Zheng Bing, Dong Dahai and Jin Yufang (2008) list seven factors which impact customer satisfaction towards logistics services, including timeliness, quality of communications, order fulfillment quality, discrepancies handling, quality of the goods transported, flexibility and convenience. Using regression analysis, they conclude that dealing with discrepancies has the greatest impact on customer satisfaction in the industry, followed by timeliness, order fulfillment quality, quality of communication and quality of the goods transported.

Liu Binglian and Wang Pengji (2003) as well as Xu Guobing and Zhang Wenjie (2008) attempt to measure customer satisfaction using a balanced scorecard. In order to give a comprehensive review of customer satisfaction towards TPL providers, the balanced
scorecard developed by Xu and Zhang includes five different levels, namely financial, customer directed, internal processing, learning and growth, and logistics services (see Exhibit 2.2).

**Exhibit 2.2: Evaluating satisfaction of logistics customers based on the balanced scorecard**

<table>
<thead>
<tr>
<th>Primary target</th>
<th>Key success factor</th>
<th>Secondary target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best service provider</td>
<td>Financial level</td>
<td>Investment return</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cash flow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operating profit</td>
</tr>
<tr>
<td></td>
<td>Customer level</td>
<td>Customer complaint rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Customer retention rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New customer rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Customer satisfaction rate</td>
</tr>
<tr>
<td></td>
<td>Internal process level</td>
<td>Market share</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Delivery punctuality rate</td>
</tr>
<tr>
<td></td>
<td>Learning and growth level</td>
<td>Employee satisfaction rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Digitisation rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Level of management</td>
</tr>
<tr>
<td></td>
<td>Logistics service level</td>
<td>Damage rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inventory accuracy rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Order picking accuracy rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Truck capacity utilisation rate</td>
</tr>
</tbody>
</table>

*Source: Xu Guobing and Zhang Wenjie (2008)*

### 2.3.2 Supply-demand relationship between TPL providers and their customers

Another angle to gauge customer satisfaction is through looking at the supply-demand relationship between TPL providers and their customers. Liu Yanping (2006) points out that TPL, also known as contract logistics, share all the characteristics of a contract. As with other contracts, logistics contracts are incomplete. This implies that there would be a “surplus” in the shared interests between logistics contracting parties, which may bring about a series of problems.

How to handle the “surplus” is an important question in contract logistics, and this gives rise to corresponding transaction costs. Liu suggests that a logistics alliance offers a key solution to reduce transaction costs.

Tian Yu (2007) compares the differences between logistics outsourcing and the logistics alliance and identifies 10 different types of contract mechanism in logistics outsourcing. He suggests that adopting the right contract mechanism can promote the formation of logistics alliances. Meanwhile, Cao Yugui (2007) maintains that the relationship between a TPL provider and its customer is a principal-agent relationship.

The study by Dan Bin et al. (2007) points to the inherent conflict of interests between TPL providers and their customers – on the one hand, customers wish to minimise logistics costs, while on the other hand, TPL providers’ income growth depends upon an increase
in customers’ logistics expenditure. To solve this problem, they designed a shared-savings contract based on a dynamic game theory model. A shared-savings contract can serve as an effective intrinsic incentive mechanism which drives TPL providers and their customers to make joint efforts to save logistics costs.

Cai Shuangli and Cai Chunhong (2006), on the other hand, analyse the relationship between TPL providers and customer satisfaction from the perspective of customer value. They hold the view that the realisation of customer value determines customer satisfaction, and there are both financial and non-financial factors affecting the evaluation of customer value. They further point out that the realisation of customer value is itself a dynamic process. The market and value orientation of TPL providers will affect the path taken by TPL providers to realise customer value.

In their empirical study, Tian Yu and Yan Qi (2007) highlight the important role of trusts in logistics outsourcing relationships. They conclude that the reputation of TPL providers, the sharing of information as well as transaction satisfaction all have a significant impact on customer trust levels, while an investment in a relationship and the period of cooperation have no significant impact on the level of trust.

Han Chaoqun, Liu Zhixue (2011) and Wang Daoping et al. (2011) investigated the relationship between TPL providers and their customers through the former’s participation in vendor-managed inventory (VMI). They suggest that TPL providers’ participation in VMI helps their customers lower the inventory and logistics costs, and improve profits. TPL providers’ participation in VMI can strengthen relationships with their customers.

2.4 Integrated supply chain services providers

Along with the continuous development of professional logistics services, we have witnessed the emergence of fourth-party logistics service providers; these are integrated supply chain service providers that assemble the resources, capabilities and technologies of their own and other organisations to design, build and run comprehensive supply chain solutions.

Song Hua (2003) notes the six features of fourth-party logistics service providers: 1) they provide comprehensive supply chain solutions; 2) they collaborate with stakeholders to redesign supply chain processes; 3) they strengthen different supply chain functions through new technologies; 4) they integrate different processes and systems and oversee operational flows; 5) they assume multiple supply chain functions and; 6) they add value through exercising an impact on the entire supply chain.

The development of fourth-party logistics service providers has generated widespread research attention. Based on their review of the evolution of logistics in China, Tian Xin and Wang Shouyang (2009) suggest that fourth-party logistics optimises the allocation of resource utilities and social division of labour. Logistics is no longer a “cost centre” for enterprises today, but a “profit centre”.

Similarly, Luo Wenping (2012) put forward the concept of advanced logistics services. Advanced logistics service providers offer integrated supply chain services. Unlike their traditional counterparts, their focus has been shifting from cost reduction to value creation, from developing a transaction-driven relationship to long-term strategic collaboration with customers, from asset ownership to resources integration (see Exhibit 2.3).
Wang Yong, Luo Fubi and Lin Lue (2006) analysed the relationship between fourth-party logistics and TPL providers. Using a principal-agent theory, they studied the incentive mechanism that fourth-party logistics providers adopt to manage multiple TPL providers. Luo Fubi and Wang Yong (2007) further point out that many factors, such as the involvement of multiple parties, complexities of logistics tasks and different company cultures, have added uncertainties in fourth party logistics operations. They propose a coordination mechanism for fourth-party logistics providers based on a multiple-agent system (see Exhibit 2.4).

Source: Luo Wenping (2012)
Wu Qian and Liu Jianting (2008) suggest three different models for collaboration between the fourth-party logistics providers and TPL providers: (1) fourth-party logistics providers help TPL providers on logistics solution planning and integration. However, they do not offer direct services to the customers of TPL providers. They maintain their relationship with TPL providers either under contract or by forming alliances; (2) forth-party logistics providers serve as a bridge between their customers and TPL providers. They integrate and leverage the resources, capabilities and technologies of their own and multiple TPL providers to provide customers comprehensive supply chain solutions; and (3) as with the second collaboration model, fourth-party logistics providers also serve as a bridge between TPL providers and customers. But under this third type, the focus is on developing supply chain solutions to multiple customers in the same industry.

2.5 Recommended reading

2.5.1 Report of China Logistics Development 2011

_Bureau of Economic Operations of the National Development and Reform Commission (NDRC), and Logistics Research Centre, the Nankai University, 2011. Beijing: China Logistics Publisher House._

Research theme: This report describes the development of China’s logistics industry, and the logistics operations in different regions and industries in China, with extensive first-hand information.
Methodology: The report illustrates China’s logistics industry development primarily with data from national and local statistical yearbooks, relevant policies and plans, and interviews with enterprises.

Content detail: The report comprises an overview, regional analyses, industry analyses, special topics, and enterprise interviews.

The overview section explains the overall position of China’s logistics industry at the macro level. Areas of investigation include China’s environment for logistics development, such as its economic and policy environment; development of China’s logistics market, including overall market size, characteristics and development trends; China’s logistics facilities and technology development, including infrastructure, storage facilities, logistics parks, and equipment development; and China’s logistics policies.

Regional analyses cover the logistics development of several major regions, including the Bohai Rim, the Chengdu-Chongqing Economic Zone, the Xinjiang Autonomous Region, the Hong Kong Special Administrative Region, the Macau Special Administrative Region and Taiwan.

Industry analyses look specifically at the current picture for fresh produce logistics and the logistics development of China’s automobile industry.

Special topics introduce the development of the “internet of things” and its role in promoting China’s logistics development; low-carbon logistics; China’s logistics development and progress during the Eleventh Five-Year Plan period, including China’s logistics market, logistics facilities and technologies, and relevant policies and plans.

Finally, by means of field studies and questionnaire surveys, the enterprise interviews section explores the development of the modern logistics market in China. In addition to findings from the “Report on China’s Transportation and Logistics Developments” in the years 2009 and 2010, this section summarises the development trends in China’s transportation and logistics industries as well as the development of various modes of transportation in the post-financial crisis period.

2.5.2 Creating Value through Advanced Logistics

Research theme: Distinguishing between advanced logistics and general logistics, this book delves into how advanced logistics creates value through building core competences, organisational innovation, performance evaluation and monitoring.

Methodology: This book mainly employs a case study approach to analysis. It collects a total of 22 case studies (16 of which are on Li & Fung).

Content detail: Instead of lengthy discussions on whether logistics enterprises are providing third- or fourth-party logistics service, this book innovatively classifies logistics service into advanced logistics and general logistics, and focuses on the enhanced value creation achieved through advanced logistics service. The book offers readers a practical insight, with in-depth analyses of the value of advanced logistics, the value creation mechanism, the formation of strategic alliances, building core competences, organisational innovation, performance evaluation and monitoring, the bidding and tendering processes of advanced logistics service and contract design.
2.5.3  Shenzhen Supply Chain Management Industry Development Report


Research theme: Intending to shed light on industrial restructuring in China, the report systematically reviews the rise of the supply chain management industry in Shenzhen, its different operational modes, profit models and value innovation, as well as the policy environment.

Content detail: The report comprises three sections: theories, case studies, and policies. The theories section introduces the background and market environment which contributes to the boom in Shenzhen’s supply chain management industry; it also explores the operational modes, market potential, contribution, profit models, operational risks, and the policy environment of the city’s supply chain management industry.

In the case studies section, seven key local supply chain management enterprises are highlighted to illustrate the operating and profit models of supply chain management enterprises in Shenzhen.

The policies section enumerates the major policies in Guangdong and Shenzhen that are highly pertinent to the development of Shenzhen’s supply chain management industry, such as “Suggestions by the Guangdong Provincial Government to Promote the Service Outsourcing Industry” and “Suggestions to Promote the Advanced Service Industry in Shenzhen”.

The authors view Shenzhen’s supply chain management industry as the enabler for industrial upgrading in China. Through the integration of global resources, the industry plays a strategic role in enhancing the level of globalised operations and promoting the coordinated development of China’s services trade and goods trade. Indeed, the industry is seen as conducive to the development of the country’s advanced service outsourcing capabilities.

Based on the experience of Shenzhen, the authors summarise four operating models of supply chain management industry, namely the “Eternal Asia” model, the “YH Global” model, the “Everich” model and the “One Touch” model, comparing these with other supply chain management models abroad.

The authors further offer policy recommendations aimed at boosting the development of Shenzhen’s supply chain management industry. Specifically, these involve advances on eight fronts: improving the strategic planning for the supply chain management industry; promoting development of the supply chains of traditional industries; strengthening the coordinated development of the supply chain management industry with other industries; promoting development of supply chains of emerging strategic industries; boosting the demand of supply chain management service in China and overseas; strengthening the intermediary role of industry associations; attracting and nurturing talent; and supporting exploratory efforts.
2.6 References


Third-party logistics and supply chain service integrators


Chapter 3
Green supply chains and sustainability

Zhang Songbo (Capital University of Economics and Business)
Rabia Turson (Xinjiang University of Finance & Economics)

Overview

The concept of green supply chain management has emerged since the 1990s and has received widespread attention. Today, the concept is guiding the activities of both governments and businesses around the world, including progressively in China.

This modern management model takes environmental impact and resource efficiency into account in the management of the entire supply chain, encompassing suppliers, manufacturers, vendors and users.

Based on green manufacturing and supply chain management technologies, the goal of green supply chain management is to minimise the negative effects to the environment and maximise resource efficiencies in the whole supply chain process, from raw material acquisition, manufacturing, processing, packaging, storage, transportation and usage, all the way to disposal.

The concept of the green supply chain has changed the environmental management practices of manufacturing enterprises; these have evolved from relying solely on traditional technology solutions for environmental problems to adopting a comprehensive approach considering entire product life cycles. Green supply chain management helps enterprises not only to produce better results when solving environmental problems, but also to achieve better operating performances. For instance, taking environmental factors into consideration in the product design phase reduces the costs of future environmental governance.

This chapter explores the concept, operation and performance evaluation of green supply chains.

3.1 The concept of green supply chains

Dan Bin and Liu Fei (2000), Wang Nengmin, Sun Linyan and Wang Yingluo (2005) and Liu Ming (2010) suggest that green supply chain management is a management model
that takes environmental impact and the operation’s overall effectiveness into account in the management of supply chains.

Based on green manufacturing and supply chain management technologies, studies have been conducted on the various components, from raw materials acquisition to disposal. Environmental protection and optimised use of resources are the constant management themes.

Jiang Hongwei and Han Wenxiu (2000) studied environmental issues encountered in different supply chain processes, and enumerate six themes in green supply chain management: Green design, green materials selection, green manufacturing, green recycling, green packaging and green consumption.

Wang Honggang and Han Wenxiu (2002) also discuss the implementation of green supply chain strategies by Chinese enterprises from three standpoints: Green design, green materials and green marketing.

Meanwhile, Wang Dongxin (2012) suggests that green supply chain management includes the following aspects: Green design, green supply, green production, green logistics (including reverse logistics), green marketing and green recycling, among other relevant factors.

Wu Chunyou, Zhu Qinghua and Geng Yong (2001) maintain that merchandisers and supply chain managers play a critical role in green supply chain management. Through selection, evaluation and development of their suppliers and improvements in purchasing programmes, merchandisers and supply chain managers help enterprises establish and maintain their competitive edge.

To achieve green supply chain management, enterprises can first start with internal logistics management and gradually establish supplier profiles so that they can assess the suppliers scientifically. At the same time, they have to strengthen green management of product design to meet environmental standards, especially in material selection.

It is worth noting that supply chain management practices vary, according to enterprise and industry. It is important to tailor the practices to fit the needs of individual enterprises so they can achieve lower costs, improve environmental benefits and enhance their corporate reputations; ultimately, they should increase profits and achieve sustainable development.

Wang Yingluo, Wang Nengmin and Sun Linyan (2003) break green supply chain systems down into production, consumer, social and environment subsystems. These subsystems encompass suppliers, manufacturers, distributors, consumers and recyclers. The goals of green supply chain operations are to improve environmental awareness and the welfare of workers and consumers, while optimising the allocation of resources.

Zhu Qinghua (2004) suggests that, through strengthening cooperation between upstream and downstream enterprises and internal communications between different departments, green supply chain operations seek to optimise several factors. These include overall effectiveness, improvement of the environment as well as economic performances; these help enterprises to achieve sustainable development.

On the other hand, Bai Qingru (2008) points out that coordination of logistics, as well as information and capital flows along the entire supply chain is essential in green
supply chain management. It is important to take a holistic view of the system, instead of viewing suppliers, manufacturers, distributors, retailers, carriers and customers as isolated entities.

3.2 Green supply chain operations

3.2.1 Factors affecting the implementation of green supply chain management strategies

Cao Jingshan and Cao Guozhi (2007) categorise the driving factors for implementing green supply chain management strategies into four groups: regulatory requirements, market demands, stakeholders’ interests, and social responsibility. They suggest that regulatory requirements and market demands are currently the two main drivers behind implementing green supply chain management in China.

In their empirical study, Qu Ying, Zhu Qinghua and Wu Chunyou (2007) also identify the drivers behind implementing strategies of green supply chain management. They recognise the critical role that management has played for manufacturers in developed countries to win in international competition.

However, they have also found that many Chinese manufacturers have implemented no such green management strategies due to low environmental awareness, less than stringent environmental laws and poor enforcement. With China’s entry into the World Trade Organization and intensifying competition when it comes to environment-related factors, Chinese manufacturers have to be more proactive in implementing green supply chain management strategies, or they will lose to the competition.

Xu Xuejun and Fan Qi (2008) believe that the major barriers for implementing green supply chain management strategies in China include poor regulation, low consumer awareness on environmental protection, technological barriers, and increasing costs of doing businesses.

To address the problems encountered when implementing green supply chain management strategies in China, Fang Wei, Huang Huiting and Liu Xinyu (2007) identify 12 factors essential for successful implementation.

On the other hand, Zhu Qinghua (2009) acknowledges the fact that Chinese manufacturers are still in the early stages of implementing green supply chain management. Based on a survey of 289 manufacturers, he found that the major challenges to green supply chain implementation include poor environmental awareness and capability by enterprises, concerns over financial performances and costs, the impact on supply chain operations and government regulations.

Further descriptive, correlation and regression analyses reveal that poor environmental regulations and enforcement are the most important factors constraining China’s developments of green supply chain management.

Zhu Qinghua and Dou Yijie (2007) urge the Chinese government to tighten environmental regulations, strengthen enforcement, increase relevant subsidies and impose suitable punitive measures.
3.2.2 Green supply chain strategies

Green supply chain operations incorporate numerous aspects, such as green material selection, product design, supplier evaluation and selection. Green production, transportation and distribution, packaging, sales and recycling are significant factors but a green purchasing strategy, meaning the selection of green supply chain strategic partners (particularly where it comes to suppliers), is key.

Zhu Qinghua and Geng Yong (2002) compare the green purchasing strategies of enterprises in different countries, and studied the impact of green purchasing strategies on the environment as well as enterprises’ financial performance.

Then again, from the perspective of improving customer satisfaction, Jiang Jijiao and Yang Naiding (2005) built a stochastic optimisation model for green purchasing in ecologically-focused supply chains.

Liu Bin and Zhu Qinghua (2005) point out that in green purchasing, enterprises must deal with uncertainties in supplier selection. They assert that environmental indicators must be taken into account in supplier evaluation, and developed a “fuzzy comprehensive evaluation” model for supplier selection. Meanwhile, Yi Jun, Geng Yong and Zhu Qinghua (2006) compared the supplier selection standards of Chinese and US purchasing enterprises, and conclude that enterprises can achieve sustainable development through green purchasing.

Zhang Songbo and Song Hua (2012) see such purchasing, among all other green supply chain processes, as a solution to the root cause of environmental issues. Green purchasing has a direct impact where it comes to improving enterprises’ environmental performances and the entire supply chain. Through model analysis, they identify eleven constraints to implementing green purchasing, including poor awareness, barriers in information dissemination, lack of relevant government regulations and lax oversight.

3.2.3 Green supply chain management technologies

Shen Chenglin and Wang Bo (2004) propose a green supply chain benchmarking system based on “gap analysis” to assess the degree of greenness in supply chains. They developed a “spider’s web” diagram to measure the “green gap” between current and targeted green supply chains. Enterprises can use this as a reference to optimise business processes and resource allocation. Cao Jie, Chen Senfa and Wu Gang (2004) also developed a prototype model for green supply chains.

Xu Qi (2006) created a “resource productivity - environmental impact - sustainability” (PES) approach for evaluating supply chains. The PES approach provides decision support to balance productivity with environmental impact. Through utilising agent technology, Xu hopes to facilitate information sharing and collaboration between various supply chain members.

Wang Nengmin and Yang Tong (2006) and Wang Nengmin, Yang Tong and Qiao Jianming (2007) also stress the importance of cooperation between supply chain members in green supply chain operations. They suggest that the coordination mechanism consists of three different sub-levels: strategic, motivational and operational. Hu Jiling, Fan Tijun and Lou Gaoxiang (2008), on the other hand, looked into the major barriers encountered by enterprises in knowledge transfers and propose a series of solutions.
Believing that a scientific and accurate definition of “green” is required, or practitioners will not fully grasp the meaning of green supply chains (leading to confusion and unfair competition), Yu Qiwu (2009) points out that standard green supply chain systems include different constituent parts: (1) green product standards; (2) green supplier selection, evaluation, and control standards; (3) green design standards; (4) clean production standards; and (5) green logistics standards. These help distinguish between general and green supply chains.

Meanwhile, Han Zhixin and Chen Tong (2009) developed a “capability maturity model” to investigate the evolution of green supply chains. They provide a theoretical framework to evaluate, as well as elevate, the performance of green supply chains.

### 3.2.4 Green supply chain operations in industries – using food manufacturing as an example

The modern industrial civilization has generated tremendous material wealth but also poses a serious threat to the survival of mankind. Also, since the 1970s, we have witnessed the rise of green movements. As a result, growing numbers of people are becoming more concerned about their health and the environment today. Against this backdrop, food safety has caught the attention of many internationally, and “green foods” are increasingly seen as the most effective solution to address the problem of quality in modern agricultural products.

The development of green foods has important implications for conserving China’s ecological environment. This requires improving the quality of agricultural products and food, increasing farmers’ incomes and promoting the sustainable development of agriculture and the rural economy. Currently, green food supply chain research in China mainly focuses on the following areas:

1. **The concept of a green food supply chain and the drivers behind green food supply chain management**

As the quality of green foods is process-based, different supply chain processes, such as production and logistics, make a significant impact. Although enterprises can ensure food quality by adopting a vertical integration strategy, the considerable length of the green food chain entails high management costs.

China’s current loosely integrated market structure means that enterprises have to take an innovative approach to quality control. Zhang Min (2006) applied supply chain management solutions to the green food industry. By replacing random market transactions with collaborative relationships between trading partners, enterprises can lower transaction costs and improve logistics management.

Li Jie (2012) lists the factors constraining China’s green food supply chain developments, such as poor transportation infrastructure, extremely low utilisation rates of cold chain vehicles, poor cold chain facilities at domestic ports and a lack of modern information technology platforms for green food supply chains.

2. **Green food supply chain configurations**

Leng Zhijie (2006) suggests that there are four configurations in which agricultural product supply chains can be integrated: (1) supply chain integration with agricultural
Green supply chains and sustainability

enterprises as the core; (2) supply chain integration based on activities of agricultural product processing enterprises; (3) supply chain integration dependant on logistics centres; and (4) supply chain integration relying on marketing enterprises. Tan Tao and Zhu Yihua (2004) distinguish between two types of agricultural product supply chain configuration, one with logistics centres as the core, and the other relying on processing enterprises.

Du Hongmei (2009) points out that consumers hold different preferences towards general and green food products, and proposes a profit model for manufacturers and retailers in green food supply chains. In her paper, she studied the pricing and coordination mechanisms in green food supply chains, and discussed the effectiveness of the systems under conditions of cooperative game and non-cooperative game. (In game theory, a cooperative game is a game where groups of players may enforce cooperative behaviour; a non-cooperative game is one in which players make decisions independently.)

She concludes that collaboration between green food processing enterprises and retailers can help attract customers, and achieve improvements for both sides’ profitability through the Pareto principle (or law of the vital few). The paper further points out that determining the right price is the key to supply chain collaboration, and uses a Rubinstein bargaining model to determine an optimal pricing policy so as to arrive at the optimal Pareto cooperative pricing decision.

Zhou Rongzheng et. al. (2009) advances the concept of closed green agricultural product supply chains, which can be understood as a strategic cooperative partnership between supply chain members. Compared with open supply chains, closed supply chains are said to enjoy better channel efficiencies and be less vulnerable to risk. Closed green agricultural product supply chains can help improve market response, while lowering transaction costs, reducing inventory, shortening production lead times and enhancing service levels. They can also increase profit margins while protecting the environment.

(3) Closed logistics

In order to control the quality of green food products from farm to table, enterprises are being persuaded to establish a quality assurance system to monitor supply chain processes. These include site selection, environmental monitoring, production planning, storage and transportation, and sales.

Huang Fuhua and Zhou Min (2009) believe that closed green agricultural supply chains should adopt joint logistics operations; they designed four joint logistics operation modes for closed supply chains: The logistics mode with a single centralised point of management control; the logistics mode with joint management control along the entire chain; the regionally-integrated logistics mode, and the logistic mode with a combination of these elements. Enterprises can flexibly choose the model that best fits their needs.

(4) Collaboration between supply chain partners

Du Hongmei and Peng Xi (2008) used the indirect channel model of “food production and processing enterprises -> retailers -> consumers” as an example to illustrate how non-cooperative relationships between food production and processing enterprises and retailers could hurt the overall interests of the supply chain, as both sides seek to
maximise their own interests. To achieve a mutually profitable situation, food production and processing enterprises and retailers should collaborate with one another. Stable collaborative relationships can help ease contradictions between production and marketing, improve market response and increase overall profitability. They point out that a good profit distribution plan, which gives both parties better profits compared with the pre-collaborative stage, is critical to success.

(5) Performance of green food supply chains

To overcome increasingly stringent technical barriers to trade, China’s green foods industry has accelerated the strategic pace of international development since the country’s accession to the World Trade Organization. The results are impressive and export grow is rapid.

The competitiveness of China’s green food in the international market is demonstrated in several ways: (1) on overall quality, enterprises have met food hygiene and safety standards in developed countries and exported products do pass rigorous testing and inspection; (2) quality assurance mechanisms, such as two-way monitoring, process control and quality certification, have enhanced the credibility of product quality and safety levels; (3) there are a number of well-established green food enterprises with strong market expansion capabilities; (4) access to sites of production for implementation of monitoring and protection programmes helps enterprises cross the resource and green barriers easily; and (5) the branding and pricing advantages of green food exports are increasingly being felt (Tian Qinglin, 2004).

3.3 Management of green supply chains and enterprises performance evaluation

One important area of research is the relationship between green supply chain management and enterprises’ performances (including their business and environmental performances).

Traditional supply chain management performance measurements are based on costs and benefits. Zhang Minshun and Wu Hongbo (2005) designed a green supply chain performance system that takes into account five factors: user satisfaction, information sharing, logistics integration, collaborative relationships and “greenness levels”.

Zhu Qinghua and Geng Yong (2006) surveyed 245 Chinese manufacturers to investigate how they implemented green supply chain management. With reference to the innovation diffusion theory, they classified Chinese manufacturers into three types according to their green supply chain management practices: Innovators, early adopters and laggards. Further ANOVA results and Scheffe multiple comparison tests show that significant differences exist among these three types of manufacturers in environmental, operational and economic performance.

To give an accurate and objective measure of green supply chain performance, Zhou Jianzhong (2008) built a green supply chain performance evaluation model based on fuzzy theory. Dong Yali and Xue Lei (2008) also designed a green supply chain management performance evaluation index system based on the Analytic Network Process (ANP) technique, which helps decision-making when different factors are correlated with one another.
To overcome the problem of subjective bias and the difficulties of assigning weighting to factors in various green supply chain performance evaluation methods, such as multi-level analysis, factor analysis and fuzzy functions, Zhou Qiang and Zhang Yong (2008) propose a performance evaluation system of green supply chain based on the “catastrophe progression” method.

Liu Jian and Ye Yingxia (2008), on the other hand, recommend the use of the data envelopment analysis method (DEA) to comprehensively evaluate green supply chain performance.

Based on the connotations and characteristics of green supply chains, Zhao Tao and Li Xiaopeng (2010) established an evaluation index system using gray relational analysis.

Miao Chaowei and Wu Xiaoyi (2009) suggest that corporate social responsibility is an increasingly important requirement for enterprises participating in international competition. From the stakeholders’ point of view, they sought to measure the components of corporate social responsibility as well as the empirical relationship between corporate social responsibility and supply chain management performance. The components of corporate social responsibility include various responsibilities, from the vendor, client and the environment itself, as well as incorporating employee rights protection and social and moral responsibility. They hold that socially responsible practices have a positive impact on supply chain management performance, such as customer service, internal efficiency and economic benefits.

Wu Yao and Mu Dong (2012) developed a dynamic, balanced scorecard, which combines the methods of balanced scorecards with system dynamics, to evaluate the performance of green supply chains on four fronts: finance, the customer, the internal process, and learning and development. They further established a corresponding system dynamics simulation model to test how factors such as employee training and the supply chain internal process affect market share and enterprises’ profits.

### 3.4 An integrated framework for green supply chain research

The literature, as described here, covers a range of definitions of green supply chains, various factors affecting implementation and different performance evaluation methods. Synthesising these perspectives, a theoretical framework for green supply chain management research is proposed for future study (see Exhibit 3.1).

In this framework, green supply chain management is broken down into five aspects: Green purchasing, green design, green manufacturing, green marketing and green logistics. Various factors affecting the implementation of green supply chain management practises are categorised into “pressure” (such as competitive or government pressures), “drivers” (including economic benefits or management support) and “resistance” (such as with supplier resistance or poor technology support). The final column on the right evaluates the impact of green supply chain management. That includes enterprises’ environmental, operational and economic performances, as well as the efficiency and flexibility of the entire supply chain.
3.5 Recommended reading

3.5.1 Green Supply Chain Management: Sustainable Development Model for Enterprises (Lüse gongyinglian guanli: qiye kechixufazhan moshi)

Research theme: The book combines concepts of supply chain management with green development, and illustrates with case studies how enterprises can improve sustainable development with green supply chain strategies.

Content detail: On the basis of sustainable development theory, ecological economics theory, environmental ethics theory and supply chain management theory, the book discusses supply chain management at three different levels: the strategic level, the tactical level and the implementation level.

At the strategic level, the author discusses the thinking behind green supply chain management, its objectives and architecture. The tactical level of green supply chain management is chiefly concerned with operations and relevant technologies and the author elaborates upon the specific strategies and technologies involved in six areas of green supply chain management; they consist of green procurement, green manufacturing, green marketing, green logistics, green consumption and reverse logistics.

The author also investigates the difficulties encountered in the operations of green supply chain management, in terms of external obstacles, information asymmetry and strategic obstacles. Additionally, the book tackles the behaviour of the government, the enterprise and the entrepreneur at the implementation level of green supply chain management; and studies whether enterprises are satisfied implementing a green supply chain management strategy.
With case studies from Yunnan, the author illustrates how enterprises can achieve sustainable development by green supply chain management.

**3.5.2 Statistics Analysis on Relationship between Practice and Performance of Green Supply Chain Management among Enterprises**


**Research theme:** The paper seeks to investigate the impact of green supply chain management practices by Chinese manufacturing enterprises on their environmental and economic performance, and analyses how quality management affects the relationship between green supply chain management and enterprise performance.

**Methodology:** In the study, green supply chain management practices are classified into internal environmental management, green marketing (towards customers) and green procurement (with suppliers). Green supply chain management performance is classified into environmental performance, positive economic performance and negative economic performance.

Based on the survey results of 314 manufacturing enterprises, the authors study the relationship between green supply chain management practices and green supply chain management performance, as well as the impact of quality management, by means of correlation and hierarchical moderated regression analyses.

**Findings:** Green supply chain management practices have a significant impact on the environmental and economic performances of enterprises, while quality management has a highly significant impact on mediating the relationship between green supply chain practices and green supply chain performances.

The paper reveals that green supply chain management practices greatly enhance the environmental performance of enterprises; the better the quality of management, the greater improvement is observed in environmental performance.

With economic globalisation and the accession of China to the WTO, green supply chain management plays an important role in enhancing the international competitiveness of Chinese enterprises, through better environmental reputations. Green supply chain management can boost exports, and increase the chances of enterprises becoming suppliers to foreign-invested enterprises in China.

**Implications:** Whether green supply chain management can improve enterprise performance has long been hotly debated within the academic community and among industry practitioners. The survey results of 314 manufacturing enterprises prove empirically the positive impact of green supply chain management on environmental performances of enterprises.

Green supply chain management also boosts the economic performance of enterprises, though with an increase in enterprise cost. This study points to the need for technological innovation in implementing green supply chain management, to lower costs and improve economic performances.
3.5.3 Investigation into the Barriers of Enterprise Green Procurement

Research theme: On the basis of literature review and panel discussions by Chinese experts in the field of green procurement and related areas, the paper explores major constraining factors to green enterprise procurement, and investigates the inter-relationships between different factors to identify the most important ones. The paper offers government and enterprises an insight into how constraining factors to green enterprise procurement can be overcome systematically, and how green supply chain development can be enhanced.

Methodology: The study mainly employs the interpretative structural modeling (ISM) method to explore interrelations between different constraining factors of green enterprise procurement. Specifically, based on panel discussion results, the paper uses graphical methods and matrix analysis to describe inter-relationships of different constraining factors; and on this basis, it further investigates the characteristics of different constraining factors by arithmetic and deduction methods.

Findings: The paper identifies eleven major constraining factors of green enterprise procurement, and describes their inter-relationships. At the bottom of the ISM model are the most critical constraining factors, including poor recognition of the value of green procurement and the barriers to the transmission of demand information. At the top of the ISM model are non-critical factors, including a lack of management support towards green procurement, a reluctance to invest, and an unwillingness to change the organisational structure of enterprises and supply chains.

Implications: The classification of internal and external factors facilitates deeper analyses of the constraining factors of green procurement. Meanwhile, the innovative use of the ISM model helps understand the inter-relationships between the eleven major constraining factors. The paper further classifies different constraining factors based on their attributes.

3.6 References


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Green supply chains and sustainability


Chapter 4
Supply chain risk management

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Overview

Accelerating globalisation and advancing technologies have been responsible over recent years for growing market competition. As a result, the focus for enterprises has shifted from competing between themselves on delivering better quality products to reforming their respective supply chain networks (Lambert and Cooper, 2000).

In a stable environment, effective supply chain design and management enable firms to become leaner and more efficient business operations. But the intrinsic vulnerability of supply chains also inevitably brings unforeseen risks. This is particularly true as enterprises have resorted increasingly to outsourcing production and research and development (R&D) activities.

Lean production, just-in-time management, service outsourcing and low-cost sourcing have become generally acceptable terms as enterprises cooperate closer. To adapt to a more dynamic and competitive environment they also have to make their internal business processes and supply chains more efficient and responsive.

These supply chain innovations have made enterprises become more dependent on the external environment as well as on other enterprises, adding to the general vulnerability of supply chains. So it is unsurprising that supply chain risk management has caught the eye of researchers and managers (Wang Shixiong, Xu Qi, and Zheng Xingwang, 2010).

Although risk management has received widespread attention in the fields of finance, management and psychology, it was not until recently that supply chain risk management became an independent field of study both in China and abroad.

Supply chain risk management is a relatively new topic in management studies; much work has yet to be done, particularly in China, where supply chain risk management research is in its infancy. Helping enterprises identify and control their risks has both theoretical and practical significance.
4.1 Understanding the concept of supply chain risks

We believe that the key to supply chain risk management is risk identification, so research has to focus on (1) defining supply chain risk parameters; (2) understanding the sources of supply chain risks; and (3) gauging the impact of risks on supply chain performance.

4.1.1 Supply chain risks

Wang Ling and Zhu Zheyuan (2011) note the rising enthusiasm for supply chain risk research after the global financial crisis in 2008. Ning Zhong (2004) defines supply chain risks as the potential destruction of supply chains due to internal supply chain risk factors and external risk factors, while Xiao Yan, Song Hui and Yu Wangmei (2009) refer to supply chain risks as uncertainties or accidents which adversely affect one or more supply chain members; these thereby reduce the operational efficiency of the supply chain, or lead to supply chain disruptions and failures.

Meanwhile, many define supply chain risk as the possibility of deviation from the target, such as supply chain performance and business revenue, caused by uncertainties (Fu Yu et al., 2004; Tian Chunming and Du Xiying, 2007; Wan Chunlong, Qi Ershi and Suo Junli, 2007; Wang Yan and Liu Yongsheng, 2008; Zhu Xinqiu and Su Cheng, 2010).

Zhu Huaiyi, Zhu Daoli and Hu Feng (2006), on the other hand, suggest that supply chain risks are dysfunctions or interruptions to supply chains caused by uncertainties. These are manifested in slow or interrupted physical goods flows, as also in information and capital flows.

Wang Xianyu, Xiao Yuming and Zhong Sheng (2008) suggest that supply chain risks are any eventualities that cause a mismatch between supply chain resources and market demand so that they result in the declining competitiveness of the supply chain. Guo Qian, Pu Yun and Li Yanlai (2011) refer to supply chain risks as sudden accidents that cause significant deviations in supply/demand or targeted costs and qualities.

Overall, the definition of “supply chain risk” emphasises two aspects: (1) risks are due to uncertainties in the internal and external environment; and (2) it would negatively impact the performance of supply chains and their members.

4.1.2 Supply chain risk management

Hu Jinhuan and Zhou Qilei (2005) identified four stages in supply chain risk management, namely supply chain risk identification, supply chain risk evaluation, supply chain risk control and supply chain risk monitoring.

Wang Yan and Liu Yongsheng (2008) suggest that supply chain risk management is a systematic and scientific management approach which includes the identification and measurement of supply chain risks; the use of the most economical method to control risks based on this identification and measurement, and the establishment of a supply chain risk monitoring and feedback system.

Xiao Yan, Song Hui and Yu Wangmei (2009), on the other hand, believe that supply chain risk management is one that identifies internal and external risks and develops a supply chain risk monitoring and feedback system. These control supply chain risks and reduce the vulnerability of supply chains through the collaboration of different chain members and the use of processing tools.
Despite the different definitions of supply chain risk management, on the whole it can be understood as a series of processes carried out by enterprises to identify, evaluate and control supply chain risks.

### 4.2 Major themes in supply chain risk literature

The literature on supply chain risks mainly revolves around three themes: (1) risk identification, i.e. sources of supply chain risks and their classification; (2) the impact of supply chain risks on enterprises and supply chain performances; and (3) risk management, i.e. strategies to manage and control supply chain risks.

Currently, most risk identification studies employ qualitative research methods such as case studies and conceptual research. There are a few empirical attempts to investigate the impact of supply chain risks on enterprises and supply chain performances. At the same time, case studies are the major methods used in risk management research. It is worth noting that the three themes are not isolated from one another.

#### 4.2.1 Supply chain risk identification

The primary question in risk management is risk identification. This deals with two questions: what are the sources of supply chain risks, and how should they be classified?

Unlike foreign studies, which usually emphasise a specific supply chain risk driver, many domestic researchers attempt to summarise a broad range of possible supply chain risk factors.

For instance, Ning Zhong, Sun Wei and Shi Xiangyan (2006) classify supply chain risks into two types: natural disasters and human factors. The former mainly includes floods, earthquakes, volcanic eruptions, the spread of major infectious diseases and other *forces majeures*; the latter are unpredictable factors, such as problems with sole distribution, information transmission, corporate culture, economic fluctuation, logistics and distribution.

However, these attempts fail to distinguish the differences between operational risks encountered by traditional enterprises and those encountered by enterprises that implement supply chain management strategies.

Another perspective in domestic studies is to look at the internal and external sources of supply chain risks (Ma Shihua, 2003; Ning Zhong, 2004; Wang Ling and Zhu Zheyuan, 2011).

Ning (2004) explains that internal risks are caused by interactions between supply chain members, while external ones are caused by interactions of supply chains with the external environment.

Hu Jinhuan and Zhou Qilei (2005) suggest that external risks include natural disasters and social instability, while internal risks include moral and technological risks, together with market, capital and default risks.

Tian Hui and Shao Xiangli (2006) point out that internal risks mainly include systemic risks, information, management and technical risks, and they are caused by the interaction between supply chain members; external risks mainly include environmental and market risks.
Supply chain risk management

Zhu Huaiyi, Zhu Daoli and Hu Feng (2006) also suggest that internal risks include supply chain partnership risks, supply chain information risks and supply chain credit risks. They also share the view on external risks being caused by interactions with the outside environment.

Similarly, Tian Chunming and Du Xiying (2007) suggest that external risks include environmental and social risks, while internal risks are caused by supply chain members. Li Gang (2011) suggests internal risks include systemic risks, information risks, management risks and financial risks, while external risks are due to uncertainties in the market and environment.

Based on their review of the literature, Yanghua and Wang Xianyu (2007) and Hung Kentang (2010) summarised three types of supply chain risks: environmental, supply chain network and supply chain enterprise risks.

Environment risks, according to them, include natural disasters and sociopolitical risks. Supply chain network risks are caused by the interaction between different supply chain members, including cooperative risks, chaos and inertia. And finally, supply chain enterprise risks lie within the boundaries of the supply chain member, which include labour and production uncertainties.

Jiang Taotao (2007) reviewed the uncertainties in supply chain management and classified supply chain risks into supply, production, demand, and external risks. On the other hand, Zhu Xinqiu and Su Cheng (2010) classified supply chain risks into internal and external environment risks, industry risks, risks due to upstream and downstream relationships and decision-support risks.

Wang Xianyu, Xiao Yuming and Zhong Sheng (2008), from a resource-based view, suggest that supply chain external risks are due to a failure of supply chain collaboration to accommodate sudden changes in market demand, which could arise from exchange rate and policy risks, natural disasters and wars. Supply chain internal risks are due to inefficient and unreasonable supply chain resource allocation.

4.2.2 The impact of supply chain risks on enterprises and supply chain performances

Only a few domestic studies, such as Chen Jingxian, Shi Guohong and Ma Hanwu (2009) and Chen Jingxian and Chen Liqing (2009), have used empirical methods to analyse the relationship between supply chain risks and supply chain performances.

In their study of domestic manufacturing enterprises, Chen Jingxian and Chen Liqing (2009) classified supply chain risks into supply and demand risks, production risks and information risks. They constructed a model to explore the relationship between supply chain risks and an enterprise’s competitiveness and found that production and information risks have a significant direct impact on competitiveness, while supply and demand risks only indirectly affect an enterprise’s competitiveness.

Chen Jingxian, Shi Guohong and Ma Hanwu (2009) also sought to measure supply chain performance from four dimensions, namely, reliability, flexibility, service quality and financial performance. Based on survey results from domestic manufacturing enterprises, they developed a model to evaluate the relationships between supply chain risks and supply chain performances. Again, they found that production risks and information risks
have a significant, direct impact on competitiveness, while supply and demand risks only affect an enterprise’s competitiveness indirectly.

Lü Suping and Li Xiaona (2011) attempted to analyse the relationship between supply chain risks and supply chain performances by studying risks in the supply chain’s operational processes. They suggest that supply chain risks can be measured in terms of four risk variables: supply risks, demand risks, production risks and information risks. At the same time, they believe that the reliability and validity of the measurement tools should be tested further.

4.2.3 Supply chain risk management

In China – and around the world – there are relatively few studies on supply chain risk management, while existing studies usually employ a case study method. However, many such studies are developed on the basis of research efforts on risk identification and the impact of supply chain risks on supply chain performances.

Zhang Cunlu and Huang Peiqing (2004) point out that supply chains are vulnerable to various unfavourable factors, as they involve multiple processes and parties spanning different regions. Addressing the issue of risk posed by suppliers, they point out that such risks can be managed by selecting quality suppliers, improving collaboration with suppliers and strengthening supplier behaviour through monitoring.

Ni Yanling, Li Haiying and Yan Xiang (2004) also suggest that enterprises can take preventative measures to address supply chain risks, such as optimising supply chain partnerships, strengthening communications and information sharing with supply chain partners, and generally improving the flexibility of supply chains.

Jiang Taotao (2007) classified such risks into supply risks, production risks, demand risks and external risks; and Jiang suggests that enterprises should enhance supplier relationships and customer demand management; hence they could increase chain flexibility so as to prepare for problems with supply chain risks.

Wang Xianyu, Xiao Yuming and Zhong Sheng (2008) share the view that flexibility is the key to effective supply chain management. Similarly, Xiao Yan, Song Hui and Yu Wangmei (2009) believe that establishing supply chain strategic alliances and enhancing flexibility can help lower risks. Zhu Xinqiu and Cheng Guoping (2011) also stand by the concept of resilient supply chains to lower supply chain risks and deal with emergencies effectively.

In their review, Ning Zhong and Sun Wei (2009) classified four types of supply chain management methods: evading risks, sharing risks, accepting risks and adopting a quick response. Zhu Xinqiu and Su Cheng (2010) also propose the establishment of an information sharing system, a multi-layered defense mechanism, a principal-agent relationship and an emergency mechanism to deal with supply chain risks.

Ning Zhong and Dai Junjun (2005) investigated the applications of option contracts under uncertainties of market demand; they advocate that certain options can enhance information flows, encourage risk sharing and improve supply chain efficiency. By aligning the incentives of supply chain partners, this can improve the chain’s responsiveness to changes in the business environment, and thereby reduce supply chain risk.

Ning Zhong and Lin Bin (2007) point out that lowering operational risks and enhancing risk- and profit-sharing are the primary targets of supply chain management, so they analysed how suppliers can meet these targets through the use of options contracts.
Li Xueqian et al. (2010) point out that supply chain network complexities are the major source of supply chain risks. They established a two-stage competition model based on price competition; they suggest that information sharing should improve supply chain performances. Nevertheless, in order to optimise supply chain operations and reduce overall risks, a reasonable incentive mechanism is essential.

Li Bin, Ji Jianhua and Meng Cuicui (2011) studied supply chain risk from the perspective of supply disruptions. They stipulate that to lower supply chain risks, enterprises can expand their supplier base, establish strategic inventory management and improve supply chain flexibility.

Zhang Ning and Liu Chunlin (2011) classified the risks to supply chain processes into supply interruptions, sudden changes in demand, and operational disruptions; they also examined how enterprises can deal with emergencies by establishing horizontal and vertical cooperative mechanisms.

4.3 The way forward

As a relatively new research field, supply chain risk has received plenty of attention from Chinese and overseas scholars, and fruitful progress has been achieved. However, a number of areas deserve further investigation.

4.3.1 Research perspective

Although many researchers have made exploratory attempts to study supply chain risk factors, most focus on particular aspects of the supply chain process, such as supply risks, outsourcing risks and demand risks. Few research studies have attempted to investigate risk factors from the perspective of supply chain networks. Indeed, supply chains today are complex networks that consist of many different enterprises. The problems a supply chain faces are significantly different from those experienced by a single enterprise.

4.3.2 Research content

Chinese and overseas researchers have attempted to classify different supply chain risks, but there are no commonly agreed classification systems thus far. Further, although some researchers have tried to investigate different risk drivers at various supply chain levels, they look at different risk drivers on an isolated basis, without acknowledging the interaction between different risks drivers and their differential impacts on supply chain performances. There is also a lack of research study on the impact of supply chain risks on enterprises’ performances in different contexts.

4.3.3 Research methodology

Most Chinese studies have taken a qualitative approach to examining the sources of supply chain risks, and they attempt to investigate the negative impact of such risks (with their respective preventative measures) on a theoretical basis. Very few studies have employed empirical methods to test the impact of supply chain risks on supply chain stability, as well as on enterprise performance.
4.4 Recommended reading

4.4.1 A Study on Supply Chain Risk Managerial Integration Model Based on Knowledge Management

Research theme: Supply chain management and risk management are interrelated. Knowledge management plays an important role in enhancing the capability of supply chain enterprises to cope with risks. The paper identifies knowledge gaps in supply chain management, and proposes an integrated supply chain risk management model based on knowledge management.

Content detail: Supply chain members share different goals, interests and risks. Unlike knowledge sharing between individuals, or internally within an enterprise, supply chain risks are ever-evolving during the dynamic process of knowledge sharing between supply chain members.

In the paper, the authors put forward the concept of knowledge-risk chains, and further identify six major knowledge gaps in the implementation of supply chain management, while analysing their causes. An integrated supply chain risk management model based on knowledge management is proposed to achieve better knowledge sharing among supply chain members.

4.4.2 Option Mechanism in Supply Chain Risk Management

Research theme: Suppliers and distributors face a large amount of risk due to market demand uncertainties. In traditional economics analyses, options contracts are often used for arbitrage and risk avoidance. The paper introduces the applications of options contracts in supply chain risk management, with the aim of helping suppliers and distributors make better informed decisions and reduce risks.

Content detail: Apart from managing supply chain risk from an operational perspective, the paper proposes a financial perspective in supply chain risk management based on the application of futures, options contracts and other financial derivatives. Unlike the use of embedded options in traditional contracts, the paper studies options contracts that are completely independent of supply chain contracts and can be traded on the open market.

Several parameters and their constraining conditions are introduced to develop a decision-making model for distributors and suppliers. The paper further analyses the mechanism of interactions between suppliers and distributors from the perspectives of supply elasticity, channel coordination and risk- and information-sharing.

Implications: The paper discusses supply chain risk management from a financial perspective. It proves that buyers can reduce their risks by controlling the number of options contracts on hand. With enhanced supply chain risk visibility, buyers can manage their supply chain investment and control their risk profile more easily. The paper further proposes establishing a supply chain options trading market, and introduces methods to determine the equilibrium of market prices in options trading.
4.5 References


Overview

Small- and medium-sized enterprises (SMEs) have played a vital, central role in the economic development of countries across the globe. Indeed, they are the main driving force for economic growth, innovation and employment opportunities in the Asia Pacific region’s economies, contributing to over 50 per cent of GDP and over 60 per cent of employment.

In Germany, SMEs (firms with fewer than 500 employees) account for 99.7 per cent of the total number of the country’s enterprises; they represent 70 per cent of employment, 49 per cent of added value created by all enterprises, 46 per cent of total investment in the national economy and 40 per cent of exports.

In China, SMEs are also a highly significant force in the development of the nation’s economy. They play an integral part in enhancing social stability. In 2011, China revised its classification for SMEs for the eighth time in its history, and they are now referred to as enterprises in the industrial sector employing fewer than 1,000 people, with operating incomes of less than RMB 400 million apiece.

According to China’s Ministry of Industry and Information Technology, SMEs contribute to more than 60 per cent of national GDP and more than 50 per cent of tax revenues, while creating 80 per cent of China’s urban employment.

On the other hand, it is noteworthy that the heterogeneity of SMEs implies that their management is affected by many different factors (Gross and Jones, 1997; Hannon, 1999); management lessons applicable to large enterprises are not fully applicable to SMEs (Westhead and Storey, 1996). At the same time, due to resource limitations, it is hard for SMEs to enjoy spillover effects from the development of supply chain operations (Li Yongqiang et al., 2012). Harland et al., (2007) point out that SMEs are lagging behind large enterprises in the development of supply chain management.
5.1 SME supply chains and entrepreneurship

5.1.1 Defining supply chain entrepreneurship

Research on entrepreneurship encompasses studies on the impact of innovation on economic development. This field of research was pioneered by scholars such as Joseph Schumpeter and Israel Kirzner; subsequently, scholars such as McClelland (1961), Collins and Moore (1964) turned their attention to entrepreneurship on the micro-level – to the entrepreneurs themselves.

In the literature today, entrepreneurship refers not only to the process of establishing new enterprises by individuals or groups, but also to activities with similar characteristics carried out in established enterprises such as risk-sharing and expansion (Amit, Glosten and Mueller, 1993; Casson, 1982). Wei Jiang, Da Weiqi and Lin Qiao (2009) suggest that entrepreneurship is a process that features risk taking, draws on opportunities, integrates resources and creates value.

Studies relevant to supply chain entrepreneurship in China mainly focus on SME supply chain management.

5.1.2 The SME supply chain

Wang Xindong, Shen Jinsheng and Li Zhenjie (2003) note the significant differences between large enterprises and SMEs in supply chain operations, and designed a management model for increasing the operational efficiency of SME-generated supply chains. In view of the challenges faced by SMEs in aspects such as technology and information sharing, they recommend developing an information system for supply chain management through application service providers (ASPs). They further comment that SMEs can benefit tremendously by building “dynamic alliances” with large enterprises, despite their relative dependence on their bigger contemporaries.

Xu Huijian (2009) attempted to develop a supply chain management model for SME printing companies. He concludes that these can become more competitive by introducing outsourced service providers into their supply chains, making better use of network resources by transforming from a single linear model into a network model.

5.1.3 Managing SME supply chains

Zhang Bixi and Gong Shuanglei (2006) developed a supply chain operations reference model (SCOR) for SME manufacturing enterprises in China. The model includes five processes, namely planning, purchasing, manufacturing, distributing and generating returns. A number of case studies are used to further illustrate the importance of information systems to streamline supply chain operations.

Du Xinfang (2007) suggests that lean production, based on a supply chain management philosophy, can reduce lead times and lower costs. Lean production is an effective means for SMEs to improve their competitiveness. Du points out that SMEs are often in a non-core position when cooperating with larger enterprises. In her paper, Du uses the case study of a company to illustrate how lean production can help to improve performances significantly where it comes to internal logistics, production flexibility and inventory management.
Ma Lin (2008) conducted an empirical investigation into SME manufacturing enterprises in Zhejiang. He analysed key risk factors in five business processes (planning, purchasing, production, distribution and generating returns), and went on to establish a composite index system with the aim of helping SME manufacturers manage their risks.

Li Chengzan (2010) looked into the current status of SME purchasing management in China. He suggests that many of China’s SMEs compete rather than collaborate, with one another in their purchasing processes. These processes are far from scientific and are underdeveloped, as the level of information sharing between purchasers and suppliers is low. There is also a lack of communication between production and purchasing departments.

Hence, Li urges China’s SMEs to switch to a demand-driven purchasing model and establish strategic partnerships to better utilise external resources. In order to reduce purchasing risks, Li suggests adopting centralised purchasing, with SMEs conducting comprehensive supplier assessments to jointly establish a purchasing information system.

Li Lan (2010) studied the management of SME supply chain costs. He points out that most SMEs are heavily dependent on the external environment. With challenges such as heavy sunk costs, weak cost control knowledge, difficulties of information sharing and high transaction costs, SMEs are often at a disadvantage in transactions and in profit sharing. At the same time, the overall degree of collaboration in SME supply chains is often low, leading to high organisation costs. Li lists the degree of collaboration and cost characteristics of different types of supply chain (see Exhibit 5.1). In order to reduce costs, he suggests that SMEs should build collaborative supply chains, establish their own information platforms and use third party logistics services more effectively.

Exhibit 5.1: Collaboration and cost characteristics of different types of supply chain

<table>
<thead>
<tr>
<th>Supply chain management model</th>
<th>Relationship between different enterprises</th>
<th>Cost characteristics</th>
<th>Total supply chain costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decentralised supply chain</td>
<td>Independent</td>
<td>High transaction costs</td>
<td>High</td>
</tr>
<tr>
<td>Centralised supply chain</td>
<td>Highly integrated</td>
<td>High organisation costs</td>
<td>Relatively high</td>
</tr>
<tr>
<td>Collaborative supply chain</td>
<td>Both competitive and collaborative</td>
<td>Relatively low transaction and organisation costs</td>
<td>Low</td>
</tr>
</tbody>
</table>

Source: Li Lan (2010)

Zhu Weihua (2011) analysed the impact of a financial crisis on SMEs. He points out that SMEs often receive limited support and few benefits when they compete in supply chains since they are not usually the chains’ core enterprises. Unstable relationships between SMEs and other downstream and upstream supply chain players have also
resulted in inefficient information exchange, posing challenges for data analysis and decision making.

During a financial crisis, SMEs can be abandoned easily by core enterprises. Also, they may not be able to grasp changes in market demand quickly enough to take appropriate measures. To strengthen SMEs’ supply chain performances, Zhu suggests that they have to take the initiative to enhance their positions in the supply chain. That includes strengthening their relationships with other upstream and downstream enterprises, and upgrading their information systems.

Taking a different approach, Cai Dongxiao (2012) investigated logistics management in supply chain competition between SMEs. He points out that many SMEs demonstrate little organisational ability in logistics management because they face a constantly changing, competitive environment. Problems in logistics management such as ineffective internal communications, poor resources allocation and inadequate information platforms result in high logistics costs.

Based on the theory of constraints, Cai concludes that SMEs in China need to establish solid supply chain partnerships, strengthen their core businesses and enhance their use of information technology. SMEs should also establish a “buffer” stock policy and encourage employees to contribute their ideas in order to optimise logistics systems.

5.1.4 Collaboration between SMEs and external partners

Based on previous studies on collaboration between enterprises in supply chains, Yi Dongbo and Deng Liming (2007) studied SMEs to explore their values, complexities and configurations in supply chain collaboration. They did so by analysing collaborative patterns using the transaction cost theory, and conclude that such firms should seek to form alliances with one another to build collaborative supply chain networks.

Su Yingsheng and Wang Xianyu (2009) investigated how SMEs in the retail industry draw on their advantages in information to gain information rent from upstream under the circumstance of asymmetric information. By strengthening sales capabilities, SME retailers can enhance the information rent for both themselves and their suppliers. They also discuss how suppliers set up incentive contracts when the sales capabilities and efforts of SME retailers are unknown.

Wang Lijie and Feng Yanyan (2010) examined information sharing in SME supply chains and studied aspects that include demand, inventory, forecasting, logistics distribution and production. They point out that sharing supply chain information plays a critical role connecting different supply chain members. However, due to factors such as information protection, data distortion, mistrust and conflicts of interests, it is often hard to achieve an information sharing stance between different enterprises. To solve this problem, Wang and Feng propose a series of strategies to facilitate information sharing by offering incentives, establishing a feedback system to facilitate accurate information and enhancing information security.

Wang Lijie and Song Fuling (2010) studied profit sharing in SME supply chains. They suggest that the factors affecting profit sharing include fixed inputs by SMEs in areas such as production, technology and human resources, their contribution to the entire supply chain, overall effort and risks factors.
Yang Hongtao, Shi Chunsheng and Jiang Ying (2011) conducted an empirical study to explore the impact of *guanxi* (relationships) on stability in collaborations across entrepreneurial supply chains. The results show that *guanxi* has a positive impact where it comes to the contribution of resources and degree of coordination in these supply chains; they also find that *guanxi* has a stabilising effect on supply chain collaboration.

5.2 Industry clusters

5.2.1 Definition of industry clusters

Porter (1998) describes clusters as geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions (such as universities, standards agencies and trade associations) in a particular field.

Li Jizi, Cai Gennv and Lu Deyin (2004) go on to suggest that a cluster is a supply chain network system with expanding and innovative capabilities in a geographic region, the development of which is led by core enterprises in core industries.

Zeng Juan and Ma Qianjun (2006) suggest that an organised network structure enables the application of supply chain management principles in industry clusters, while Zheng Junjun and Ke Hui (2007) regard industry clusters as one of several supply chains centralised in any given region.

On the other hand, Chen Rao, Cai Gennv and Yang Weimin (2008) advance the concept of cluster supply chains. They conceive of these as network structures adopting supply chain management practices with the aim of enhancing efficiencies. Cai Youhua, Chen Guohong and Xiang Xiaodong (2012) suggest that cluster supply chains are significantly different from other industry clusters or supply chain systems.

5.2.2 Resources and capabilities SMEs can acquire from cluster supply chains

Wu Qun and Shen Feilong (2007) point out that SMEs in related industries constitute the bulk of cluster supply chains. Further, Xue Xiao, Zhang Jibiao and Huang Biqing (2010) suggest that cluster supply chains combine the advantages of both industrial clusters and supply chain management to help SMEs achieve breakthroughs in critical elements of the value chain. These advantages include strategy development, core technology and workflow optimisation; together they enable SMEs to compete on the international market.

(1) Boosting technological innovation

Using the optoelectronic industry in Wuhan as an example, Li Jizi, Liu Chunling and Zou Dewen (2006) find a positive correlation between organisational succession in a high-tech cluster supply chain and technological innovation in the industrial cluster and its firms. As the hi-tech industry cluster matures, organisational succession becomes the main driver of technological innovation and brings technology advances into every process of the cluster supply chain. Similarly, Lü Hongfen and Yu Xiangping (2007)
also suggest cluster supply chains are the main drivers of technological innovation among enterprises.

Cai Youhua, Chen Guohong and Xiang Xiaodong (2010) compare the strategies and profit levels of two cluster supply chains, each with one core enterprise and one upstream supplier; they find that a duopoly in R&D cooperation will yield significantly higher profits for participating enterprises. The results also indicate that R&D investment boosts the competitiveness of the products in the market.

Liu Chunling et al. (2011) analysed three technology innovation models in cluster supply chains, namely a technology-driven model, a demand-driven model and a composite one. They find that technological innovation in a cluster supply chain is a gradual process that includes three stages: linear cooperation, interactive collaboration and vertical integration. The transmission mechanism for technological knowledge differs within each stage.

(2) Lowering enterprise costs

Wu Qun and Shen Feilong (2007) view a cluster supply chain as a low-cost information and knowledge transmission system, which can help enterprises lower their transaction and total supply chain costs. Meanwhile, Liu Jun and Yan Guanghua (2006) studied the spillover effects of industry clusters. They point out that collaboration between supply chain members in an industry cluster can help lower inventory costs and shorten production lead times. Also, information systems and relationships of trust in an industry cluster help reduce transaction costs of supply chains and boost the competitiveness of SMEs in the cluster.

Li Baixun and Li Jizi (2007), on the other hand, suggest that inventory management programmes yield better results in cluster supply chains. They developed a model to study cross-chain inventory management and found that cooperation between chains helps reduce total supply chain costs by 11 per cent.

(3) Controlling the bullwhip effect

Liu Chunling, Li Jizi and Meng Bo (2007) constructed a model for cooperative inventory control in cluster supply chains. Their empirical research found that exercising $H\infty$ control can help determine the optimal order level in cluster supply chains and stabilise the level of safety stocks needed when demand fluctuates.

According to them, cluster supply chains can facilitate emergency replenishment of downstream players across different supply chains, so that the downstream players are less vulnerable to fluctuations in the level of orders placed by their upstream counterparts due to factors such as demand amplification and production rescheduling, which greatly ease the bullwhip effect of oscillations along the supply chain.

With the aim of reducing inventory and increasing profits, Li Jizi, Liu Chunling and Li Baixun (2007) also developed a model to find the optimal levels of regular and emergency replenishments. The empirical results show that high retail prices, a faster inventory rate, short order intervals and low emergency transshipment prices all encourage enterprises to adopt cooperative inventory control.

Chen Rao, Cai Gennv and Yang Weimin (2008) suggest that cluster supply chains combine the elements of both horizontal and vertical integration and therefore help
reduce the bullwhip effect by lowering transaction costs and reducing information distortions due essentially to opportunism.

Huang Chunhui et al. (2012) used the bill of materials (BOM) to analyse the multi-level and multi-object features of upstream suppliers in supply chains. In the paper, they developed an inventory management model based on BOM, and discuss the model using a system dynamics approach. The results show that supplier emergency inventory management can effectively restrain customer demand fluctuation from the supply side, lower total inventory and logistics costs, reduce the bullwhip effect and improve customer service levels. Analysis showed that among the different configurations, an inventory management model with three suppliers yields the best performance.

(4) Other research on cluster supply chain competitiveness

Li Jizi and Liu Chunling (2007) point out that cluster supply chains have an edge when launching mass customisation programmes. In the paper, Li and Liu investigated the integrated management of suppliers, outsourced services providers, manufacturers, wholesalers and retailers in cluster supply chains. The results provide insights into the mass customisation of a supply chain cluster’s master production schedule (MPS), material requirements planning (MRP) and production planning.

Li Jizi and Li Baixun (2007), on the other hand, designed an operational flow for mass customisation programmes in cluster supply chains. Citing the Jinjiang shoemaking cluster as an example, they point out that mass customisation in cluster supply chains has an edge in terms of flexibility, response time as well as price.

5.3 Recommended reading

5.3.1 Cluster Supply Chain Management


Research theme: The book puts forward the concept of cluster supply chains to combine studies of industrial clusters and supply chain management, and illustrates systemically the characteristics, structure, and integration process of cluster supply chains with eight case studies. Risk management and performance evaluation of cluster supply chains are also discussed.

Content detail: The book includes:

(1) theories of cluster supply chains, which combine the theories of industrial clusters and supply chain management, and define cluster supply chains according to industries and geography. The characteristics and functions of cluster supply chains are also introduced;

(2) the structure of cluster supply chains, which gives a detailed classification of the operating platforms and structures of cluster supply chains, and points out the three phases of the evolution of cluster supply chains. Based on the development and evolution characteristics of industrial clusters and supply chain chains, a classification of cluster supply chains is offered;
(3) the integration of cluster supply chains, which introduces seven types of co-competition targets and two modes of co-competition;

(4) operations of mass customisation and time-based competition, which offer a framework for the operation of mass customisation; the author also introduces the concept of time-based competition into cluster supply chains, and proposes an optimised model for internal and inter-firm planning and management; and

(5) risk management and performance evaluation of cluster supply chains, which describes the characteristics and classifications of cluster supply chain risk and introduces the four stages in risk management. A performance evaluation system of cluster supply chains is also introduced.

Implications: The book was written at the turn of the 21st century. At that time, supply chain management was often considered relevant only for large enterprises, and SMEs in China faced a number of obstacles in implementing supply chain management strategies. At the same time industrial clusters grew in influence in China’s national economy, but factors such as overheated investment, high inventory levels and poor competitiveness of SMEs have hindered their development.

Breaking the traditional paradigm of single-chain analyses in traditional supply chain studies, this book puts forward the concept of cluster supply chains, and discusses the topic from the perspectives of spatial integration and forward and reverse logistics integration. Combining the analyses of cluster supply chains and mass customisation, this book is of practical implication to practitioners and students.

5.3.2 Analysis of Technological Innovation Game Model in Firms of Supply Chain in Clusters


Research theme: The cluster innovation network plays a crucial role in enabling enterprise-led technological innovation in industrial clusters. This paper discusses, at a micro-level, three possible market forces shaping technological innovation in a network environment. The paper analyses the selection strategy and profit level of the supply chain in the game models for R&D cooperation and R&D non-cooperation, and investigates the R&D decisions and performances of major players in cluster supply chains.

Methodology: The paper constructs two two-tier supply chain models, each comprising one core enterprise and one upstream supplier. With assumptions that enterprises can fully protect their technological secrets so that there is no spillover of innovation activities between different supply chain systems, and there is perfect information symmetry so that both supply chain parties understand the structure, rules and payment functions of the game model, the annual output and profits of the supply chains are calculated.

The annual output and profits of supply chains under different payment functions are derived based on the Cournot competition model and the Stackelberg competition model.

Content detail: Increased R&D investment by core enterprises helps boost the equilibrium output of respective supply chain systems, expand market share, increase product revenue and enhance market competitiveness. This also reduces competitors’
market share and lowers their equilibrium output and equilibrium profits. R&D cooperation between supply chain parties in an industrial cluster can enhance the strength of both parties.

**Implications:** Most studies offer descriptive analyses related to enterprise technological innovation in cluster supply chains, without giving an accurate depiction of the internal mechanism of technological innovation in cluster supply chain. Other studies focus on the game model analyses on co-competition in cluster supply chains, but fail to acknowledge decision-making in technological innovation. In addition, the game model between different supply chains differs in the various stages of cluster supply chain development.

Taking different game models into consideration, the paper calculates the output and profit of simple two-tier supply chain systems, which provide references for cluster supply chain enterprises in making technological innovation decisions. The study lays a foundation for future investigation into technological innovations under the conditions of knowledge spillover due to insufficient patent protection.

5.3.3 Empirical study on Influence of GUANXI Culture on the Stability of Symbiosis of Entrepreneurial Supply Chain


**Research theme:** Apart from integrating their own resources, start-ups need to establish supply chains with other upstream and downstream players that match their needs to develop their businesses. However, entrepreneurial activities work well only in certain circumstances. The lack of effective administrative and economics control measures can cause unstable cooperative relationships between supply chain enterprises. From a relational transaction perspective, this paper investigates the impact of the culture of guanxi on the stability of entrepreneurial supply chain relationships.

**Methodology:** The paper explores entrepreneurial supply chain relationships from three angles - the degree of contribution at the resource level, coordination at the operational level and the level of maturity at the relationship level. Based on the structure-mechanism-function (SMF) framework, the culture of guanxi is classified on the basis of guanxi (the structures), the principles of guanxi (the mechanisms), and the benefits of guanxi (the functions); and the survey questionnaire is designed accordingly.

The paper further presents seven hypotheses to test how guanxi impacts upon the stability of entrepreneurial supply chain relationships. Four representative Chinese provinces are selected according to the Chinese regional data published by the Global Entrepreneurship Monitor to conduct a questionnaire survey with 360 respondents. The data collected are processed with Structural Equation Modeling (SEM) for calculation and validation.

**Content detail:** The hypotheses of the study are verified by SEM. The empirical results prove that the stronger the basis of guanxi, the higher resource contribution of the entrepreneurial supply chain partnerships, and the better operational coordination. The strength of the principles of guanxi is positively correlated with resource contribution by the entrepreneurial supply chain partnerships. The more resources are contributed, the better operational coordination and the more mature the relationships. Meanwhile, the stronger the benefits of guanxi, the higher degree of resource contribution and the more mature the relationships.
**Implications:** Entrepreneurial supply chains are relatively new and inherently unstable. Enterprises can take the culture of *guanxi* into account in supply chain relationship governance to improve the stability of supply chains and increase the odds of entrepreneurial success.

### 5.4 References


Overview

As a new economic growth point for the global economy, the service industry has captured the attention of both business executives and academics. Across the globe, the share of services in the total spend of enterprises has been on the rise. Enterprises are paying increasing attention to providing quality services and reducing services costs.

The service industry is becoming more important both in terms of jobs provision and value added in international trade. Between 1998 and 2000, 97 per cent of all new jobs in the United States were generated in the service sector. In 2001, the US service sector had created 95 million jobs.

In 2002, global trade in services was valued at US$1.6 trillion, which amounted to 20 per cent of total global trade. Along with the rise of the services economy, people have since shifted their attention from the industrial sector to the services sector. We will first review the definition and characteristics of service.

6.1 Introducing the concept

6.1.1 Defining service

In 1960, the American Marketing Association defines service as activities, benefits, or satisfactions that are offered for sale, or provided in connection with the sale of goods. Regan (1963) classified services into two categories. According to him, “services represent either tangibles, yielding satisfaction directly (transport, housing) or intangibles, yielding satisfaction jointly when purchased either with commodities or other services”.

According to Grönroos (1990), “a service is an activity or series of activities of more or less intangible nature that normally, not necessarily take place in interactions between the customer and service employees and/ or physical resources or goods and/or systems of the service provider, which are provided as solutions to customer problems”. On the other hand, Lehtinen (1983) defines service as “an activity or a series of activities which
Servitisation and service supply chains

take place in interaction with a contact person or a physical machine and which provides consumer satisfaction”.

In 1990, the International Organization for Standardization (ISO) defined service as an activity to satisfy customer needs through the internal operations of the service supplier and its integration with customers.

Generally speaking, all these definitions conceive of services as being a series of human activities with the aim of satisfying customers’ needs.

As for the characteristics of services, Wang Shoufa (2007) points out that they are distinct from physical products in many respects. (1) Services are intangible, therefore unlike physical products, cannot be seen, felt or perceived before being purchased; (2) services are inseparable and perishable; inseparability chiefly means that the production and consumption of services usually take place simultaneously and furthermore, unlike physical products, services are perishable since they cannot be stored; (3) services are heterogeneous, so the same type of service delivered can vary in quality, due to variations in factors such as time, location and staff; and (4) in order to be useful, provision of service is often required to support goods. In view of the many unique characteristics of services, their supply and procurement have taken the attention of many researchers.

6.1.2 The “services-dominant logic”

Along with the growth of the services economy, we have witnessed the shift of market attention from a “goods-dominant logic” to a “services-dominant logic”. The “goods-dominant logic” places its emphasis on the output and exchange of tangible resources, while the “services-dominant logic” focuses on the exchange and consumption of intangible resources. Vargo and Lusch (2004) suggest that along with productivity growth, the competitive advantage of enterprises will be increasingly determined by their intangible resources, such as knowledge, experience and technology.

Yang Shanlin, Cheng Fei and Yang Changhui (2011) also note the widespread attention to service manufacturing with economic globalisation. The trend towards servitisation is driving increasing numbers of enterprises to outsource their service operations; more people are paying attention to the development of services supply chains (Meng Lijun and Huang Zuqing, 2012; Lu Zhongdong, 2012).

6.2 Service supply chain: definition and network structure

Today, services activities have created more value than that from traditional product supply chains. Services supply chains have become a new focus in the field of supply chain management. Indeed, a lot of studies look into the definitions, models and structures of service supply chains.

6.2.1 General definitions and different models of service supply chains

Different views are held in the Western literature regarding the definition of service supply chains but basically they can be classified into three schools of thoughts:

(1) Service supply chains concern only the services-related activities in supply chains (Edward Anderson and Douglas Morrice, 1999; Dirk de Waart and Steve Kemper, 2004);
(2) Services supply chains concern the supply chains of the service sectors (Cook, DeBree and Perolet, 2001; Akkermans and Vos, 2003; Ellram, Tate and Billington, 2004; Sengupta, Heiser and Cook, 2006);

(3) Services supply chains are service-oriented integrated supply chains (Baltacioglu et al., 2007).

Yu Kangkang (2007) opts for the third definition, which highlights the dynamic interaction between service and other supply chain activities. As an integrated service provider receives a service request from a customer, it will review the request and may outsource part of the service activities to other service providers, depending on needs. A services supply chain is thus formed (see Exhibit 6.1). The integrated service provider is responsible for the integration and overall management of different service elements and processes.

Exhibit 6.1: The service supply chain model proposed by Yu Kangkang (2007)


Meanwhile, Liu Weihua, Ji Jianhua and Wang Zhenqiang (2008) propose a similar services supply chain model for service products comprising functional service providers, integrated service providers and customer(s) (see Exhibit 6.2).

Source: Yu Kangkang (2007)

Fu Qiufang and Wang Wenbo (2010) suggest that a services supply chain is a ring structure comprising customer, integrated service provider, and service suppliers. The integrated service provider offers service solutions through demand analyses and collaborated operations with other service suppliers (see Exhibit 6.3).

Exhibit 6.3: The service supply chain model proposed by Fu Qiufang and Wang Wenbo (2010)

Wang Zhenfeng et al. (2009), on the other hand, suggest that service supply chain management is the process of managing different aspects of a service network (such as information, service, relationship, and human resources) based on the use of information technology. They propose a services supply chain model (see Exhibit 6.4) based on work by Baltacioglu et al. (2007).

Exhibit 6.4: The service supply chain model proposed by Wang Zhenfeng et al. (2009)

Song Danxia and Huang Weilai (2010) also suggest that the integrated producer service provider is the core constituent of a typical producer service supply chain. Integrating
information and service flows, services supply chain management encompasses service information management, service capacity management, service demand management, customer relationship management, service supplier relationship management, service procurement management, service delivery management, and cash flow management (see Exhibit 6.5). Information sharing enables the collection, integration, and delivery of services between nodes in the service supply chain.

Exhibit 6.5: The service supply chain model proposed by Song Danxia and Huang Weilai (2010)

Source: Song Danxia and Huang Weilai (2010)

Despite placing emphasis on different aspects of a service supply chain, there is general consensus towards the core role that the integrated service provider plays in a services supply chain. The views of different researchers can be generalised by the service supply chain model developed by Song Hua and Yu Kangkang (2008). (See Exhibit 6.6).

Exhibit 6.6: The service supply chain model proposed by Song Hua and Yu Kangkang (2008)

Source: Song Hua and Yu Kangkang (2008)
6.2.2 Service supply chains in different industries

Researchers have attempted to investigate services supply chains from an industry perspective with the aim of guiding industry practices.

(1) Logistics service supply chain

The logistics service supply chain is one of the most extensively researched areas. Yan Xiuxia, Sun Linyan and Wang Kanchang (2005) suggest that in a logistics service supply chain model, the core enterprise creates value for its customers by controlling the logistics flow, information flow, and capital flow with the use of modern information technology. In their model, different logistics players from procurement, transportation, warehousing, packaging, processing, and distribution enterprises, down to the final users, form a functional network structure. The logistics players in the network collaborate and compete with one another.

Meanwhile, Shen Chenglin and Wang Bo (2005) suggest that a logistics service supply chain is a new type of supply chain that aims to provide a full range of logistics services. In a logistics service supply chain, an integrated logistics service provider serves as the core enterprise.

Based on the research mentioned above, Ren Jie (2006) developed a logistics service supply chain model (see Exhibit 6.7). In the study of a port logistics service supply chain, Li Zhaokun, Guo Beibei and Yang Zan (2009) also propose a similar model (see Exhibit 6.8).

Exhibit 6.7: The logistics service supply chain model proposed by Ren Jie (2006)

Source: Ren Jie (2006)

Exhibit 6.8: The logistics service supply chain model proposed by Li Zhaokun, Guo Beibei and Yang Zan (2009)

Source: Li Zhaokun, Guo Beibei and Yang Zan (2009)
Zhong Bolan (2010) studied the aviation logistics service supply chain. She suggests that aiming at satisfying customer demand, an aviation logistics service supply chain is one which starts with the organisation of supplies through different processes such as ground transportation services, airport cargo terminal services, and air transport services, for delivery to customers. The physical flows, transfers of custody, and information exchanges between different parties are realised through the supply chain.

Gui Shouping et al. (2010) distinguish definitions of logistics service supply chains between a narrow and a broad approach (see Exhibit 6.9). The narrow definition suggests that a logistics service supply chain is a network cooperation structure comprising upstream functional logistics enterprises, an integrated logistics service provider, and the final customer. The broad definition of logistics service supply chain extends to cover upstream logistics equipment and information technology service providers, together with other departments and enterprises involved in the provision of integrated logistics services.

Exhibit 6.9: The narrow and broad definitions of logistics service supply chains

Source: Gui Shouping et al. (2010)

Taking after-sales operations into account, Wang Yong and Yu Hailong (2010) propose a logistics service supply chain model as illustrated in Exhibit 6.10.

Exhibit 6.10: The logistics service supply chain model proposed by Wang Yong and Yu Hailong (2010)

Wang Yong, Jiang Yiyang and Deng Zhefeng (2011) suggest that the integrated logistics service provider serves as the core in a logistics service supply chain. Driven by customers’ logistics demand, the integrated logistics service provider integrates the resources and capacities of other logistics service providers in the network by managing the service flow, information flow, and capital flow.

Skirting the definitions above, Ni Lin and Wang Weixin (2011) suggest that the logistics service supply chain is a new type of supply chain in which the integrated logistics service provider manages the product supply chain by offering a flexible logistics service. This definition implies that a logistics service supply chain is actually a component of a product supply chain; Chen Hu and Ge Xianlong (2011), Chen Hu and Jiang Jiyun (2011), and Chen Yuzhen and Zhao Yifei (2012) echo this view.

Liu Wei and Gao Zhijun (2012) conclude that different definitions of logistics service supply chains share some common themes: 1) Logistics service supply chains share and integrate logistics resources; the primary focus of the study is the mechanism of interaction and integration within the logistics networks; 2) they emphasise the role of the leading enterprise in integrating logistics flow, service flow, capital flow and information flow within a logistics service supply chain; and 3) they stress value creation within the logistics service supply chain.

(2) Tourism service supply chain

The tourism service supply chain specifically receives much attention. Huang Xiaojun and Gan Xiaoqing (2006) suggest that travel agencies serve as the core in a tourism service supply chain; other service supply chain members base operations on the activities arranged by these travel agencies.

Lin Hongmei (2012) points out that similar to other types of supply chain, the tourism service supply chain is a service network comprising functional service providers, integrated service providers and customers. Integrated service providers offer support services to both functional service providers and customers.

(3) Medical service supply chain

Jia Qingping and Gan Xiaoqing (2009) studied China’s rural medical service supply chain. They suggest that the medical service supply chain is a complex system revolving around medical enterprises to provide different forms of medical services by effective management of medical services flow, medical information flow, and capital flow.

Wang Zhenfeng et al. (2012) suggest that a medical service supply chain is a network structure comprising medical service suppliers, hospitals and patients. Initiated by patients’ demands, hospitals control the information, physical and capital flows in the procurement of drugs, medical supplies and medical equipment, as well as providing service delivery to patients.

(4) Port service supply chain

In the study of port services in Hong Kong, Yang Mingming (2006) suggests that the port operator is the core enterprise in a port service supply chain; it links together various types of service providers (including handling, processing, transportation, warehousing, storage, distribution, financial services and business services) with customers (such as
shippers and shipping companies) to deliver the right quantities of goods to the right place, at the right time, at the lowest overall cost. Li Zhaokun, Guo Beibei and Yang Zan (2009) adopt the same definition in their study.

Exhibit 6.11 illustrates the port service supply chain model developed by Gao Jie, Zhen Hong and Sha Mei (2012). They suggest that the port service supply chain is a multi-layered structure comprising service providers, port operators and customers on the basis of long-term and stable partnerships. Information technology is the enabler of the port service supply chain.

Exhibit 6.11: The port service supply chain model proposed by Gao Jie, Zhen Hong and Sha Mei (2012)

(5) IT service supply chain

In the IT service supply chain, Li Xinmin, Liao Xiuwu and Chen Gang (2011) found that the rapidly growing rate for adopting the model of an application service provider (ASP) for the application software industry is, in essence, a service supply chain model.

Guo Yanli and Yan Jianyuan (2012) point out that the software supply chain has both horizontal and vertical dimensions. The horizontal dimension concerns the number of tiers in the supply chain, whereas the vertical dimension concerns the number of actors within each tier. The horizontal dimension of a supply chain can be long, with many tiers, or short, with just a few tiers. Similarly, the vertical dimension can be narrow, with only a few players, or wide.

Guo and Yan further distinguish between a software service supply chain and a software service supply network. In the chain, suppliers and IT service providers may develop either “functional” or “embedded” relationships. In the network, there are no upstream/downstream players. Unlike traditional service supply chain, different service providers in a software service network offer services to multiple customers through a single platform.
6.3 Service supply chain processes

6.3.1 Information exchange in service supply chain

A smooth information flow plays a critical role for enterprises to identify needs, share information, as well as evaluate performance; it can help enterprises reduce supply chain risks and uncertainties. Yang Shanlin, Cheng Fei and Yang Changhui (2011) studied the information sharing mechanism in service supply chains. Their findings, based on mathematical modelling, demonstrate that a collaborative strategy furthering an information alliance can maximise a supply chain’s performance.

Zhang Dehai and Liu Dewen (2008) point out that information sharing among logistics service providers can improve customer satisfaction and loyalty.

In their study of the port service supply chain, Gao Jie, Zhen Hong and Sha Mei (2012) find that an integrated information management (or circular) model can meet the requirements for flexibility and a quick response in a port service supply chain. They further develop a three-level (strategic level, controlling level and operational level) information management model to enhance information sharing.

Shen Huizhang, Zhao Jidi and Robin Qiu (2010) investigate the distributed information system for service supply chain based on service-oriented architecture (SOA), and develop a distributed information-sharing platform for service supply chain.

6.3.2 Service procurement and capacity in service supply chain

Service procurement is an important method by which service providers can acquire relevant resources needed for service provision. However, this significant service supply chain process is under researched.

Wang Xiaoli and Ma Shihua (2011) look into capacity coordination in logistics service supply chains under demand and supply uncertainties. They point out that integrated service players can improve supply chain coordination by launching a revenue sharing scheme.

Ma Cuihua (2009) suggests that there are a number of ways logistics service supply chain players can achieve better capacity coordination, such as investing in relation-specific assets, establishing knowledge-sharing routines, integrating resources, regulating enterprise behaviour, reducing layers in cooperation, and offering timely review and feedback.

On the other hand, Gui Yunmiao, Gong Bengang and Chen Youming (2009) test different coordination strategies empirically and find that the service supply chain has an edge in capacity coordination among different players. They find that capacity coordination in a service supply chain yields better supply chain performances than in the Stackelberg game coordination strategy.

6.3.3 Relationship between customers and suppliers in service supply chain

Wang Ying (2008) studies the supply chain management of the after-sales service for engineering machinery. To address the problem of poor after-sales services and weak collaboration between supply chain players, Wang proposes a customer-centric after-sales service system in order to build good relationships with customers.
Zheng Siwei and Wang Lingling (2010) study the exhibition and tourism service supply chain, and suggest that identifying the customers’ needs, establishing an information-sharing mechanism to better grasp customer demand, and measuring customer satisfaction can all help create better value for customers.

Supplier selection is the first step in service supplier relationship management. Some supplier selection models include the activity-based costing (ABC) method, a linear programming (LP) method, an analytic hierarchy process (AHP), a fuzzy comprehensive evaluation method, a neural network method, the technique for order of preference by similarity to ideal solution (TOPSIS), data envelopment analysis (DEA), principal component analysis, gray comprehensive evaluation, and a combination of the above.

Tian Yu (2003) employs both the AHP and LP methods to select multiple suppliers as well as to determine the optimum allocation of order quantity among them.

Chen Hu and Ge Xianlong (2011) seek to establish a comprehensive and objective logistics service supplier evaluation system. Their system evaluates suppliers from six dimensions: customer satisfaction, service quality, service costs, corporate qualifications, collaboration capabilities and green competitiveness. Further, they attempt to develop a qualitative and quantitative evaluation model by calculating the weight vector of logistics service providers using the entropy method, as well as assigning the weight vector to secondary indicators by expert scoring.

Yu Li (2010) builds a three-dimensional model to classify different types of customers based on profit contribution, characteristics of enterprise resources consumed, and compatibility with core businesses. Yu further uses the gray relational analysis method to evaluate the core customers of enterprises.

Selecting the right integrated service provider is important to customers as well. There are plenty of studies in this area. Ren Jie (2006) establishes an index system for the selection of integrated logistics service providers based on logistics service quality, cost, collaborative development capability, and green logistics capability.

Lin Hongmei (2012) seeks to evaluate integrated tourism service providers based on their service flexibility, price, quality, service capability, and collaborative development capability. Song Danxia and Huang Weilai (2010) construct a producer service provider evaluation model with six second-level indices (service quality, price, service flexibility, service capability, collaborative capability, and development potential) and with 18 third-level indices. They use a combination of AHP and entropy methods to evaluate suppliers.

### 6.3.4 Coordination and relationship governance in service supply chain

Effective coordination between service providers and consumers is critical for value creation in a service supply chain; it helps different supply chain parties work towards common goals and maximise the benefits of service supply chains. Effective coordination can bring enterprise cost and profit advantages (Liu Weihua et al., 2008), and build institutional legitimacy between service providers and their customers (Song Hua and Chen Jinliang, 2009). Relationship governance plays a crucial role in effective coordination.

Sun Chaoyuan and Guo Xirui (2011) conduct a case study of hydraulic escalator joint venture Chengdu Kobelco to investigate collaboration in the service supply chain. They suggest that collaboration in the service supply chain involves two levels: cooperation and coordination. The former refers to a long-term cooperative relationship, a scientific
management system, and a certain degree of information sharing, whereas the latter refers to service capacity coordination and service planning coordination. The collaborative mechanism has two dimensions. The vertical dimension concerns collaboration between upstream and downstream players, while the horizontal dimension focuses on relationships between service flow, physical flow, capital flow, and information flow.

Fu Qiufang and Wang Wenbo (2010) study the service industry in Guangdong and point out the problems within the industry such as outdated operation management practises as well as poor efficiency and competitiveness. They suggest four factors critical to effective service supply chain collaboration, which are service flexibility, professionalism among service staff, the mode of service delivery, and a capability to control and allocate service resources and capacity.

Some researchers also study the mode of relationship management. Song Yuanfang and Song Hua (2012) suggest that co-creation of value not only directly improves cooperative performance, but also boosts performance indirectly by improving relationship management between enterprises.

To achieve a scientific benefits-sharing scheme so as to boost incentives for service suppliers, Wang Zhenfeng, Wang Xu and Deng Lei (2011) develop a benefit sharing system for the service supply chain based on the Shapley value, which has taken into account the factors of input, effort, and risk.

In their study on transportation service supply chain, Wang Chuanxu and Jiang Liangkui (2010) seek to develop an optimal transportation price discount policy to facilitate a long-term supply chain cooperative relationship between carriers and shippers.

Zhu Weiping, Liu Wei and Gao Zhijun (2012) study the principle-agent relationship in a logistics service supply chain with a double-sided moral hazard. The results of their mathematical model suggest that the optimal investment level of an integrated service provider is negatively correlated to the incentive factor, while the optimal investment level of other service suppliers is positively correlated to the incentive factor. They also find a positive correlation between optimal marginal revenue and investment efficiency as well as output factors. The optimal incentive factor is positively correlated to the cost factor of an integrated service provider, and negatively correlated to the cost factor of other service suppliers.

6.4 Recommended reading

6.4.1 Service-oriented Supply Chain Operations

Chapter 1 reviews the concept of product supply chains and discusses its limitations. On this basis, the concept of service supply chains is introduced. After comparing different schools of thought on service supply chains, the book defines them as service-oriented integrated supply chains.

Chapter 2 outlines changes in interpretation of service supply chain management models in the academic world. Goods-oriented supply chain management models, such as the Hewlett-Packard (H-P) supply chain management model, the supply chain operations reference model (SCOR), and the Global Supply Chain Forum (GSCF) model, have heavily influenced early studies of service supply chain management models. Despite
strong emphasis on service supply chain processes, topological structures and strategic elements of services supply chains were not discussed in earlier service supply chain models. In the second half of the chapter, the three elements of service supply chain models (the structure of service supply chains, management processes, and management components) are discussed.

Chapter 3 details the interactions in service supply chains, including interaction processes and interaction entities. Interaction entities refer to integrated service providers, customers, micro-specialists and stakeholders. These four entities develop six types of interactions: (1) interactions between integrated service providers and customers to co-create value; (2) interactions between integrated service providers and micro-specialists to unbundle the value chain and exchange service components to create value; (3) interactions between micro-specialists and customers to create value through specialised service; (4) and (5) interactions between integrated service providers, micro-specialists and stakeholders – stakeholders determine the legitimacy of integrated service providers and micro-specialists; institutional entrepreneurship between micro-specialists and integrated service providers helps eliminate institutional uncertainties and barriers; (6) interactions between stakeholders and customers: Stakeholders indirectly shape the value propositions of customers; on the other hand, customers also exert their influence on stakeholders by shaping a socio-economic environment which is more favourable for them to realise their value.

Chapter 4 investigates the determinants of service supply chain strategies and behaviours from the perspective of integrated service providers. According to the institutional theory, the industry organisation theory and the resource-based view, the risk and revenue target of supply chains are determined by institutional and industry characteristics, resources and capabilities. Meanwhile, the risk and revenue targets of supply chains also determine the service structure and service interactions, which will ultimately impact enterprise performance. Sharing different supply chain risk and revenue targets, integrated service providers adopt different service supply chain strategies. This chapter illustrates four types of service supply chain strategies with case studies, including the service supply chain model featuring embedded services in products, a service supply chain model featuring seamless connections of different supply chain players, a service supply chain model featuring business processes integration, and a service supply chain model featuring integrated modular services.

Chapter 5 probes the strategy of outsourcing to micro-specialists from the perspective of integrated service providers. Despite extensive studies on outsourcing both in China and overseas, the author suggests that they fail to investigate the basis of decision-making, management components, or the selection of outsourcing activities. The author points out that the types of resource (operand/operant resource as well as composite/interconnected resource) that service providers hope to acquire are determinants of outsourcing decisions.

Chapter 6 studies the business model transformation of supply chain management company Li & Fung, which has evolved from an import/export trading company into an integrated supply chain solutions provider. The processes, structure and components of Li & Fung’s service supply chain are analysed.

Chapter 7 looks into various supply chain finance and risk control models. A case study of China CITIC Bank is included to illustrate supply chain finance operations and risk
management. The author analyses the challenges as well as the outlook of supply chain finance, and revises the foreign supply chain finance evaluation model developed under the Economic Value Added (EVA) perspective.

**6.4.2 A Review on the Service Supply Chain Literature**  

**Research theme:** The paper gives a general overview of service supply chain theories and introduces the current development and future trends of service supply chain research.

**Findings:** The authors note three major trends in service supply chain studies, which include (1) further clarification into the concepts, attributes and models of service supply chains; (2) a focus on developing a generalised service supply chain model for different industries, and further investigation into the characteristics of service supply chains of different industries; and (3) combining the features of service with manufacturing supply chains to offer more comprehensive analyses.

**6.4.3 An Order Allocation Model in Two-Echelon Logistics Service Supply Chain**  

**Research theme:** The paper investigates the order allocation of a two-tier logistics service supply chain comprising a logistics service integrator (LSI) and a functional logistics service provider (FLSP).

**Content detail:** Developing upon the work by Jukka and Wang et al., the authors construct an order allocation model for the two-tier logistics service supply chain. The paper investigates how results of task allocation change with the degree of uncertainty and relationship cost coefficient.

**Findings:** There is a significant positive correlation between demand uncertainty and the total cost of LSI. Demand uncertainty is also correlated with the overall satisfaction and penalty intensity of FLSP. High demand uncertainty lowers the overall satisfaction but increases the penalty intensity of FLSP. There is a positive correlation between the relationship cost coefficient of LSI and its total cost. The relationship cost coefficient is also closely correlated with the overall satisfaction and penalty intensity of FLSP. The higher the relationship cost coefficient, the higher the overall satisfaction and the lower the penalty intensity.

**6.4.4 Research on Market Risk Sharing Mechanism of Two-Stage Application Service Supply Chain under Demand Uncertainty**  

**Research theme:** The paper studies the market risk sharing mechanism of a two-stage service supply chain comprising an application service provider (ASP) and an independent software vendor (ISV). Based on the Stackelberg game model and the newsvendor model, an optimisation model is developed for the ASP and the ISV, with profit maximisation as the goal. The model takes into account opportunity costs and residual costs, as well as the
fact that market demand for the ASP is affected by long-term market share and short-term external random factors. Two kinds of risk-sharing mechanisms are studied, hypothesised with either the ASP or the ISV taking the risk.

**Findings:** In the risk-sharing arrangement in which the ISV takes the risk, the ASP would purchase from the ISV at the upper limit of the software rental service market demand due to the disappearance of the opportunity cost.

In the risk-sharing arrangement in which the ASP takes the risk, the ISP would propose to the ASP a software license sales plan where price is associated with purchase quantity. At the same time, the ISP would improve the quality of software development and maintenance, as well as upgrade the service level, to encourage the ASP to increase the quantity of orders.

From the perspective of system optimisation, a risk-sharing arrangement in which the ASP takes the risk is preferable so as to lower market risk.

### 6.5 References


Servitisation and service supply chains


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Servitisation and service supply chains


Overview

Enterprises in China face a high degree of uncertainty when managing their supply chains. Fast-changing market conditions and shifting consumer demand, as well as varying operational processes, all pose challenges to management. While some of these challenges can be overcome by concerted effort and attention, others are more unpredictable to control (Zhang Zhiwen 2005).

The traditional supply chain management model is manufacturer-centric. Manufacturers formulate their production plans based on demand forecasts; most of them keep safety stock to mitigate the risk of stock-outs. However, there are often gaps between forecast and actual demand, which can result in excessive stock and create cash flow problems for the enterprises concerned.

Further, information systems used by traditional supply chains are generally weak – key information dispersed across different parts of the supply chain often cannot be transmitted quickly and accurately, affecting overall operating efficiency (Dai Yong, 2005). With increasing uncertainties in consumer demand and uncertainties in the supply chain structure, the social environment, economic developments and production technologies, there are growing calls for enterprises to develop flexible supply chains.

Enhancing supply chain management flexibility has practical implications for enterprises. Liu Limeng (2009) points out that rapid economic and technological developments have created large uncertainties for internal and external supply chain environments.

For instance, China’s cotton industry was hit hard due to the sluggish performance of the garment market during the global financial crisis; the global rubber industry suffered as a result of a stagnant automobile market; and many companies in China’s coastal regions were under tremendous pressure during the economic downturn in the United States.

To win competitively, supply chain enterprises must be able to deal with external and internal uncertainties flexibly. Some Chinese researchers have attempted to look at the importance of supply chain flexibility in specific industries. For example, Luo Wei
Supply chain flexibility (2009) suggests that along with the rise of “fast fashion”, the organisational structure of many traditional supply chain enterprises, as well as their forecast-driven supply chain operations, can no longer address the needs of the fast-changing and increasingly diversified fashion market.

Supply chain flexibility and responsiveness have become the make-or-break factors for the fashion industry. On the other hand, with regard to the intensification of competition among different automobile supply chains, Zhang Wei and Jing Fengyan (2011) point out that improving supply chain flexibility and adaptability to deal with changes in internal and external environments are the future directions for the automobile industry.

A few researchers such as Wu Bing and Liu Zhongying (2007) Wang Lan (2011) have investigated supply chain flexibility from a theoretical perspective. Wang observes that most current studies on supply chain flexibility are confined to the investigation of internal production operations of a single enterprise; she suggests that studies should be extended to include the instances of interaction with other supply chain enterprises.

In this chapter, we review the definitions, dimensions and measurements of supply chain flexibility and investigate the driving factors and benefits of supply chain flexibility.

7.1 Definitions and dimensions of supply chain flexibility

7.1.1 Definitions of supply chain flexibility

Liu Lei, Tang Xiaowo and Ding Yixiang (2005) refer to supply chain flexibility as suppliers’ ability to respond quickly to changes in downstream demand with a smaller incremental increase in time and cost. Dai Yong (2005) suggests that supply chain flexibility implies a demand-driven production model which strengthens the competitive advantage of enterprises by rationalising resources flows in supply chains, trimming inventory levels, shortening delivery times and lowering capital ratios.

Some academics view supply chain flexibility as a performance indicator. In an empirical study on manufacturing enterprises, Liu Li (2010) sees supply chain flexibility as one of the four dimensions of supply chain performance (the others are supplier performance, responsiveness to customers, and supply chain costs). Fu Hong et al. (2011) believe that supply chain flexibility is a critical factor in the analysis of supply chain logistics performance; it can be reflected in the capability of supply chains to adapt to or resist changes in external environment, as well as the capability to interact with other supply chain enterprises to achieve innovation.

Bai Shun, Song Guofang and Chen Shunzheng (2004) define supply chain flexibility as the capability of supply chains to respond quickly to changes in market and customer demand, with the lowest possible costs and best possible customer service level. Zhang Wei and Jing Fengyan (2011), on the other hand, suggest that supply chain flexibility is the ability of enterprises to deal with uncertainties by transforming their own organisational or external inputs. Xiao Jiuling and Wang Jiankang (2006) point out that supply chain flexibility is the capability of the supply chain to adjust its speed, target and capacity in a timely manner to respond to market changes; these may be brought about by different demand quantities, or demand for customised or new products.

Zhang Yunbo and Wu Zhenye (2003) refer to supply chain flexibility as the capability of a supply chain to coordinate its “software” and “hardware” systems to deal with changes in
the internal and external environment, or to create favourable changes flexibly. According to Zhang and Wu, the “software system” of a supply chain is concerned with the corporate culture, organisational structure, management philosophy, as well as the software, protocols, and operating platforms of the information systems, whereas the “hardware” system is concerned with the machinery, equipment, facilities and all tangible materials used in service provision.

Some academics hold the view that supply chain flexibility should stress the ability of the entire supply chain system to respond to market changes. This requires each member of the supply chain to possess organisational flexibility so as to ensure smooth information flows, physical flows and capital flows between the upstream and the downstream (Xu Jian, 2006).

Hou Yulian (2004) defines supply chain flexibility as the capability of an organisation to respond to change together with its upstream and downstream players in the procurement process. This is achieved by adjusting raw material prices and the quantity and structure of suppliers to handle special order requests efficiently.

### 7.1.2 Dimensions of supply chain flexibility

Xu Jian (2006) suggests that supply chain management mainly encompasses four areas: raw materials supply, production planning, logistics and customer demand; correspondingly, supply chain flexibility can be classified according to procurement flexibility, manufacturing flexibility, logistics flexibility and the flexibility to launch new products.

Ma Lijuan (2009), on the other hand, notes that supply chain flexibility includes a different version of the four dimensions, namely as to supply, R&D, manufacturing and distribution. Supply flexibility is the supply chain’s ability to reconfigure itself for product supply changes according to customers’ needs. R&D flexibility is the ability of the supply chain to design new products and allocate relevant resources flexibly at low cost. Manufacturing flexibility refers to chain enterprises’ capabilities to manufacture different types of products in various quantities within a short period of time, at low cost. And finally, distribution flexibility provides the capability to distribute different types of products in various quantities quickly and again, at low cost.

Based on the major activities in a supply chain, Zhang Yunbo and Wu Zhenye (2003) classify supply chain flexibility into eight subsystems, namely R&D flexibility, resources flexibility, manufacturing flexibility, logistics flexibility, information flexibility, decision-making flexibility, supply flexibility and corporate culture flexibility. Subsequently, Zhang Yunbo, Wu Zhenye and Yang Chenglian (2004) developed an integrated model to support supply chain flexibility based on the relationships between different subsystems using a systems analysis approach (see Exhibit 7.1).

Xiao Jiuling and Wang Jiankang (2006) suggest that supply chain flexibility can be observed in five aspects, including the chain’s operational system, logistics process, supply network, organisational design and information system. Meng Jun and Zhang Ruoyun (2007), on the other hand, classify supply chain flexibility into product flexibility, outcome flexibility, capital flexibility and information flexibility.

From the perspective of supply chain processes and operations management, Zhang Wei and Jing Fengyan (2011) suggest that supply chain flexibility encompass R&D, production, logistics, capital, the information system and organisation.
Supply chain flexibility

Exhibit 7.1: An integrated model for a supply chain flexibility system

Fang Ming and Deng Mingran (2002) conclude that supply chain flexibility should include 1) product flexibility, meaning the capability of the supply chain to introduce new products within a certain time period; 2) time flexibility, being responsiveness towards customer demand; and 3) quantity flexibility, or the capability to deal with changes in the quantity of demand.

Wang Zailong and Xu Minli (2006) offer a more detailed breakdown of supply chain flexibility. In their research, product flexibility is further classified into cost, quality, sales and price flexibilities; time flexibility is classified into flexibility of response and flexibility in delivery; resource flexibility is classified into flexibility as to material, energy, facility, human resources, information, technology and capital; quantity flexibility is classified into the out-of-stock rate, the delayed orders rate, the orders ahead of schedule rate, and the average waiting order.

7.1.3 Measurements of supply chain flexibility

Given the multiple factors, objectives and levels involved in the evaluation of supply chain flexibility, many researchers have utilised the fuzzy analytic hierarchy process approach to create evaluation models for supply chain flexibility (Ma Lijuan, 2009; Wang Qingxi, 2012).

One of the more comprehensive measurement systems includes the supply chain flexibility evaluation model developed by Fang Ming and Deng Mingran (2002), which comprises four parts: 1) product flexibility, which measures the share of new products or categories introduced in a certain period of time, and it can be classified into second-level indicators such as a cost indicator, a quality indicator and a sales indicator. The second-level indicators can be further classified into third-level indicators. For instance, the cost indicator is classified into enterprise cost, social cost and consumer cost; 2) time flexibility, which measures the supply chain responsiveness to changes in the environment. Indicators include speed of response and flexibility in delivery; 3) resources flexibility, which measures the utilisation of different kinds of resources; and 4) quantity flexibility, which measures the proportion of quantity demand that can be fulfilled by supply chain operations.

Meng Jun and Zhang Ruoyun (2007) also develop a supply chain flexibility evaluation system that comprises three parts: (1) product flexibility, which is measured by the varieties on offer, time flexibility and quantity flexibility; (2) output flexibility, which includes the rate of customer complaints, share of lost sales, share of delayed deliveries, share of deliveries ahead of schedule, average waiting order rate, price flexibility, profit...
margins and financing flexibility; and (3) information flexibility, which is concerned with information system operations and communication mechanisms.

Meanwhile, Zhang Lingling, Zhang Naiwei and Wang Liangdong (2005) put supply chain flexibility evaluation to practical use. In their paper, they discuss the basic supply chain flexibility management principles of the South-to-North Water Transfer Project in China. By using the fuzzy analytic hierarchy process approach, they enumerate the issues that enterprises in the Project face in supply chain flexibility management.

On the other hand, some researchers have conducted in-depth analyses into the evaluation methods of supply chain flexibility. Wang Guihua (2010) employs the extension theory on supply chain flexibility evaluation and establishes a matter-element model to conduct a quantities analysis for all dimensions of supply chain flexibility.

Wu Bing, Liu Yili and Zhao Lindu (2008) also propose an index system to measure supply chain flexibility. They further compare four different supply chain flexibility measurement methods, and conclude that the black box method is relatively objective and simpler to use (see Exhibit 7.2).

### Exhibit 7.2: Comparison of four different supply chain flexibility measurement methods

<table>
<thead>
<tr>
<th>Measurement methods</th>
<th>Theoretical basis</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constraint model</strong></td>
<td>Theory of constraint</td>
<td>Measures the degree of flexibility of different sub-systems; adopts the one with the highest value as the overall degree of flexibility of the supply chain</td>
</tr>
<tr>
<td><strong>Additive model</strong></td>
<td>Superposition principle</td>
<td>Measures the degree of flexibility of different sub-systems; the overall degree of flexibility of the supply chain is the weighted average degree of flexibility of different sub-systems</td>
</tr>
<tr>
<td><strong>Multiplication model</strong></td>
<td>Multiplication principle</td>
<td>Measures the degree of flexibility of different sub-systems; the overall degree of flexibility of the supply chain is calculated by multiplying the degree of flexibility of different sub-systems</td>
</tr>
<tr>
<td><strong>Black box model</strong></td>
<td>Black box theory</td>
<td>Measures the response flexibility index of the supply chain</td>
</tr>
</tbody>
</table>

*Source: Wu Bing, Liu Yili and Zhao Lindu (2008)*

### 7.2 Factors affecting supply chain flexibility

#### 7.2.1 Internal factors

Supply chain flexibility is affected by different internal factors; basically, these factors are related to the following areas:
(1) **Knowledge and information system**

Liu Yili (2008) analyses the impact of knowledge on the operating efficiency of supply chains. In his paper, he also investigates the relationship between supply chain flexibility and environmental uncertainties; there is a proposal for a knowledge-based conceptual model for supply chain flexibility. He concludes that the knowledge and innovation capabilities of supply chains are direct determinants of supply chain flexibility. Liu Ting and Zhong Fangsi (2012) believe that supply chain flexibility based on knowledge sharing and innovation is a major management direction; therefore, core enterprises should employ scientific planning and forecasting methods to respond to market changes quickly, and encourage their employees to innovate.

On the other hand, information systems and technology also play a critical role in supply chain flexibility. Liu Fei (2009) suggests that information technology can help achieve supply chain optimisation. For instance, vendor-managed inventory (VMI) technology can help lower supply chain costs, and the collaborative planning, forecasting, and replenishment (CPFR) system helps reduce the bullwhip effect. Shi Yuhui (2007) reviews how the large-scale manufacturer, Hunan Valin Xiangtan Iron and Steel Co., Ltd, improved its management and control of supply chain operations with the implementation of an enterprise resource planning (ERP) platform.

(2) **Operating and control system**

Pan Jingming and Tang Xiaowo (2004) study the optimisation of manufacturing decisions in a flexible supply chain, given uncertain demand. Using total supply chain costs minimisation as the target function and manufacturing flexibility as a constraint condition, they establish a model for production optimisation. They calculated the efficient frontiers of production flexibility and their economic significance. Pan and Tang further introduced a minimised cost-flexibility coefficient as a criterion to determine the optimal solution. With regard to the lack of flexibility in the traditional decision support system, Zhang Yunbo (2005) proposes an artificial intelligence supply chain flexible decision support system to help decision-making in a dynamic environment.

(3) **Internal logistics**

Internal logistics refers to activities such as warehousing and transportation. Many researchers focus on the impact of vendor-managed inventory (VMI) on supply chain flexibility; they agree that VMI can enhance supply chain flexibility through informational and functional integration of both the supply and demand sides.

Bai Shun, Song Guofang and Chen Shunzheng (2004) demonstrate that VMI can improve supply chain flexibility in the aspects of costs, customer service level and lead time. Li Lei and Zhang Yuxian (2008) point out that VMI enables suppliers to forecast demand based on actual sales data directly. In times of demand fluctuation, suppliers can adjust their fulfillment strategies, and coordinate with production and transportation departments to change operational plans swiftly.

On the other hand, Zou Anquan, Liu Zhixue and Liu Ying (2008) use the activity-based costing (ABC) method to reengineer the procurement process in the Iron and Steel industry. With a much shorter procurement lead time, enterprises are able to make prompt
responses to market changes. Supply chain flexibility can be further enhanced, with the use of information technology.

(4) Organisational design

Organisation design is mainly concerned with internal integration. Zhang Yunbo (2003) takes a systemic approach to studying supply chain flexibility. He suggests that, 1) instead of simply offering products, enterprises in China should change their mindset to offer total solutions to their customers; the entire enterprise system should be driven by market needs; 2) enterprises should strive to nurture employees’ abilities to adapt to change; 3) they should pay attention to promoting reform in their organisational structures; and 4) they should establish information systems that promotes flexibility.

As observed, many academics in China have offered general descriptions of a wide range of internal factors that could affect supply chain flexibility, instead of concentrating on in-depth analyses of specific internal factors. For instance, in their study of the supply chains of the ship-building industry, Zhang Guangming et al. (2007) suggest that supply chain flexibility can be enhanced with the implementation of VMI, modular manufacturing, a postponement strategy, the establishment of supply chain information systems, the formation of knowledge alliances, strengthened forecasting, and nurturing a corporate culture that embraces supply chain management.

Wang Jiuhe and Ge Peng (2009) investigate mass customisation supply chains and list six factors that affect supply chain flexibility: new product ratios, the quality rate, on-time delivery rate, the product price factor, the degree of modular applications and the investment ratio. On this basis, they use the Gray Correlation Method to determine the key factors affecting the flexibility of mass customisation supply chains, and conduct an empirical analysis using the actual data of a home electronics enterprise.

Huang Shanghai (2010) points out that enterprises can improve supply chain flexibility to reduce supply chain risks. There are two ways to achieve this goal. On the one hand, enterprises can take measures to reduce the vulnerability of their supply chains, such as by reducing the possibility of deliberate attacks, establishing cooperative safety methodology and keeping buffer stock. On the other hand, enterprises can mitigate the impact of shocks by adopting postponement strategy, a flexible supplier strategy and nurturing a flexible corporate culture.

Jiang Tingting and Zhang Yang (2012) use the Quality Function Deployment method (QFD) to optimise supply chain flexibility; they suggest that viable strategies to enhance supply chain flexibility include information management, supplier management, production design, demand-driven production, waste reduction, continuous improvements, just-in-time production, and quality management.

7.2.2 External factors

The success of supply chain management lies in the effective control of uncertainties. There are multiple sources of external uncertainty. Xiao Jiuling and Wang Jiankang (2006) suggest that customers, suppliers, technology, and competitors are the major sources of such uncertainties.

Supplier flexibility and selection have specifically received researchers’ attentions. Connecting suppliers, manufacturers, wholesalers, retailers and customers together,
Supply chain flexibility

modern supply chains face a great deal of complexity and uncertainty, including price fluctuations and information discrepancies. Besides, modern flexible manufacturing also exacerbates supply chain uncertainties (Hou Yulian, 2004). Ding Husong and Xu Xiaoyan (2009) suggest that reducing lead times can increase supply chain flexibility, lower inventory cost, and boost supply chain revenue.

In view of the crucial role revenue sharing plays in strengthening the relationship between supply chain partners, Ding and Xu build a Stackelberg game model based on revenue sharing between a manufacturer and a retailer, in which the manufacturer’s investment in flexible production equipment helps reduce lead times and boost the retailer’s revenues. Their model aims to determine the optimal revenue sharing ratio between downstream and upstream supply chain players.

Supply chain networks and relationships are two critical components of a flexible supply chain. The results of an empirical study of 194 enterprises show that close supply chain relationships can promote logistics and purchasing flexibility; relationship capability is positively correlated to purchasing flexibility but demonstrates no significant relationships with logistics flexibility (Song Hua and Wang Lan, 2008; Song Hua, Wang Lan and He Feng, 2009).

Apart from trust between enterprises, Song Hua and Yu Kangkang (2009) point out that the legitimacy of the supply chain relationship also affects distribution flexibility and performance. The empirical study by Liu Linyan and Song Hua (2010) suggests that inter- and intra-firm coordination have positive impacts on supply flexibility and enterprise performance; and supply flexibility also impacts enterprise performance indirectly.

On the other hand, some researchers use the concept of relational contracts to investigate supply chain flexibility. Wu Bing, Liu Zhongying and Zhao Lindu (2007) analyse the major parameters of procurement contracts between supply chain players. They suggest that establishing procurement contracts is a key method by which supply chain players share responsibilities in an uncertain supply chain environment; an effective procurement contract can help determine the best procurement strategy in the areas of lead time, scope and cost.

Liu Jin and Duan Yi (2008) studied a supply chain model based on options contracts, and suggest that these may bring significant improvements in supply chain flexibility, overall supply chain profits and supply chain relationships.

With regard to cooperation issues in supply chains with high demand uncertainties, long production lead times and short selling seasons, Hu Benyong, Wang Xingyu and Peng Qiuyuan (2008) developed a model of quantity flexibility contracts, and suggest that bilateral options contracts can improve purchasing flexibility and lower market risks, though at the expense of revenue.

Li Jiang, Yao Jian and Yang Shanxiang (2010) also agree that the introduction of options contracts can lower market risks, enhance supply chain flexibility and improve overall supply chain profits. Considering the impact of the spot market and risk aversion of suppliers, Luo Meiling et al. (2012) point out that real options contracts help achieve supply chain coordination.

Apart from relationship strength, some researchers focus on how the structure of relationships (i.e., network and integration factors) influence supply chain flexibility. For instance, Ma Dong and Song Bingliang (2008) point out that internal supply chain
integration is necessary for enterprises to avoid competition between two supply chains after a horizontal merger.

Business process reengineering (BPR), advanced forecasting, vendor managed inventory (VMI), and delayed product differentiation strategy (DPD) can facilitate internal integration and improve efficiency, the response speed and internal supply chain flexibility.

Xu Jian (2006) believes that supply chain flexibility is determined by the flexibility of the respective supply chain members, and is also affected by the level of coordination among them. Building a demand-driven supply chain system, encouraging knowledge sharing and innovation of supply chain members, establishing an efficient supply chain information system, and modular product designs can all promote supply chain flexibility.

### 7.3 Performance indicators of supply chain flexibility

#### 7.3.1 Enterprise-level performance indicators

Most researchers in China have focused on the trade-off between costs and benefits in their investigation of enterprise-level supply chain flexibility performance. For instance, Zhang Cuihua and Huang Xiaoyuan (2002) analyse the cost structure of supply chains, and have developed a supply chain flexibility optimisation model taking various production and distribution constraints into account. Using the evolutionary programming method, they built a simulation model for a company in the agricultural sector to test the sensitivity of supply chain flexibility towards variations in total supply chain costs.

On the other hand, Zhang Kai, Gao Yuanyang and Sun Ting (2006) developed a model for a flexible batch order contract that can help lower ordering costs and achieve better sharing out of supply chain risks.

Using the multi-objective programming method, Wei Bo and Fu Zhuo (2008) built a model for optimising supply chain flexibility and costs, taking into account overall supply chain efficiency and interests of individual supply chain members.

However, some researchers suggest that where the supply chain flexibility level is too high or too low, both will be unfavourable to supply chain operations. To determine a suitable level, Liu Limeng (2009) suggests taking costs and benefits as well as the constraint conditions into consideration; the flexibility of different supply chain subsystems should match one another to realise the overall strategy.

#### 7.3.2 Supply-chain-level performance indicators

Supply chain flexibility is a critical factor behind the success of supply chain management. Hong Jiangtao and Nie Qing (2011) conduct an empirical investigation into China’s foreign trade enterprises, and find that “supply chain partnerships and coordination”, “supply chain flexibility capability” and “development and use of information systems” are major drivers behind the success of supply chain management; however, “supply chain process optimisation” and “management philosophy, attitude, and support of top management” are relatively less important.

Then again, a larger number of empirical studies point out that supply chain flexibility only affects the results of supply chain management indirectly; in fact, supply chain flexibility impact the results of supply chain management through its influences on several other performance indicators. The first of these is the quality of the relationship, Wang Lihu and
Supply chain flexibility

Sheng Zhaohan (2004) suggest that customer satisfaction is an important parameter in stabilising the supply chain structure and is closely connected with its flexibility.

Xu Jian (2006) states that the components of supply chain flexibility – being in purchasing, manufacturing, logistics, and in launching new products – will ultimately affect customer satisfaction. Supply chain flexibility also affects the supply chain performance through its influence on service quality.

Hu Benyong, Wang Xingyu and Peng Qiyuan (2007, 2009) study the quantity flexibility aspect in the contracts present in perishable product supply chains, and construct two flexible contract models based on unilateral and bilateral options contracts. They suggest that both types of contract can increase the quantity of the total order.

Finally, supply chain flexibility impacts supply chain performance through its influence on an enterprise’s capabilities. The empirical study by Yang Weifeng et al. (2009) on the relationship between enterprise flexibility and logistics capability in cluster supply chains concludes that the three dimensions of cluster supply chains (adaptation, innovation and communications capabilities) have a significant, positive correlation with the two dimensions of logistics capability (delivery and response).

7.4 An integrated framework

Earlier, we reviewed the definitions of supply chain flexibility, its various dimensions, and different factors affecting supply chain flexibility. Exhibit 7.3 provides a theoretical framework integrating all these elements; we believe that the framework can assist future research. To conclude, supply chain flexibility represents the ability of supply chains to respond to internal and external change, and has the effect of propelling enterprises’ performances and enhancing the overall supply chain.

Exhibit 7.3: A theoretical framework for supply chain flexibility

[Diagram showing the framework with internal factors, supply chain flexibility, enterprise performance, and external factors]

Internal factors
- Knowledge and information systems
- Operations and control systems
- Internal logistics
- Organisational design

External factors
- Environmental uncertainties
- Relationship strength
- Relationship structure

Enterprise performance
- Costs and benefits

Supply chain performance
- Satisfaction
- Service quality
- Enterprise capability
7.5 Recommended reading

7.5.1 Measurement of Supply Chain Flexibility

Research theme: Most studies focus only on measurements of particular aspects of supply chain flexibility. In view of this, the paper seeks to develop a comprehensive index system to measure supply chain flexibility. In addition, the paper compares four different kinds of supply chain flexibility measurement methods: The constraint model, the additive model, the multiplication model, and the black box model.

Methodology: The supply chain flexibility of a company between 2003 and 2005 is measured by combining methods of field study and questionnaire survey. Six aspects of supply chain flexibility are covered in the survey, including supply chain structure flexibility, logistics flexibility, information technology flexibility, purchasing flexibility, manufacturing flexibility and distribution flexibility.

Findings: Compared to other models studied, the black box model is a relatively simple and straightforward supply chain flexibility measurement. It requires only the measurement of the supply chain response flexibility, without looking into the internal structure of the supply chain's flexibility. The other methods, however, require a calculation of the degree of flexibility of different sub-systems.

Implications: Difficulty in measuring flexibility is one of the reasons behind flexibility receiving little attention in supply chain decision making. The paper establishes a comprehensive supply chain flexibility index system; additionally, it concludes that the black box model is a relatively simple and objective supply chain flexibility measurement method. The major goal in the measurement of supply chain flexibility is to strike a balance between flexibility and efficiency; the authors suggest future studies to investigate economic decision making, given supply chain flexibility in a dynamic environment.

7.6 References


Supply chain flexibility


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Supply chain flexibility


Overview

The global financial crisis in 2008 brought immense challenges to the economic and business environment. Both in China and overseas, commercial banks adopted credit tightening measures. However, the growth in supply chain finance bucked the trend with a cascading flow of funds (Shenzhen Development Bank – China Europe International Business School “Supply Chain Finance” Task Group, 2009).

Euromoney magazine described supply chain finance as the hottest theme in transactional banking business over the past few years. In the first quarter of 2009, six listed banks in China (ICBC, Bank of Communications, China Merchants Bank, Industrial Bank, SPD and Minsheng Bank) discounted funds to the tune of RMB 456 billion, an increase of 66.4 per cent compared to the fourth quarter of 2008, indicating the growing preference of small- and medium-sized companies (SMEs) for trade finance. Conversely, this also reflected the increasing importance of supply chain finance to commercial banks (Shenzhen Development Bank – China Europe International Business School “Supply Chain Finance” Task Group, 2009).

Supply chain finance has in turn caught the attention of China’s researchers, who have shown growing interest towards supply chain capital flows and the business models for supply chain finance (Yang Shaohui, 2005; Zheng Xin and Cai Xiaoyun, 2006; Yan Junhong and Xu Xiangqin, 2007).

Chen Xiangfeng et al. (2005a, 2005b, 2006) from the School of Management, Fudan University, published a series of papers to introduce an innovative financial service model in the field of warehousing and logistics namely, the Finance-Transportation-Warehouse (FTW) service.

In this chapter, we review the concept of supply chain finance and its development in China.
8.1 The concepts of supply chain finance

China’s researchers have yet to offer a precise definition of supply chain finance. Terminologies such as “supply chain finance”, “supply chain financing” and “supply chain trade finance” have all appeared in domestic studies. Compared to overseas efforts in this field, most domestic studies place a heavy emphasis on the relationship between supply chain finance and SMEs.

Although performances of individual enterprises are closely related to the capacity of the overall supply chain, performance can vary significantly between core enterprises and SMEs within the same supply chain due to differences of resources and capabilities, and several historical factors.

Compared to the traditional, vertically integrated manufacturing model, Hu Yuefei and Huang Shaoqing (2009) suggest that the supply chain version could bring heavier financial costs to the entire production processes, because 1) more market coordination of production activities lead to increases in trade volumes and transaction frequencies; and 2) the common practice of sale on credit in supply chains superficially appears to reduce the financial costs of core enterprises, while most of the financial pressure is actually transferred to the SMEs. Hu and Huang believe structured trade finance can effectively ease cash flow pressures on the supply chain.

Despite their less advantageous position, SMEs play an integral role in supply chain operations. To keep the capital flow in supply chains running smoothly, core enterprises in supply chains can leverage supply chain financing from banks to offer value-added services to their partners. At the same time, core enterprises in supply chains can play a “screening” role for banks, while banks can rely on a network of core enterprises to develop new bases of quality customers.

Growing demand for supply chain finance has also fostered development of new financial instruments, such as domestic letters of credit and online payments, which promote revenue growth for the intermediary banking business. On the other hand, logistics enterprises also have an important role in supply chain finance. They are usually responsible for the coordination and control of business, physical goods and financial flows in supply chains. For many models of supply chain finance, collateral is held in and monitored by logistics centres.

Tang Shaoyi (2005) tests the feasibility of a new financing model for SMEs using the concept of supply chain finance. From the point of view of commercial banks, Yang Shaohui (2005) defines supply chain finance as a new financing model tailored to SMEs. Supply chain finance provides an inherent promise to offer trade finance services to every supply chain member, including those at a disadvantage in the supply chain.

Based on the experience of Shenzhen Development Bank, Yan Junhong (2007) defines supply chain finance as comprehensive financial services offered to single or multiple upstream and downstream enterprises in the supply chains, with the aim of promoting the stability and smooth capital flows of supply chains; the finance factor also promotes development of a healthy and sustainable ecosystem for banks and supply chain enterprises. On the other hand, Hu Yuefei (2007) suggests that supply chain finance is a financing business in which banks offer credit services based on the trade and credit levels of core enterprises in supply chains; this is in conjunction with the provisions of other short-term financial products and closed loan operations. Future cash flows from trade operations are a direct source of repayment within supply chain finance.
Yan Junhong and Xu Xiangqin (2007) analyse the edge that supply chain finance brings to bear in easing financing difficulties encountered by SMEs. Yan Junhong (2007) categorises supply chain finance into three basic models: accounts receivable financing, inventory financing, and prepayments financing. Jiang Jingmei and Zhan Minghua (2012) find that SMEs face difficulties in obtaining financing because they are often not able to provide collateral and have insufficient access to information, but along with developments in technology and management by logistics and supply chains, many innovative supply chain finance services are now provided by commercial banks.

Some researchers have investigated the application of supply chain finance in specific industries. For instance, Yan Kun (2007) proposes a framework for developing financial services for agricultural supply chains based on the characteristics and needs of the agricultural sector.

### 8.2 Supply chain finance models

Yi Zhihong, Song Hua and Yu Kangkang (2008) investigate the supply chain finance management models of commercial banks. In their paper, management models and the associated risks of supply chain finance are considered in the automobile, steel, and home appliances industries based on a case study of China Citic Bank, which launched the logistics finance service “Yin Mao Tong”. “Yin Mao Tong” offers comprehensive financial services specifically designed for trade and logistics customers. Core manufacturers play a vital role in this supply chain finance model, driving cooperation in chains comprising “manufacturers-distributors-banks” or “manufacturers-distributors-TPL providers-banks”. A combination of commercial credits and bank credits can resolve the financing problems of SMEs. By improving cash flows, “Yin Mao Tong” also helps manufacturing enterprises strengthen their sales network management and expand market share.

In order to improve SMEs’ working capital turnover and expenses settlements, Zhao Daozhi and Bai Mapeng (2008) propose an innovative logistics finance model based on notes receivable management (NRF - LC Model). They analyse the role of stakeholders and establish a game theory model reflecting the relationship between the fund suppliers and buyers to determine a feasible range in the NRF - LC model. By integrating logistics flows and fund flows, it is hoped that the model can boost stakeholders’ economic benefits.

Xiong Xiong et al. (2009) find that supply chain finance models offer a new perspective to banks in identifying and evaluating risks faced by SMEs, on top of the existing method of accessing individual SMEs’ financial data. Their paper focuses on credit risk evaluation in supply chain finance models, and develops a credit risk evaluation system based on both overall rating and debt rating. Principal component analysis and logistic regression methods were employed to improve the objectivity of the system. They compare compliance by SMEs in traditional and supply chain finance models and suggest that it is the supply chain finance one that can mitigate SMEs’ financing difficulties. Based on these results, they advocate establishing a customer database and view this as a prerequisite for an effective supply chain finance model.

He Yiqing and Guo Tingting (2010) also offer the view that supply chain finance has changed banks’ credit evaluation of SMEs, by focusing less on the risk management of a single enterprise and more on the entire supply chain. They use a game theory model to compare the strengths and weaknesses of the three basic supply chain finance models.
Supply chain finance

namely credit guarantee financing, inventory financing, and accounts receivable financing, and conclude that both banks and SMEs are more inclined to adopt the accounts receivable financing model.

On the other hand, Li Xia (2010) recognises the growing importance of SMEs in China’s national economy and suggests using prepayment financing backed by specific transactions in bonded warehouses for enterprises with short-term cash flow difficulties to obtain short-term credit support from banks.

Jia Wei, Zhang Hongfang and Cai Liyi (2011) finds that that a higher level of supply chain management is a prerequisite for effective supply chain finance. Due to varying supply chain management performances, there are huge differences in applications of supply chain finance in different industry sectors. For instance, supply chain finance fails to bring significant changes to the petrochemical equipment industry due to product homogenisation, a client body that is constantly changing, and a poor level of supply chain management.

Zhong Yuanguang et al. (2011) study the application of supply chain finance in the retail industry, and discuss the optimal ordering and pricing strategy for retailers with constrained initial capital. They developed a model to find retailers’ optimal order quantity and pricing in the circumstances of no financing, external financing from a third-party financial institution (such as banks), and internal financing using core manufacturers’ trade credits. They found that retailers’ order quantity and profits increase with financing; they discovered that internal financing is the better option in most circumstances.

Shi Yongqiang et al. (2012) note the growing concern in the automobile industry for supply chain efficiency enhancement and cost reduction through supply chain finance. They analysed four basic financing models, including factoring, purchase order financing, inventory financing, and bonded warehouse financing, to assist upstream parts suppliers and downstream players to make proper financing choices.

Zhou Min and Huang Fuhua (2011) look into the complexities of tea logistics finance, and seek to optimise logistics for the tea industry from the perspective of back propagation artificial neural network (BP neural network) theory.

8.3 Supply chain finance risk management

Risk management is crucial for the success of supply chain finance. Based on financial systems engineering, Li Yixue (2011) establishes a risk identification system for logistics finance. The system classifies logistics finance risk into systemic and non-systemic risks. The former includes macroeconomic and industry risk, while the latter includes credit risk, liquidity risk, and operation-related risk.

He Mingke and Qian Wenbin (2011) points out that logistics finance has helped ease the financial burdens of SMEs during the 2007-8 global financial crisis. The development of logistics finance also helps boost the profitability of logistics enterprises. He and Qian discuss in their paper the identification and assessment of logistics finance risk, and measures for coping with them. They summarise 15 risk factors in logistics finance, and set up a risk assessment model based on the BP neural network. From the results, they discuss different financial and operational approaches in dealing with logistics finance risks.

Yang Lin (2012) notices an increasing trend for commercial banks to develop supply chain finance as priority business. While deeper involvement in supply chain finance helps
commercial banks yield better overall economic benefits, Yang cautions banks to focus on supply chain risk control.

Lin Fei, Yan Jingmin and Shi Yunchang (2010) suggest that TPL providers can help mitigate the problem of asymmetric information between banks and SMEs. First, with strong industry knowledge, TPL providers can help supervise the properties of SMEs so that banks are more willing to accept them as collaterals. Secondly, TPL providers can act as banks’ information agents by offering more information about the SMEs. Thirdly, TPL providers can provide credit guarantees for SMEs, reducing information asymmetry between banks and SMEs.

Similarly, Cheng Chenzi (2011) finds that on top of the conventional role of the logistics services provider, TPL providers now acquire an additional role as a financing agent/controller. The new role of TPL providers has drawn attention to the options of internal and external financing. Using the model of a newsvendor, Cheng analyses the pros and cons of the two financing options.

Bai Shaobu (2010) uses an ordered logistic regression model to evaluate credit default risk and creates an early-warning system for supply chain finance. On the other hand, Zhou Xuenong (2010) developed a supply chain finance model consisting of users, manufacturers, and commercial banks. He shows that supply chain finance will be more effective if manufacturers take the Stackelberg leadership in setting the risk-undertaking portion before banks determine the lending rates. In his model, Zhou uses the backward induction method to find the sub-game perfect Nash equilibrium.

While logistics finance can facilitate financing for SMEs, it also involves significant risk. Zhang Jing, Zhu Jinfu and Li Yuan (2010) stress the importance of risk avoidance in improving the utilisation of funds in logistics finance. By using the extension theory, they analyse the risk of credit financing in logistics finance, and propose a series of measures to help enterprises lower their risk.

In view of the differences in economic environment, Song Hua (2012) adjusts the supply chain finance evaluation model developed overseas under the Economic Value Added (EVA) perspective. He argues that the three dimensions put forward by Moritz Leon Gomm, namely duration (time), volume (monetary value), and capital cost rate have put supply chain enterprise performance evaluation in an isolated context. Besides, these static and absolute indicators cannot best reflect real-world performances, which is particularly true for enterprises in China, as the financing environment in the country is much more challenging. In the adjusted model, Song chooses three dynamic and relative indicators for evaluation. An interview with an oil trading company in Chengdu confirms that the adjusted model is more suitable for supply chain finance performance evaluation in China.

In supply chain finance, while the suppliers have to ensure that they have sufficient working capital to support their own operations, they also need a good grasp of the financial strengths of their upstream and downstream partners to ensure the overall financial health of their supply chains. The integration of supply chain management and financial management, (basically with the use of financial management tools and indicators to monitor supply chain operations) can serve to promote the development and optimisation of supply chain integration.

Supply chain finance boosts the development of supply chains by offering a wide range of support services (such as credit servicing and accounts receivable recovery) to enterprises within the supply chains. When value-added of the entire supply chain increases, core
Supply chain finance

enterprises can also reduce their financing needs, and benefit from “no-cost financing” and even “negative cost financing”.

8.4 Challenges and developments

For increasingly internationalised supply chains, forecasting the demand of overseas markets poses a big challenge. VMI applications, which are getting increasingly popular, can improve inventory and demand visibility, so that enterprises can better manage their inventory levels and payment cycles to lower entire supply chain costs.

Technologies such as the electronic bill payment platform (EIPP), the ERP payment module, automated platforms to manage transactions, and online payments, are also crucial for the implementation of supply chain finance strategies. With improved visibility of physical goods flows and cash flows, financial institutions can better assess the financial risk to supply chains, greatly facilitating the financing of enterprises.

Supply chain finance is an emerging area. Today, the supply chain finance market in China is still in its infancy, and the speed of development will be determined by the readiness and willingness of enterprises in outsourcing financial processes. However, we can foresee that supply chain finance will rise in importance in the years ahead. To benefit from this growing trend, it is becoming crucial for enterprises to improve their supply chain finance knowledge, integrate key financing processes, master the use of technologies and adopt financing options suitable for the international environment.

8.5 Recommended reading

8.5.1 Supply Chain Finance


Research theme: The book uses Shenzhen Development Bank, a pioneer in the supply chain finance business in China, as an example to investigate empirically the theories and practices of supply chain finance, including risk management, organisation structure and financial ecosystem.

Content detail: The authors observe that the focus of supply chain management has been shifting from the logistical level to the financial level. The book comprises 10 chapters, aiming to answer the following questions:

(1) the core value of supply chain finance and its differentiation with traditional commercial banking businesses;

(2) how domestic and foreign banks should learn and interact with one another, given the huge differences in supply chain finance practices;

(3) how to establish a practical supply chain finance framework and business model, including the product system, and sales and marketing strategies;

(4) how supply chain finance practices interact with the socio-economic environment;

(5) how to establish a theoretical framework of supply chain finance.
The book elaborates upon the supply chain finance business of Shenzhen Development Bank, featuring the components, modules, and system integration of its self-liquidating trade finance products as well as the bank’s unique “1+N” sales and marketing strategy. Other examples of supply chain finance practices of Chinese and overseas banks are also introduced to substantiate the study.

**Implications:** Supply chain financing is the most important as well as the riskiest business of commercial banks, thus heightened attention has to be paid to the risk management of supply chain financing. In addition to traditional credit risk management measures, risk management must address the specific operational risk in supply chain finance. Further, in supply chain risk management practices, six supply chain finance variables have to be considered carefully, including the core enterprises and supervisory partners unique in supply chain financing, and the access systems, operating platforms, chattel mortgage, early warning systems, and contingency plans.

The authors also give a detailed analysis of the organisational structure of banks that offer supply chain finance service, and investigate the implications of supply chain finance to banks, enterprises and supply chains from a socio-economic perspective. The hot topic of financial logistics is also discussed.

### 8.5.2 Operating Models of Finance-Transportation-Warehouse (FTW) Service


**Research theme:** Based on the stages of the operating cycle, this paper classifies three modes of Finance-Transportation-Warehouse (FTW) service. Illustrated with case studies, the paper introduces the design and risk management of FTW service.

**Content detail:** According to the characteristics of the risk and capital gap encountered in the course of enterprise operations, the FTW service can be classified into three types.

1. **FTW operation model based on movable property management.** This model is mainly applicable to vertical or star-shaped FTW. The example of Jiangsu Huacheng Automobile Trading Group is cited to illustrate how enterprises overcome their financing difficulties through warehouse receipts pledges. Other methods include the use of chattel mortgage and the bonded warehouse.

2. **The FTW operation model based on capital management.** This model is also applicable to vertical or star-shaped FTW. Enterprises file their loan applications mainly using receipts of accounts receivable or payable as guarantees. The case studies of the provision of FTW services by UPS to Wal-Mart and its small- and medium-sized suppliers, as well as the operations between Jiangsu Guanxin Photoelectric Company and its large-scale upstream and downstream enterprises using the accounts receivable model are cited to illustrate the important role the FTW operation model based on capital management in facilitating the growth of SMEs.

3. **The FTW operation model based on risk management.** This model is applicable to every stage of the operational cycle. Usually, financial derivative instruments such as options and futures are used in risk management. Controlling the risk of a FTW service can boost supply chain performance.
8.5.3 Credit Risk Analysis of Supply Chain Finance


Research theme: Rather than relying solely on the financial data of individual SMEs for credit risk evaluation, the authors employ principal component analysis and logistic regression methods to establish a credit risk evaluation model for supply chain finance. Comparison of the compliance by SMEs in traditional and supply chain finance models suggests that supply chain finance can mitigate the financing difficulties of SMEs to a certain degree.

Content detail: Banks rely traditionally on financial data of enterprises in credit risk evaluation. But due to incomplete financial data and poor transparency, it is often difficult for SMEs to obtain credit. Supply chain financing models allow banks to replace static analyses of financial statements with dynamic control of logistics and cash flows, and offer credit to a single project; traditional barriers of SME financing are thus overcome.

Implications: In establishing the credit evaluation model, banks have to pay attention to the information collected on applicants in order to develop a comprehensive database. Apart from the risk related to borrowers, banks also have to fully consider the impact of the economic cycle. The establishment of credit evaluation models for SME supply chain finance does not only lower the risk to banks, but also boosts the development of SMEs – so a win-win situation is achieved.

8.6 References


Chapter 9
Logistics cost and supply chain performance evaluation

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Overview

Today, increasing numbers of enterprises in China are scrutinising and evaluating supply chain and logistics management. Through the integration of different business processes such as procurement, manufacturing, distribution and service, supply chain management enables enterprises to respond to customer needs quickly and to minimise inventory and overall operational costs at the same time.

In this chapter, the measurement of logistics costs – one of the key components of supply chain costs – is introduced in the next section, and reviews of other methods of supply chain performance evaluation follow in subsequent sections.

9.1 Logistics costs measurements

9.1.1 Understanding logistics costs from different perspectives

Researchers have investigated logistics costs from different perspectives, namely the macro- and micro-levels. Some academics have also studied logistics costs at the meso-level (Song Ze and Chang Dongliang, 2005a, 2005b, 2005c; Shao Ruqing, 2006; Song Hua, 2007a; Feng Gengzhong et al., 2007; Yi Hua, 2011). Macro-level logistics costs refer to societal logistics expenditure.

Meso-level logistics costs usually refer to the “average logistics costs” of a specific industry, which can be used as a benchmark for practitioners in respective industries (Yi Hua, 2011). Meso-level may also refer to a specific product’s average logistics expenditure in the horizontal dimension and its total logistics expenditure in the vertical dimension (Song Hua, 2007b).

Micro-level logistics is concerned with the logistics activities of enterprises. It refers to the logistics costs of different enterprises, including the logistics costs of the consigners (i.e., the logistics costs of manufacturing and distribution enterprises) as well as the logistics costs of logistics service providers.
Along with rapid development of societies and economies, and the accelerating pace of globalisation, logistics costs accounting has become a major management concern. Enterprises are paying heightened attention to core competence and overall performance improvements in order to reduce overall logistics costs. Against this backdrop, micro-level logistics costs have grasped researchers’ attention; and this will also be the main theme for this chapter.

The role of logistics cost management in improving enterprise performance and lowering overall costs has been widely recognised (Song Hua and Wang Lan 2009). Researchers in China, in general, have studied the measurement and calculation of logistics costs from two angles: (1) logistics costing models, and (2) logistics cost accounting methods, such as statistical accounting techniques, mission costing, activity-based costing (ABC), and total cost of ownership (TCO).

### 9.1.2 Logistics costing models

There are three major enterprise logistics costing models, namely the “cost accounting” model, the “statistical accounting” model and the “management accounting” model (Zhang Guoqing, Ye Minqiang and Liu Longqing, 2007). The first two of these models are elaborated upon below.

#### (1) The cost accounting model

Single-track accounting and dual-track accounting are the two most commonly used accounting principles for the purpose of tracking logistics costs. Single-track accounting adds all extra items of logistics expense to the existing accounting system. In other words, logistics cost accounting is processed together with other enterprise cost accounting, such as product cost accounting, responsibility cost accounting and variable cost accounting. Under this arrangement, a single accounting system can provide information about a variety of costs; logistics cost accounting follows the same set of financial standards, but the records are kept separately to facilitate costing and cost analyses (Zhang Guoqing, Ye Minqiang and Liu Longqing, 2007; Liu Yanping, 2009; Wang Yonglan and Jia Siyuan, 2010).

Li Huitai and Zhang Wenjie (2002) have long advocated the keeping of separate accounts and records for the purpose of logistics cost accounting for manufacturing enterprises. Similarly, Xu Feng (2007) points out that existing financial accounting and costing systems have failed to reflect enterprise logistics costs accurately. He suggests enterprises establish a “virtual” account for logistics costing, i.e., to set up a primary account for logistics costing. According to specific accounting and management needs, enterprises may further set up a secondary account for various logistics processes such as supply, production, sales and recycling, detailing different types of logistics expenses or payment methods.

Dual-track accounting involves setting up a separate logistics cost accounting system distinct from the one in use for the other accounts, which follows a different set of accounting standards. This separate accounting system offers a comprehensive record of different types of enterprise logistics costs, and also provides details about the location and purpose of the logistics activities (Liu Yanping, 2009; Wang Yonglan and Jia Siyuan, 2010). Fang Guiping (2012) believes that dual-track accounting can address the problem of mixing logistics cost accounting with other types of cost accounting.
(2) The statistical accounting model

The statistical accounting model obtains enterprise logistics costs with statistical principles. With this method, logistics-related expenses are extracted from current accounting statements; and enterprise logistics costs are estimated using statistical methodology (Zhang Guoqing, Ye Minqiang and Liu Longqing, 2007). The statistical accounting model is relatively easy to operate; however, since the model fails to provide an accurate, comprehensive and continuous account of enterprise logistics costs, its applications have been fairly limited.

In view of this major drawback, Liu Yanping (2009) suggests combining the cost accounting model with the statistical accounting model. She points out that in actual operations, enterprise logistics costs can be divided into explicit and implicit logistics costs. While the explicit logistics costs are already reflected in different items of the current cost accounting system, the implicit logistics costs, which are chiefly concerned with the opportunity cost of inventory, are not measured by the system. It is suitable to use the cost accounting model to obtain the explicit logistics costs; meanwhile, it is advisable to estimate the implicit logistics costs based on inventory information using the statistical accounting model.

9.1.3 Logistics cost accounting methods

(1) Traditional accounting method

The traditional accounting method arrives at logistics costs by separating the logistics expenses from related cost items in existing accounting statements, based on certain accounting principles and methods (mainly according to labour and machine hours attributable to logistics activities). Nevertheless, the procedures involve an arbitrary attribution of costs, which calls the accuracy of the results into question (Zhang Guoqing, Ye Minqiang and Liu Longqing, 2007).

The practice of taking the end-of-period balance from the “logistics costs” account in single-track accounting or the separately calculated amount in dual-track accounting as the enterprise logistics costs, can also be classified as one of the traditional accounting methods. Although these methods offer more reasonable grounds for separating logistics expenses from other enterprise costs, their usage in logistics cost management is limited, since they do not provide much insight into when logistics expenses occur nor offer any tracking analyses.

(2) Mission costing

The idea of “mission costing”, which employs the total cost method in logistics cost management, was first introduced by Martin Christopher in 1971. Subsequently, Timothy Barrett (1982) introduces the planning, programming, budgeting system (PPBS) to provide a framework that brings practical applicability to mission costing. The framework aims to offer an analytic tool for logistics processes. Barrett perceives of the logistics system composing several interrelated subsystems that yield revenue by interacting with one another to provide various kinds of service to customers. Mission costing emphasises the interrelation between different logistics subsystems from a total cost perspective, and is also able to provide cost information about different services (Shuai Bin and Sun Chaoyuan, 2006). On the other hand, Zhu Yuguang and
Supply Chain Perspectives and Issues in China

Logistics cost and supply chain performance evaluation

Zhou Yongxiang (2003) employ mission costing to analyse customer profitability, and put forward the concept of “attributable cost”. Zhou Min and Wang Chenggang (2005) also categorise different types of logistics services based on the ideas of mission costing to calculate logistics costs. From this point of view, both mission costing and the activity-based costing (ABC) methods share the same basic idea of tracing costs according to specific activities. Both methods provide useful information for logistics cost management.

(3) Activity-based costing

Researchers such as Yang Ping and Lei Yan (2001), Chen Xiaolong, Zhu Wengui and Zhang Xiandong (2002), Fang Fang and Yang Yang (2003), Dai Kun (2003), Fu Guilin (2004) and Lian Guilan (2004) introduced the ABC method for the calculation of logistics costs in early studies of China’s logistics industry. Among these, the work by Dai Kun (2003) is one of the most representative. Dai perceives logistics costs as including both direct and indirect components. Direct logistics costs refer to expenses, such as labour expenditure, depreciation and maintenance costs, which can be designated directly to a specific product or service; and formulating a logistics accounting statement can help classify and calculate different direct logistics costs.

On the other hand, indirect costs can be obtained using the ABC method. The necessity of using this method is shared by Bao Xinzhong (2006), Lü Jing, Zhao Hongchu and Zhang Shuang (2006) and Shu Lianzhi (2007). In fact, the ABC method is widely used in enterprise logistics cost accounting in developed countries (Song Hua, 2007b).

(4) Total cost of ownership

The total cost of ownership (TCO) method determines the logistics costs of products by reviewing supply chain activities of the entire upstream, such as procurement, storage, quality control and distribution. TCO calculates both the direct and indirect costs of products, providing a comprehensive account of the relevant logistics costs (Song Hua, 2007b). At the same time, the TCO method offers a means to evaluate the impact of inter-firm relationships on overall logistics costs, and helps enterprises understand how costs are induced in every single logistics process.

In China, the TCO method is mainly used in the evaluation of enterprise procurement cost. Zhu Xiaojing and Zhu Qiqui (2007) state that the TCO method is of strategic importance in procurement cost management, as it aims for total cost reduction by continuous improvements in the business processes of buyers and sellers. The TCO method can also be used in cost analyses of reverse logistics (Yan Fuchuan and Yan Shuang, 2009).

9.2 Current picture of enterprise logistics costs in China

According to the China Logistics Yearbook 2011, total logistics costs in China reached RMB 7,100 billion in 2010, up by 16.7 per cent yoy. Of this figure, transportation costs were valued at RMB 3,800 billion in 2010, up by 14 per cent yoy, accounting for 54 per cent of all logistics costs (down by 1.3 percentage points yoy). Inventory costs valued at RMB 2,400 billion, up by 20.5 per cent yoy, accounting for 33.9 per cent of all logistics costs (up by 1.1 percentage points yoy). Management costs, valued at RMB...
900 billion, were up by 19% yoy, accounting for 12.1% of all logistics costs (up by 0.2 percentage point yoy). Taken together, the logistics costs to GDP ratio dropped by 0.3 percentage point yoy to 17.7 per cent in 2010, indicating greater efficiency within China’s logistics industry (China Federation of Logistics & Purchasing, 2011).

The 2010 National Statistical Survey Report on Logistics of Key Enterprises by the China Federation of Logistics & Purchasing reveals the picture of logistics costs in several major industries in China.

The steel industry: the logistics cost ratio was relatively high at 12.0 per cent in 2009, 2.2 percentage points higher than average. Accounting for a 58.9 per cent share of the total logistics cost, transportation plays a critical role in cost control in the steel industry. The logistics ratio of the steel industry in 2009 dropped by 0.3 percentage point yoy, implying logistics efficiency improvements.

For the petrochemical industry, the logistics cost ratio was relatively high at 12.3 per cent in 2009, which is 2.5 percentage points higher than average, and 1.5 percentage points higher than the average for the manufacturing industry. Transportation accounted for a dominating share of 67.1 per cent of total logistics costs. The logistics cost ratio of the petrochemical industry has been steadily rising over the past few years.

As for the electrical machinery and equipment manufacturing industry, the logistics cost ratio was 5.8 per cent in 2009, down by 0.9 percentage point yoy. Transportation accounted for 60.1 per cent of the total logistics costs, up by 0.3 percentage point yoy. Management, packaging, inventory and processing costs accounted respectively for 20.6 per cent, 10 per cent, 4.1 per cent and 0.2 per cent of the total logistics cost, up by 1.5, 3.6, 0.3 and 0.1 percentage points yoy.

For the building materials industry, the logistics cost ratio was high at 19.5 per cent. The industry’s logistics costs were up by 7 per cent yoy in 2009; transportation, packaging and management costs were the major reasons for the overall cost increase; they grew by 4 per cent, 27 per cent and 15 per cent, respectively.

The automobile industry sees the logistics cost ratio at 9.1 per cent, 0.7 percentage point lower than average. Transportation, management and inventory costs accounted for 46.2 per cent, 18.7 per cent and 7.1 per cent of total industry costs, respectively. The logistics costs ratio in 2009 was 1.1 percentage points lower than 2008, suggesting better logistics efficiency in the automobile industry.

In the paper manufacturing and products industry, the logistics cost ratio was high at 20.3 per cent in 2009, despite a decrease of 0.5 percentage point yoy. The logistics cost ratio of the industry was 10.5 percentage points higher than average. Transportation costs accounted for 52.3 per cent of the total logistics cost.

For the agricultural products processing industry, the logistics cost ratio was 12.9% in 2009, up by 0.2 percentage point over the past year. The logistics cost ratio of the agricultural products processing industry was 0.2 percentage point higher than average. Transportation, inventory and management costs accounted for 54.9 per cent, 12.7 per cent and 14 per cent of the total logistics cost, respectively.

The pharmaceutical industry showed a logistics cost ratio of 11.3 per cent in 2009, up by 0.2 percentage point yoy. The logistics cost ratio for the pharmaceutical industry was 1.5 percentage points higher than average. In 2009, the industry’s logistics costs climbed by 18.1 per cent yoy. Although its share registered a decrease of 2.5
percentage points over the past year, transportation - accounting for 45.8 per cent of the total logistics cost - remained the major driver of logistics cost growth. The high cost of transportation is a primary reason behind poor logistics efficiency in the pharmaceutical industry.

For the non-ferrous metals industry, the logistics cost ratio in 2009 was up by 7.3 per cent yoy. Transportation accounted for 60.6 per cent of the total logistics cost.

9.3 Supply chain performance evaluation

Logistics cost management is not only important for improving enterprise performances, but also plays a critical role in enhancing the performance of the supply chain. For enterprises, the goal of logistics cost management is to enhance their supply chain performances through integrating supply chain resources and reducing supply chain costs. As such, supply chain performance management is the ultimate challenge for enterprises.

Before the supply chain performance can be evaluated, the right indicators have to be selected. Statistical methods are mainly used in supply chain performance evaluation; examples include the analytic hierarchy process (AHP), the analytic network process (ANP), the fuzzy analytical hierarchy process (FAHP), the grey relation analysis (GRA), the fuzzy comprehensive evaluation method, and the data envelopment analysis (DEA). After determining the evaluation methods, it is then appropriate to proceed to benchmark best practices and improve an enterprise's supply chain performance by comparing its current practices with best practices in the industry.

9.3.1 Indicator selection

Indicator selection based on the supply-chain operations reference model

Indicator selection based on the supply-chain operations reference (SCOR) model operates under the assumption that supply chain performance is dependent upon five basic supply chain processes: to plan, source, make, deliver and return. This selection method has caught the attention of many Chinese researchers, such as He Zhongwei and Mao Bo (2003), Mao Huifang and Zou Huixia (2004), Zha Dunlin (2003), Chu Ying, Liu Lu and Zhang Wei (2004), Yang Maosheng, Li Tao and Bai Shu (2005) and Ma Lijuan (2005). Based on standard evaluation indicators of the SCOR model and a vast number of supply chain case studies, Tong Jian and Wen Haitao (2011) developed a new performance evaluation parameter called “order fulfillment efficiency” (OFE). This parameter measures the qualitative and quantitative performance in order fulfilment, as well as the correlation between invested resources and related output. OFE can be used to assess the performance of every part of a supply chain; it may also serve as a secondary parameter to evaluate an entire supply chain’s performance. The introduction of OFE improves the accuracy of supply chain evaluation based on the SCOR model.
(2) Indicator selection based on the balanced scorecard

The rationale behind using the balanced scorecard for indicator selection is that the current operational or financial performance only reveals a partial picture of supply chain performance. In order to have a complete picture of supply chain performance, both short-term and long-term performances should be considered. Ma Shihua, Li Huayan and Lin Yong (2002) were among the first to introduce the use of the balanced scorecard in supply chain performance evaluation in China. They developed an index system comprising four dimensions: finance, the customer, business operations and innovation.

Chen Chouyong and Hu Baoliang (2003), on the other hand, established an index system to evaluate the performance of manufacturers’ demand-driven supply chains. The index system attempts to evaluate performances on four fronts: finance, customer, operational processes, and learning and development. Song Wei and Teng Hua (2004) further refine the indicators of the balanced scorecard. In their system, customer indicators are broken down into flexibility, reliability, the customer retention rate, the customer acquisition rate, and customer profitability; internal operational indicators are divided into supply chain costs, delivery lead times, product or service cycle, and the achievement rate of supply chain cost targeting; learning and innovation indicators are divided into new product development time, the proportion of revenue from new products, the structure of intellectual capital, the growth of recommendations from staff, and the information sharing level; financial indicators are classified into return on capital, cash turnover, sales growth, profit growth, accounts receivable turnover, inventory turnover and cost reduction.

Focusing on automobile supply chains, Yang Bai (2007) suggests that the balanced scorecard can effectively align an automobile enterprises alliance’s strategic objectives with its internal management activities. Through monitoring the supply chain management activities of the alliance, and providing feedback, the balanced scorecard can enhance the alliance’s supply chain performance.

However, since the balanced scorecard is intended to measure the performance of a single enterprise, some researchers argue that adjustments must be made, if the balanced scorecard is used to give a scientific evaluation of the broader supply chain performance. For those enterprises with Enterprise Resource Planning (ERP) implementation, it is advisable to add a “stakeholder” dimension to the balanced scorecard to give a comprehensive evaluation of supply chain performance (Ai Wenguo, An Shi and Sun Jie, 2003).

Shi Jiafang and Zhang Yuan (2004) put forward a “balanced scorecard-supply chain” (BSC-SC) index system. Integrating features of supply chain operations into the balanced scorecard, the BSC-SC system aims at enhancing the core competence of enterprises. The BSC-SC system evaluates a supply chain performance from six dimensions: Customer orientation, supply chain internal operations, information technology, supplier relationship, future developments and financial value.

Xu Zhongyan and Sun Rui (2004) suggest that the evaluation of supply chain alliances should include five dimensions: Customer satisfaction, enterprises’ supply chain processes, the supply chain enterprise “satisfaction” factor in the supply chain, economic benefits of the supply chain, and innovation and development capabilities.
On the other hand, Zheng Pei and Lai Kin-keung (2008) take a critical view; they suggest that the traditional balanced scorecard for supply chain evaluation has ignored an important factor— that is, the supplier. They include this function in their five-dimensional balanced scorecard model.

Meanwhile, Zeng Xianyang et al. (2004) developed a supply chain evaluation model with five dimensions: Financial, the customer, process, development and environmental. Shi Liping and Cai Xin (2003) propose a six-dimensional balanced scorecard index system.

Since an evaluation of supply chain operational performance is implicit in the balanced scorecard, some researchers suggest integrating the SCOR indicators with the balanced scorecard to better reflect a supply chain performance. In this approach, the SCOR indicators can be used in the dimension of "internal business process" within the balanced scorecard. The study and evaluation by Zha Dunlin (2003), which proposed a "supply chain-balanced scorecard-SCOR model" to measure supply chain performance, is among the most representative.

Yang Jiehui and Liu Jin (2009) suggest integrating the balanced scorecard with the metagraph. When constructing an evaluation system from a strategic supply chain management point of view, the balanced scorecard provides a comprehensive picture of overall supply chain operations. By contrast, the metagraph analyses and compares different supply chain structures from a strategic perspective; it can serve as an analytic tool for enterprises in building their supply chains. The integrated use of both approaches helps achieve a balance in various aspects. This is the case where it comes to, for example, different stakeholders, "lagging" vs. "leading" indicators, short-term vs. long-term and financial vs. non-financial aspects. It offers a comprehensive supply chain evaluation at both decision-making and operational levels, and also helps gauge if the supply chain operations are in line with the strategic goals.

(3) Indicator selection based on supply chain value creation

The value chain perspective considers a supply chain performance as 1) the total value created on the basis of information sharing and coordination between different supply chain members by activities such as logistics management, production, sales and marketing, customer service and information development, and 2) different actions taken by the supply chain members to attain the aforementioned goal, i.e., the operational performance (Huo Jiazhen, Sui Minggang and Liu Zhongying, 2001, 2002a, 2002b).

Huo, Sui and Liu point out that the value created by supply chain activities can be classified into customer value and supply chain value. The former refers to the value gained by consumers or final customers through the purchase of products or services, whereas the latter refers to the value added or created by different activities of supply chain members. The study by Wang Fengbin (2004) supports this idea.

On this basis, Huo, Sui and Liu developed a multi-tier evaluation system to measure integrated supply chain performance. The system comprises four secondary-level indicators and 23 basic indicators in the dimensions of customer satisfaction, supply chain input, supply chain output and supply chain finance.

Xu Linwen (2004) also agrees that customer value and supply chain value are two important components of integrated supply chain performance. Xu suggests that
customer value is the external manifestation of supply chain performance, and it can only be evaluated by customer satisfaction. Specifically, customer satisfaction can be measured by four secondary indicators, including flexibility, reliability, price and quality. On the other hand, supply chain value is an internal manifestation of supply chain performance; it can be evaluated from three dimensions: the supply chain input, the supply chain output and financial performance.

Li Shujuan (2005) suggests that supply chain management performance should include three distinct but interrelated components: internal performance evaluation, external performance evaluation, and integrated supply chain performance evaluation. Internal performance evaluation is chiefly concerned with the performance of internal operations of supply chain enterprises; external performance evaluation is concerned with the performance of inter-firm operations; and integrated supply chain performance evaluation measures the performance of the entire supply chain. Her evaluation system assesses supply chain performance from six dimensions: supply chain business processes, supply chain inter-firm relationships, economic benefits, supply chain innovation, learning capability, and supply chain integrality.

Similarly, Jiang Fangtao (2006) classifies supply chain performance into internal, external and overall supply chain performances. Jiang’s evaluation of internal performance takes in four first-level indicators: financial conditions, competitiveness and technological capabilities, learning and innovation, and service; evaluation of external performance includes two first-level indicators: user satisfaction and supply chain cohesiveness; and lastly, evaluation of overall supply chain performance includes three first-level indicators, namely customer value, supply chain value, and development capabilities and potential. Weighting factors are assigned to different indicators using the fuzzy comprehensive evaluation method.

(4) Indicator selection based on supply chain levels

Supply chain levels offer another important basis for indicator selection, as it is often more appropriate to evaluate different aspects of a supply chain with different sets of indicators. Liu Xiaoping and Li Hongfu (2002) and Zhang Tianping (2009) put forward supply chain evaluation index systems based on the strategic, tactical and operational level of a supply chain. On the other hand, based on the result-, operational- and strategic-level capabilities of the supply chain, Huo Jiazhen and Ma Xiubo (2005) developed a process-based supply chain evaluation system.

9.3.2 Performance evaluation

Performance evaluation is mainly based on statistical methods and the major ones are as follows:

(1) Analytic hierarchy process

The analytic hierarchy process (AHP) is an analytical tool developed by American scholar Thomas L. Saaty (1980). Chen Chouyong and Hu Baoliang (2003) are among the first in China to employ AHP in supply chain performance evaluation. They established a model to evaluate the performance of demand-driven manufacturing supply chains from four dimensions: finance, the customer, business processes, and
Learning and development. Chen and Hu used the benchmarking method to determine the qualitative indicators, and then employed the AHP to determine the weighting factors. Fang Chengwu and Lei Xunping (2005) developed a supply chain evaluation model based on customer satisfaction. Using the AHP, the quantitative model includes four first-level indicators: flexibility, reliability, price, and quality.

Due to the inadequacies of the AHP, more and more researchers opt for an improved version of the AHP. For instance, since the determination of weighting factors of supply chain performance indicators in AHP relies heavily on experts' judgment and often this involves ambiguities, Ji Yiming and Zhang Jinlong (2005) employed the fuzzy AHP (FAHP) to determine weighting factors of the four first-level indicators (i.e., customer service, production and quality, asset management, and cost) in their supply chain performance evaluation system.

Li Guichun, Li Congdong and Li Longzhu (2004), on the other hand, propose a dynamic fuzzy evaluation method. They point out that the FAHP is not suitable for dealing with certain kinds of problems since the method treats the evaluation indicators as constants, or evaluates the targets only at certain points of time, without acknowledging the fact that the characteristics of the targets may change over time. Therefore, they introduced a time parameter to the evaluation matrix of the dynamic fuzzy evaluation method, which enables real-time dynamic evaluation. Meanwhile, in view of the fact that the AHP and the fuzzy comprehensive evaluation method fail to recognise the interactions between factors in the same or different hierarchical levels, nor the influence on a upper-level target by feedback from lower-level elements, Huang Ling and Da Qingli (2009) used the analytic network process (ANP) in their performance evaluation of reverse supply chains to address these problems.

(2) Fuzzy comprehensive evaluation method

The fuzzy comprehensive evaluation method, based on fuzzy mathematics, attempts to quantify ill-defined or hard-to-quantify factors. In supply chain performance evaluation, while some indicators can be derived using statistical methods, others must be derived by expert evaluation. At the same time, there are also qualitative indicators in supply chain performance evaluation. In this situation, the fuzzy comprehensive evaluation method can handle both quantitative and qualitative indicators.


Guo Mei and Zhu Jinfu (2007) observe that too many indicators are used in supply chain performance evaluation of logistics service providers, and propose reducing the number of indicators based on fuzzy rough sets. Their method transforms the real value of continuous attributes into a fuzzy value, and regards all attributed values of each evaluation target as a fuzzy set. Lower and upper approximation and attributes reduction are based on similarities of the fuzzy sets and variable precision rough sets.
Combining quantitative tests with expert evaluation, Zhang Tianping (2009) employs the fuzzy comprehensive evaluation method to assess the performance of green supply chains.

(3) Gray relation analysis

The gray relation analysis (GRA) is a multi-factor statistical method of analysis. Based on sample data, the GRA describes the strength, magnitude and order of the correlation between different factors. A larger GRA value suggests a stronger correlation (i.e., direction, magnitude and speed of change) between two factors (Liu Weidong et al., 2007). First of all, the GRA will determine a reference sequence. The correlation between a set of sequences with the reference sequence is then calculated. A ranking order is obtained according to the degree of correlation: a strong correlation suggests higher similarity with the reference sequence. When using GRA in supply chain performance evaluation, a reference sequence is established with a set of pre-determined reference values for the supply chain performance indicators.

(4) Data envelopment analysis

The data envelopment analysis (DEA) is an analytical method developed by renowned American operations researchers Charnes, Cooper and Rhodes in 1978 based upon the concept of “relative efficiency”. It is a powerful tool for studying multi-input and multi-output production functions. In social, economic and management realms, there are often needs to assess the relative efficiency of the same types of departments and enterprises, or the relative efficiency of an enterprise in different points of time. These departments, enterprises or time periods are called the decision-making units (DMUs), or the evaluation units. The DEA evaluates the relative efficiency of the DMUs based on the input and output indices of the units.

The applications of DEA in supply chain performance evaluation include: 1) determination of benchmarks for supply chain performance evaluation. For instance, He Zhongwei and Mao Bo (2003) used the DEA to develop benchmarking models for supply chain performance evaluation. Employing the pair-wise efficiency game (PEG) to correct the results, He and Mao selected suitable performance benchmarks for different enterprises by cluster analysis; 2) selection of the best-performing supply chain according to selected indicators. Yang Maosheng, Li Tao and Bai Shu (2005) used the DEA to evaluate the supply chain operational efficiency of 12 branded retail enterprises in Xi’an.

Some researchers have attempted to further improve DEA based on supply chain characteristics. Zhong Zuchang and Chen Gongyu (2006) put forward a network DEA model and demonstrated that it is more advanced than the traditional DEA model. Shi Wenli (2008) proposes to combine rough set theory with DEA in supply chain performance evaluation, and used the Malmquist index to obtain the total factor productivity of supply chains. He further decomposed the index into a technical progress index, a resources allocation index, a pure technical progress index, and a scale efficiency index for analyses.
9.4 Recommended reading

9.4.1 Logistics Costs and Supply Chain Performance Management

Research theme: Logistics cost management plays a strategic role in modern businesses. The book offers an in-depth review of modern logistics and supply chain cost management theories, and introduces the current logistics picture in China.

Details: This book comprises five parts:

Part 1 (chapters 1 and 2) probes the essence of logistics cost management and the components of logistics cost on the basis of literature review and an evaluation of various logistics cost management methods. The author suggests that the major methods used in the integrated management of logistics costs include direct product profitability (DPP), activity-based costing (ABC), total cost of ownership (TCO), target costing and efficient consumer response (ECR).

Part 2 (chapters 3 and 4) introduces the current logistics cost management practices of developed countries such as the US and Japan, and offers a general performance review of the current logistics operations in China. By means of empirical analyses, it concludes that an effective information management system, cross-functional and cross-organisational collaboration, a well-established cost accounting system and the awareness of the strategic importance of cost management are the key determinants of supply chain management performance.

Part 3 (chapters 5 and 6) examines three major enterprise logistics costs accounting methods; and on this basis, it gives a preliminary analysis of logistics costs accounting of operations such as transportation and storage.

Part 4 (chapters 7 and 8) investigates how logistics systems can be optimised and how an effective logistics cost budget can be devised. It elaborates upon the essence, procedures and applications of logistics profitability analysis, logistics costs budgeting and differential analysis, zero-based budgeting, and the establishment of independent logistics costs accounting.

Part 5 (chapters 9 to 11) explores logistics costs and supply chain performance management at a strategic level, and explains their strategic importance to China. Sales and operations (S&OP) and collaborative planning, forecasting and replenishment (CPFR) platforms, professional logistics service, electronic operations, reverse logistics and green supply chains are regarded as the key components of supply chain performance management.

9.4.2 The Status and Development of China Company’s Logistics Cost Management

Research theme: The paper looks empirically into enterprise logistics cost management in China.
Content detail: Based on the review of literature generated in China and overseas on the key components of enterprise logistics costs, and the actual situation of Chinese enterprises, the paper sets out seven hypotheses.

Hypothesis 1: Logistics costs as a percentage of total sales tend to be lower for enterprises that attach greater importance to logistics cost management; further, the impact of logistics cost management on enterprise competitiveness is stronger for enterprises that attach greater importance to logistics cost management.

Hypothesis 2: Enterprises that emphasise logistics cost management are more likely to develop a system for logistics costs reporting to grasp the picture of enterprise logistics costs within a certain period.

Hypothesis 3: The lack of effective logistics costs accounting tools and systems is a major hindrance to enterprise logistics cost management in China. Enterprises that stress logistics cost management are more likely to employ the ABC accounting method in addition to traditional financial management methods.

Hypothesis 4: The lack of professional talent on logistics costs accounting and management poses another challenge for enterprise logistics cost management in China.

Hypothesis 5: Despite heavy investment in information systems, poor data integration remains a barrier to effective enterprise logistics cost management in China.

Hypothesis 6: The lack of cross-functional and cross-workflow management teams is another major hindrance to enterprise logistics cost management in China.

Hypothesis 7: Enterprises that emphasise logistics cost management tend to perform better in information integration and cross-functional team building.

Methodology: To test the hypotheses, 780 questionnaires were sent to manufacturers, distributors and logistics enterprises in China; 126 valid responses were collected. Non-parametric tests were conducted.

Findings: First, management awareness of enterprise logistics cost management in China has improved in recent years, which is reflected in the increasing popularity of professional logistics cost management systems and institutional logistics costs reporting systems.

Secondly, despite growing awareness of logistics cost management, the lack of effective logistics costs accounting tools and systems poses a major challenge to enterprise logistics cost management in China, in particular to distribution enterprises.

Thirdly, apart from logistics costs accounting tools and systems, the nurturing of professional logistics cost management talent is a critical factor.

Fourthly, despite heavy investments in information systems by enterprises, poor information integration and lack of data constitute the barriers to effective enterprise logistics cost management in China.

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